IRRB

THE

INTERNATIONAL RED RIVER BOARD

Eleventh Annual

Progress Report

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PREFACE

This report documents water quality trends and exceedences of objectives, effluent releases, and control measures for the Red River basin for the 2008 Water Year (October 01, 2008 through September 30, 2009). In addition, this report describes the activities of the International Red River Board during the reporting period October 01, 2009 to September 30, 2010 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.

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

Respectfully submitted,

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Co-Chair, Canadian Section

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Water Quantity

River flows in Manitoba were between the median to upper decile range during the autumn 2008 and through winter 2008/2009. The high soil moisture was followed by an above average snowpack. The 2009 spring snowmelt produced high runoff and peak flows largely as a result of above average soil moisture levels. A heavy rainstorm during the first week of November 2008 was a significant factor in adding extra soil moisture.

Significant ground frost due to a cold winter added to high spring runoff. The melt rate was not unusually high and came in two melt events. An early melt in late March melted most of the snow in the United States portion but was followed by two weeks of sub zero temperatures that delayed runoff in the Manitoba portion of the Red River watershed. A record high crest occurred in the Fargo area on March 28 following strong melting March 20 to 23. The March melt episode initiated runoff from Grand Forks to Winnipeg. However, runoff was interrupted by a cold weather spell and did not resume until the Easter weekend just before mid April. As a result, crests in the Manitoba portion did not occur until after mid April.

The 2009 flooding in the Red River watershed was significantly worsened by abnormal ice conditions that caused blockages in the drainage system and raised river levels beyond what would have occurred under normal conditions. River levels from St. Adolphe to Breezy Point were particularly affected by ice. River ice was generally of average thickness based on an early March survey but was unusually strong due to a cold winter. The two week cold spell from late March to early April kept river ice from deteriorating prior to spring runoff. Ice jams developed on the Red River when high flows resulting from the March melt in the United States portion encountered strong solid ice in the Manitoba portion. Serious ice jams first developed from Lockport to Lower Fort Garry during the last week of March raising levels in the area to within one foot of the 1997 crest. Ice jams in the Winnipeg and Selkirk to Breezy Point areas April 9-11 raised levels well above open water conditions.

In the City of Winnipeg ice was solid and immobile and as a result, southern portions of the City experienced particularly high water levels. Flooding was generally averted by emergency diking but a few low-lying buildings and roads were temporarily flooded. The amphibex ice breaker was employed to break up an ice jam at the South Perimeter Bridge. Ice finally cleared out of southern portions of the City on April 10 and out of central and northern portions on April 11 following a series of ice jams, the last of which broke at Redwood Bridge near noon on April 11th.

The City experienced an open water crest of 22.5 feet on April 16 when an ice run on the Assiniboine River coincided with crests on local streams in the Winnipeg area and high flows on the Red River at St. Norbert. A crest of 17.3 feet occurred on May 13, primarily in response to a 50 mm rainstorm over the City with some added effect from floodway operation. The peak flow diverted through the Red River Floodway in 2009 was 43,000 cfs compared to a peak flow of 66,000 cfs in 1997. The peak discharge at Emerson in 2009 was the fourth highest on record since 1948. The crest discharge increased from 85,000 cubic feet per second (cfs) at Emerson to 97,900 cfs at the Floodway Inlet, an unusually large increase for a large event. The 1997 and 2006 crests only increased by about 5,000 cfs and the 1979 crest actually decreased by 10,000 cfs.

The 2009 flood inundated 1000 km^2 of agricultural lands between Emerson and the Floodway Inlet compared to 1840 km^2 for the 1997 flood. The flood had a long duration with overbank flows at Morris from April 3 to May 18. PTH 75 at Morris was closed to traffic for 37 days from April 7 to May 13, compared to a 45 day closure in

1997. PR 200 between Morris and the Floodway Inlet was closed to traffic from April 9 to May 12. Many homes in the Red River Valley were accessible only by boat for more than a month. While disruptions to transportation were extensive, there were only a few homes evacuated or flooded. Ninety-five percent of buildings that had been flood proofed following the 1997 flood remained dry. River levels receded slowly from spring time flood flows to early summer. Flows in the Red river were generally between the upper and lower decile levels during early summer but declined close to median levels in autumn 2009.

The 2009 spring run-off over the U.S. portion of the Red River Basin was much greater than normal. The basin was fairly wet following the wettest fall on record in the upper reaches of the Red River Basin in 2008. Rapid melting (2 weeks early) was followed by heavy March rains. Despite high the runoff in 2009, the flood-fight in the US was successful. Flood stages at Fargo - Moorhead were at record high. Similar to Manitoba, ice jams were a major problem during the flood.

The Devils Lake sub-basin had experienced an extremely wet fall in 2008, receiving approximately 300% of normal precipitation. The lake rose significantly in 2009. The peak on June 27, 2009 was 1450.7 ft-msl, a record since the USGS began monitoring water levels in 1901. This precipitation had saturated the soil profile including the potholes and sloughs. The state outlet was operated for 167 days in 2009 (May 22 to November 4) and released 27,653 acre-feet of water into the Sheyenne River.

Devils Lake reached yet another peak elevation of 1452.05 ft-msl on June 27, 2010, while Stump Lake peaked at 1452.09 ft-msl on June 28, 2010, a record for recently recorded data. This is about 1.4 feet higher than the previous record on June 27, 2009.

Water Quality

Some exceedences of the International Joint Commission (IJC) water quality objectives were observed at the international boundary during the 2008 water year. Dissolved oxygen generally remained well above the objective level of 5.0 mg/L. Exceedences of the International Joint Commission (IJC) water quality objectives, and concentrations approaching the objective level for Total Dissolved Solids (TDS) were observed at the international boundary during the 2009 water year. The TDS objective of 500 mg/L was exceeded from October 2008 to February 2009. The highest observed value of 751.5 mg/L recorded on December 2008. The *chloride* objective (100 mg/L), and the Fecal coliform objective (200 colonies/ 100 mL) were not exceeded during the reporting period. The sulphate objective (250 mg/L) was exceeded in November and December 2008 with values of 250 mg/L and 268 mg/L, respectively.

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, 2009 - September 30, 2010 which succeeds the 2009 water year. The key activities are highlighted below.

In 2009, the IRRB created a new 3-year work plan to reflect the current 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 assessment of fish and macro-invertebrate communities,

distribution and abundance of exotic species, as well as plant community structures and trends. Key IRRB activities also include - development and implementation of apportionment/flow targets at the International Boundary; completion of the final year of the three-year Pathogen/Parasite Sampling Program; continuation of the development of Comprehensive Flood Mitigation Strategy (CFMS) as per the terms of reference of the Committee on Hydrology Committee; LiDAR mapping and hydraulic modeling of the Lower Pembina River Basin; and setting nutrient objectives for the Red River at the International Boundary.

The IRRB held its fifth bi-annual meeting January 21-22, 2010 to address select issues in the basin, and the sixth bi-annual meeting September 14-15, 2010 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, prioritized flood mitigation plans, and biological monitoring and nutrient management strategies for the basin. The Board also developed a draft white paper on Devils Lake for discussion and to make recommendations to the IJC to resolve outstanding issues related to water quantity/flooding, water quality, biota transfer, and operation of the Devils Lake Outlet structure. Various scenarios, including a potential natural spill from Devils Lake into the Sheyenne River are being examined by the Board.

Completion of a three-year sampling program for parasites and pathogens as a result of multi-agency negotiations led by the White House Council on Environmental Quality (CEQ) was a significant IRRB undertaking during the reporting period. The objective of the sampling program, which was initiated in September 2006, is 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 biota from the Devils Lake outlet to aquatic ecosystems downstream. A further objective is to use the comprehensive fish survey to support the overall framework for biological monitoring in the Red River basin as identified in the IRRB work plan.

The IRRB has completed its three year sampling program in 2008. The Canadian analysis of fish samples collected over the three year period (2006-2008) has been completed. The US FWS is currently working on its analysis of fish samples collected in 2008 from the US portion of the Red River Basin. The preliminary results from the 2007 data analyses, which only show presence or absence, are consistent with findings in 2006.

Key points and preliminary conclusions from U.S. and Canadian sampling in 2007:

- No unusual findings for bacterial agents for any species in any location,
- No detection of viral agents,
- Additional parasites detected in Devils Lake and Lake Traverse,
- No unusual findings in Devils Lake including parasites,
- Asian tapeworm, from an unknown source, has been found at the International Boundary in 2007, but not detected in U.S.,
- Blood-dwelling trematode prevalent in walleye (27 out of 60 infected), and
- No indication of clinical disease resulting from bacterial or viral agents for any fish species in any location.

The AEC was approved for funding from the IJC in 2009 to finalize its Devils Lake Fish Pathogen and Parasite Survey. However, completion of analysis of samples collected in 2008 has been delayed due to unforeseen circumstances in the U.S. and Canada.

AEC proposes to conduct a 2-day workshop in Grand Forks, ND in March 2011, to consult a team of experts who will review fish parasite, pathogen, and histopathology data collected over three years, from 2006 to 2008. A team of experts will prepare a consensus based initial "risk assessment" based on the fish parasite, pathogen, and histopathology data collected from Devils Lake, Red River, Lake Traverse, and Lake Winnipeg from 2006 to 2008. The cost of the workshop is expected to be around $10,000. The Final Synthesis Report will be prepared in the April 2011 to September 2011 time frame. The Final Report will be written in 2011, and it will summarize and synthesize all parasite, pathogen and histopathology data collected from Devils Lake, Red River, Lake Traverse, and Lake Winnipeg from 2006 to 2008.

The Final Report will make recommendations on future monitoring for fish health and fish community stability. It will also make recommendations on the scope and direction for a final report on "risk assessment" that assess the potential for Devils Lake fish parasites and pathogens to have an adverse effect on the Red River and Lake Winnipeg ecosystems. The Report will have either Canada and USA co-authors; or a Canadian author and a USA editor; or a USA author and a Canadian editor. Final report will be peer-reviewed by a Canadian authority and USA authority on fish health. It is expected that the review process will take 6 months with a total cost of $85,000 that will include report preparation and peer-review.

1.03 International Red River Board Three-Year Draft Work Plan (2009-2012)

A three-year work plan was approved by Board and its committee members at its September 2009 meeting held in Gimli, Manitoba. Priorities include:

- Report Water Quality Objectives,
- Completion of the Parasite/Pathogen Sampling Program,
- Comprehensive Flood Mitigation Strategy,
- Water Quantity Apportionment,
- Lower Pembina Flooding,
- Enhanced Bio Assessment,
- Nutrient Objectives, and
- IWI funded Projects.

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 eleventh IRRB annual progress report to the IJC.

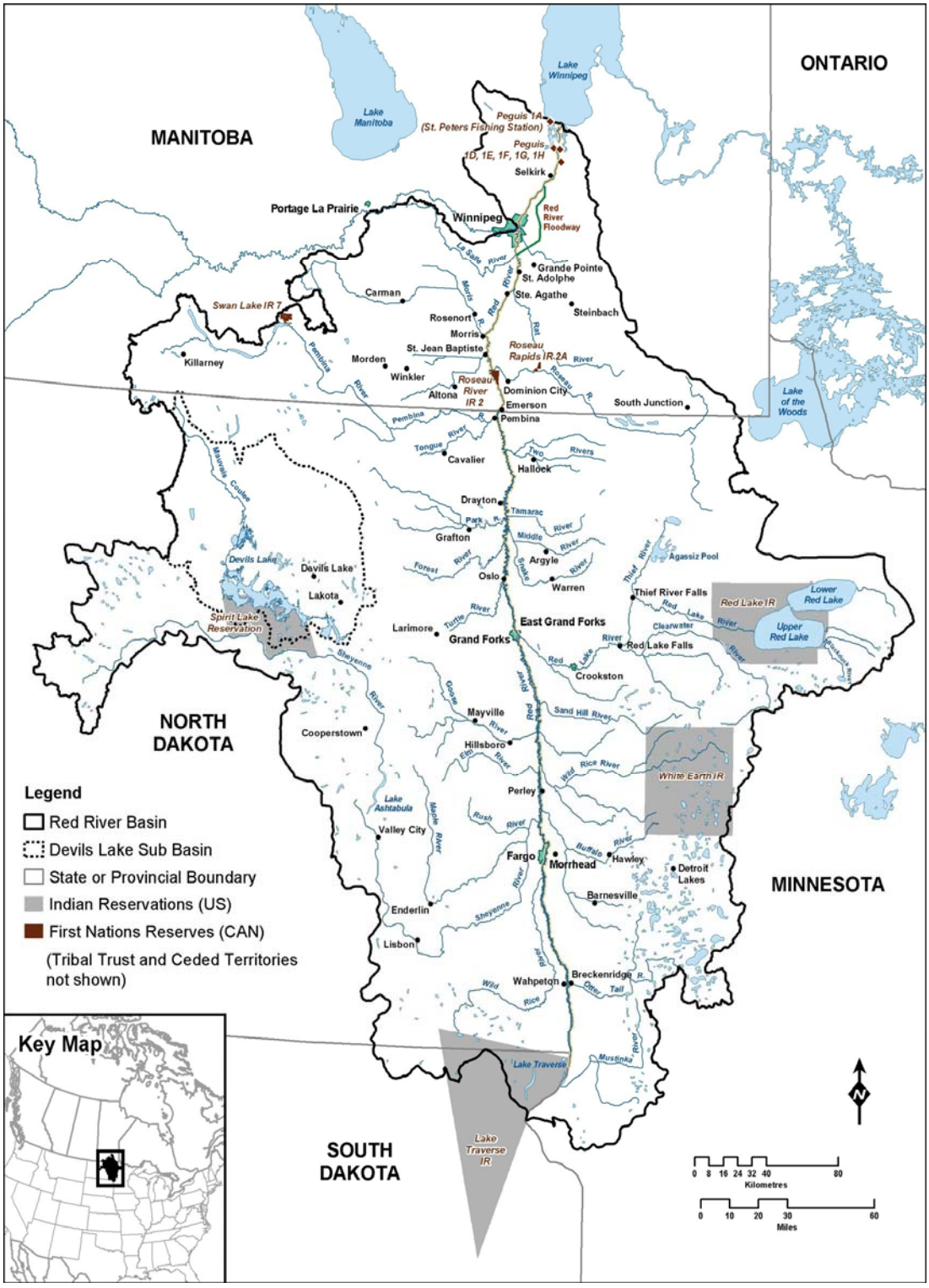

Figure 1. Red River and its Tributaries

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.

In 2010, Colonel Jonathan Christensen was replaced by Colonel Michael Price, U.S. Army Corps of Engineers, as U.S. Co-Chair. Kevin Cash, Environment Canada, has completed his term and is not seeking another term with the International Red River Board. Also, Scott Jutila has replaced Craig Evans from the U.S. Army Corps of Engineers as the U.S. Co-Secretary.

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4.0 INTERNATIONAL RED RIVER BOARD ACTIVITIES

During the reporting period October 01, 2008 - September 30, 2009, 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 fifth bi-annual meeting January 21-22, 2010 to address select issues in the basin, and the sixth bi-annual meeting September 14-15, 2010 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, prioritized flood mitigation plans, and biological monitoring and nutrient management strategies for the basin.

Except for half-day executive sessions during the January and September 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.

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.

In 2009, the IJC funded a number of projects that were undertaken by the International Red River Board (IRRB) and its various committees. IRRB acknowledges and thanks the IJC for its continued financial support for initiatives carried out by the Board in the Red River Basin.

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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.*

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 three 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. 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.

The Committee on Hydrology (COH) was re-established in 2006-2007 with a broader agency representation and new members.

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 had 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.

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 are 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 is 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 assigns 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, are being applied to both streams of work. The project is being 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 allows for peer review of the interpretive reports. The three year sampling was completed in 2008.

The results from the 2006 and 2007 Pathogen Survey of Devils Lake, the Red and Sheyenne Rivers indicate 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 2007 sampling results were presented to governments via a conference call on March 10, 2009 (see also Section 1.02 of this report). For more information, please go to - http://www.ijc.org/conseil_board/red_river/en/irrb_home_accueil.htm, "*publications/other reports"*.

4.03-3 International Water Quality Objectives for Nutrients

In 2004, the AEC met to consider the Manitoba proposal to the IRRB that water quality objectives for nitrogen and phosphorus be established for the Red River at the international boundary. The Manitoba proposal reflects concerns about the continued eutrophication of Lake Winnipeg. One of the key AEC recommendations presented to the IRRB was the need for a joint effort on the part of the U.S. and Canada to protect and restore Lake Winnipeg's trophic status. Lake Winnipeg is the main ecological end point in the Red River system and an integrated analysis of the conditions in the watershed is required to identify the numerous factors that are contributing to the trophic status of the lake.

In 2008, the AEC recommended that the development of objectives for nutrients at the international boundary be delayed until Manitoba identified the target trophic status for Lake Winnipeg and numerical nutrient objectives for Lake Winnipeg.

In January 2010, the AEC met to further discuss options for setting water quality objectives. Three possible approaches were presented and discussed, including:

1. long term flow-weighted trends at the international boundary based on historical data,
2. exceedances of not more than some percentage of flow weighted samples taken at the international boundary, and
3. Lake Winnipeg objectives for nutrients as proposed by Manitoba.

After some discussion, AEC members agreed that the third option was the preferred one. Although it is likely to be politically challenging, setting objectives for Lake Winnipeg would be ecologically relevant. If Manitoba were to withdraw its request for nutrient objectives to be set for the international boundary, objectives instead would be set for Lake Winnipeg. Member agencies would continue monitoring and report on progress to reduce nutrients entering the Red River and associated tributaries. All agencies are equalized under this approach. Nutrient levels in Lake Winnipeg would be checked and progress monitored. Once we know what is going into the Lake, agencies can set reduction targets throughout the drainage basin. Most of those data are now available.

Several ongoing research projects must be completed before Manitoba can set nutrient objectives for Lake Winnipeg. These include a paleolimnological assessment of historic nutrient levels, modeling of the relationships between nutrients and algae and modeling of the relationship between nutrients and food web characteristics. In addition, there are policy decisions to be made with regard to using historic nutrient levels as the goal.

Nine principles that would be used to guide the development of ecologically based nutrient objectives for Lake Winnipeg were presented and accepted:

1. Preserve the current ratio between nitrogen and phosphorus,
2. Reflect but do not necessarily restore historical nutrient regime (For example, conditions at the time of widespread settlement in 1800s but before major landscape changes could be the bench mark),
3. Ensure healthy functioning of the Lake Winnipeg ecosystem,
4. Minimize the duration, frequency and intensity of blue-green algal blooms including the need to minimize algal toxins,
5. Minimize duration, frequency and intensity of blooms of other forms of algae including those that foul commercial and subsistence fishing nets or that otherwise interfere with the successful harvest of fish or recreational activities,
6. Ensure optimal balance between nutrient enrichment, productivity of the commercial and subsistence fishery and subsequent economic return to communities while protecting the lake ecosystem,
7. Be protective of the upstream contributing watersheds and downstream environment in the Nelson River and Hudson Bay.
8. Consider social and economic implications of implementation and compliance, and
9. Water quality objectives established for the tributaries of the Red River and water quality objectives for nutrients established in contributing watersheds need to recognize Lake Winnipeg.

A tenth principle that would apply during the allocation process was also developed during the discussion. This principle does not apply to the process of setting ecologically based objectives for Lake Winnipeg.
10. Allocation of nutrients among sources to meet nutrient objectives in Lake Winnipeg should be comprehensive and shared equitably.

The committee identified key items that need to be done or could be started to move the process forward.

1. Decide how trophic status will be measured. Complete paleolimnology and water quality modeling, catch rates from fishery and other science activities that are ongoing to define historical, present and future conditions. Main pieces should be completed by 2012. Nutrient objectives for Lake Winnipeg will be then set using the nine principles,
2. Ecosystem modeling exercises. Results would indicate what reductions in loading are needed to meet the nutrient objective,
3. Mass balances for nutrients entering the system and tributary estimates need to be updated regularly. This information will be available once models are completed. Update other sources. Need more information on atmospheric deposition (wet and dry),
4. Develop allocations for all nutrient sources. Principle 10 applies to this activity. This is already ongoing in Minnesota, some in North Dakota and also in Manitoba. Tributary loads are being estimated. SWAT modeling (soil and water assessment tool) is also being done in some areas,
5. These activities would be similar to those in Box 4 but scaled down from the watershed level to a specific point on a river,
6. Recommend nutrient objective at the international boundary to the IRRB. Member agencies should formally report, at the annual meeting, on what they have done to reduce nutrient loading in the Red River Basin,
7. Jurisdictional decisions regarding nutrient objectives are made. These decisions are up to agencies within those jurisdictions. Similar decisions would be made in Manitoba, and
8. Monitor, evaluate, review and refine. Once we define how monitoring is going to be done, the results would be reviewed and used to refine nutrient objectives.

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 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.

The COH presented a proposed framework on the development and implementation of flow apportionment on the Red River at the January 2008 meeting. 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 proposed framework plan developed is multi-year and will require involvement of many partners.

As part of the work on the development and implementation of a flow apportionment procedure for the Red River, the COH developed and submitted two IWI proposals to the IJC. The first proposal funded Dr. Rob de Loe, University of Guelph, to review apportionment governance procedures relevant to the Red River basin, and to recommend 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 recommends 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 IJC funded report, by R. Halliday & Associates, entitled "Determination of Natural Flow for Apportionment of the Red River" was completed, and dated May 30, 2010. This report established a process for the development and implementation of water quantity apportionment procedures. Various apportionment methodologies in the context of the Red River basin to assess natural flows were investigated and the Project Depletion Method is recommended. The report reviews the actual natural flow calculation and provides information on how the calculation can be accomplished. Gaps and concerns were discussed, particularly: hydrometric and meteorological networks, water allocation, water use, and instream flows. More detailed discussion on natural flow determination dealt with evaporation, minor projects, channel losses and travel times. Apportionment was addressed with regards to location(s), period, make-up water and dispute resolution.

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 United States.

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 supercede 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.

4.04 Lower Pembina River Flooding

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

Recently, the LPRFTT oversaw three International Watersheds Initiatives (IWI), resulting in two reports entitled "Preparation of a two-dimensional Hydrodynamic Model of the Lower Pembina River Flood Plains", a Phase 1 report, and the "Simulation of Flood Scenarios on the Lower Pembina River Flood Plains with the 2D Hydrodynamic Model", a Phase 2 report.

A field survey of the erosion through the Swietzer Ridge was undertaken with the resulting data planned to be used in the modelling effort documented in the Phase 2 report. The two reports were conducted with IJC Canadian Section IWI funds and the survey was conducted with American IWI funds. The USACE conducted the survey of the Swietzer Ridge area, which received significant erosion during the spring of 2009. The National Research Council (NRC) of Canada undertook both two-dimensional hydrodynamic initiatives and used the Telemac 2-D model for both assessments.

The first report (Phase 1) was completed during July 2009; model details including model description, how it was applied to the Lower Pembina River flood plains, calibration, verification, etc. were presented at the IRRB September 2009 meeting by the NRC modeler, Thierry Faure; and the report was later approved by the IRRB at its January 2010 meeting and was to be forwarded to the IJC. Reviewers of the first phase thought that the model fairly accurately replicated what flooding occurred during the spring of 2006.

The second study (Phase 2) expanded the model domain geographically and included more infrastructure, such as more roads and culverts. This was accomplished by provision of additional agency infrastructure data and by additional LiDAR information to the NRC. Based on consultations with a number of stakeholders, simulation scenarios such as removal of both County Road 55 and the border road dyke, and flattening of all roads; along with various flood mitigation scenarios including set-back dykes, various floodway alignments and various diversion alternatives, were simulated using the 2006 flood event. Stakeholders consulted included the Pembina River Basin Advisory Board, the Pembina County Water Resource District, the Red River Basin Commission, and the IRRB.

The Phase 2 model is excellent for the Lower Pembina River, however, to properly assess the impact on the tributaries from the various mitigation measures, more detail is required including the inclusion of local runoff within the tributaries (e.g. Buffalo Creek) and better defined cross sections. The LPRFTT recommended acceptance of Phase2 Report.

The LPRFTT will apply to the IWI for funding to refine the model with more detailed information along tributaries including Buffalo Creek, Aux Marais River, Rosebud Coulee, Louden Coulee and Tongue River and the ability to include local tributary runoff. The downstream boundary will be extended to Morris, Manitoba, to properly assess the confluence of Buffalo Creek with the Red River. The model will assess USACE developed hydrographs at Walhalla for annual return events including the 1:10, 1:50, 1:100, 1:200 and 1:500 and the 1:10 summer season event. The model will once again be calibrated for the 2006 spring runoff and verified with 2009 spring runoff.

A member of the LPRFTT has presented the results from Phase 1 and proposed actions under Phase 2 to the January 2010 Annual Red River Basin & Water International Summit Conference and made a similar presentation to the International Roseau River Watershed (IRRW) Board meeting on March 18, 2010 in Vita, Manitoba. The IRRW Board was impressed with the Lower Pembina River Flood Plains Telemac model but based on flooding issues within the Roseau River watershed a two-dimensional model may not be a necessity.

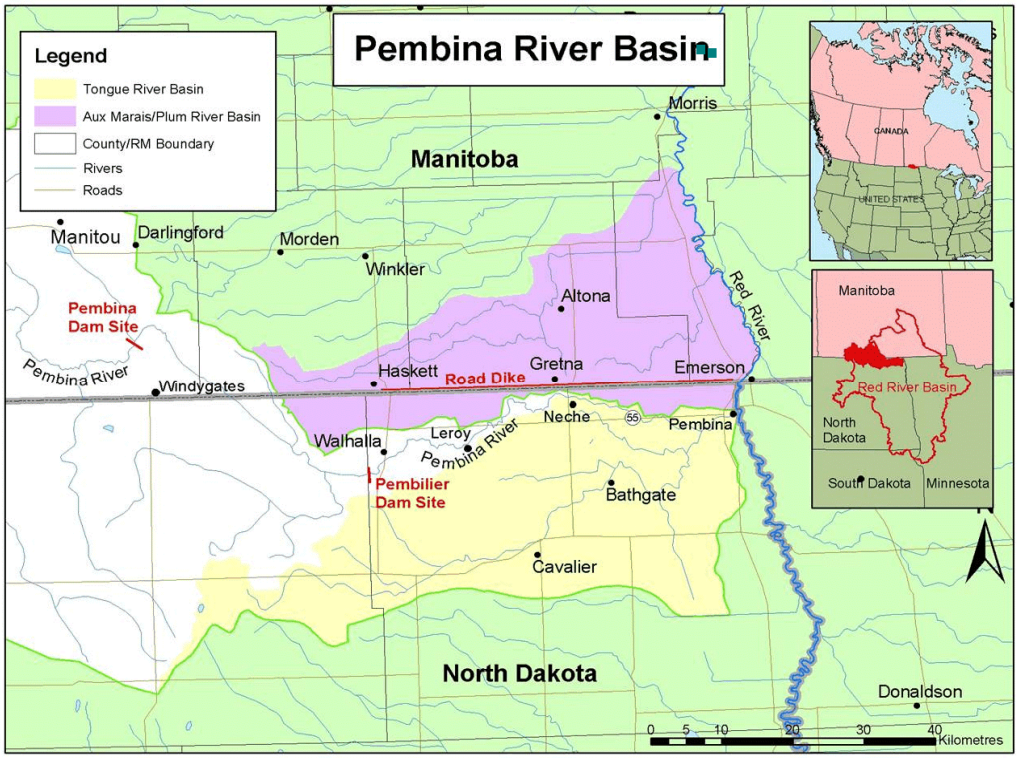


Figure 2. Pembina River Basin. The yellow and white areas comprise the Pembina River Basin.

4.06 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, 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 2012.

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 2009 was derived from the daily specific conductance data collected on the East Poplar River at the international boundary supplemented by the four monthly boron and TDS samples collected by the USGS. No exceedences of the water quality objectives were observed for the 2009 monitoring year.

Based on IJC recommendations, the United States was entitled to an on-demand release of 370 dam^3 (300 acre-feet) from Cookson Reservoir in 2009. A volume of 442 dam^3 (358 acre-feet) was delivered between May 1 and May 31, 2009. Further, in 2009, daily flows met or exceeded the minimum recommended by the IJC for most of the year except for June 12 to July 16 and several periods during January and December when daily flows were below the recommended minimum due to ice conditions in the channel.

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 2008 water year (October 1, 2008 - September 30, 2009). 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. Detection of exceedences 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 carries the responsibility for providing this monitoring service for the IRRB and maintains a permanent water quality and water quantity data collection site at Emerson, Manitoba.

The five parameters for which the IJC has 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.

pH **and Temperature**

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 *fecal coliform* bacteria. The IRRB is responsible for monitoring and reporting on compliance with these objectives.

Dissolved Oxygen

Dissolved oxygen generally remained well above the objective level of 5.0 mg/L.

Total Dissolved Solids and Specific Conductance

Some exceedences of the International Joint Commission (IJC) water quality objectives, and concentrations approaching the objective level for Total Dissolved Solids (TDS) were observed at the international boundary during the 2008 water year. The TDS objective of 500 mg/L was exceeded from October 2008 to February 2009. The highest observed value of 751.5 mg/L was recorded on December 2008.

Chloride

The *chloride* objective (100 mg/L) was not exceeded during the reporting period. Other monthly values ranged from a high of 88.7 mg/L in October 2008 to a low of 6.3 mg/L in April 2009.

Sulphate

The sulphate objective (250 mg/L) was exceeded in November and December 2008 with values of 250 mg/L and 268 mg/L, respectively.

Bacteriological Characteristics

The bacteriological characteristics of the Red River are assessed on the basis of observed fecal coliform bacteria for which an IJC objective (200 colonies per 100 ml) has been defined. During the 2008 water year, observed *fecal coliform* bacteria were well below the IJC objective of 200 colonies/100 ml with values ranging from 2 colonies/100 ml in December 2008 to 53 colonies/100 ml in April 2009. The Bacteriological results for the 2008 water year range form less than 2 to 53 colonies per 100 ml.

New E. Coli Standard *- In December 2009, the IRRB requested the IJC to switch its bacterial indicator from Fecal coliform to E. coli to be consistent with other participating agencies. Subsequently, the IJC recommended to the Governments of Canada and United States endorsing the Board's request. In a letter sent to the IJC in July 2010, Canada and the United States supported the recommendation from the IJC and have agreed to amend the objective. The new E. coli objective will be effective starting October 1, 2010 (beginning of new water-year).*

Although some exceedences of the IJC water quality objectives, and concentrations approaching the objective level for some parameters were observed during the reporting period, no intervention or action by the IRRB or participating agencies was required.

5.02 Alert Levels

Sixteen of the suite of pesticides, herbicides and metals for which alert levels were established by the former International Red River Pollution Board were detected during the reporting period. Based on a total of 15 water samples (12 regular monthly samples and three flood-related samples), 12 pesticides and/or herbicides with a total aggregate of 119 exceedences (greater than detection concentration) were recorded during the October 1, 2008 - September 30, 2009 reporting period (Table 1). The number of exceedances may be higher because some of the later samples are still missing pesticide/herbicide data. The detection levels were below the Canadian Aquatic Guidelines. Given that the Red River basin is an agriculturally dominated region, the presence of pesticides and herbicides is expected.

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 monitor trends in these concentrations and their frequency of detection with the view to updating its assessment as new scientific information becomes available.

Table 1. Exceedences of Alert Levels, Red River at International Boundary (Emerson, Manitoba) October 1, 2008 to September 30, 2009

Parameter	Units	Alert Level	Number of Exceedences	Exceedence Values		Canadian Aquatic Life Guidelines
				Min	Max	
pH		6-9	0			6-9
Chloride	mg/L	100	0			NG
TDS	mg/L	500	7	539	752	NG
Cadmium	ug/L	Detect	26	0.021	0.298	0.017ug/l
Manganese Total	ug/L	50	21	98.7	391	NG
Iron Total	ug/L	300	24	303	3880	300 ug/l
2,4-D	ng/L	Detect	15	29.7	87.7	4000 ng/l
Bromoxynil	ng/L	Detect	7	1.6	231	5000 ng/l
Clopyralid	ng/L	Detect	15	8.77	260	NG
Dicamba	ng/L	Detect	12	2.93	80.9	10000 ng/l
Imazamethabenz-methyl a	ng/L	Detect	0			NG
Imazamethabenz-methyl b	ng/L	Detect	0			NG
MCPA	ng/L	Detect	13	3.46	91.6	2600 ng/l
Mecoprop	ng/L	Detect	12	1.24	16	NG
Picloram	ng/L	Detect	8	15.3	56.4	29000 ng/l
Aldrin	ng/L	Detect	0			NG
g-Benzenehexachloride	ng/L	Detect	0			NG
Pentachloroanisole	ng/L	Detect	1	0.64	0.64	NG
Atrazine	ng/L	Detect	12	18.9	42.6	1800 ng/l
Desethyl Atrazine	ng/L	Detect	12	10.5	41.4	NG
Metolachlor	ng/L	Detect	11	4.65	31	7800 ng/l
P,P-DDE	ng/L	Detect	1	0.75	0.75	NG
Alpha-Endosulfan	ng/L	Detect	0			20 ng/l
Beta-Endosulfan	ng/L	Detect	0			20 ng/l
Heptachlor Epoxide	ng/L	Detect	0			10 ng/l
Metribuzin	ng/L	Detect	0			NG
Total PCB	ng/L	Detect	0			NG

*DL = Detection Level 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 use, 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

In Water Year 2008, the Minnesota Pollution Control Agency launched a watershed-based approach to monitoring, assessing and managing water bodies throughout the state, including the Red River of the North Basin. The watershed approach is a 10-year rotation for addressing waters of the state on the level of Minnesota's major watersheds. This approach was recommended by the Minnesota Legislature and its advisors. The key organizing approach used in this strategy is that of the "major," or eight digit hydrologic unit code (HUC), watershed. There are 81 major watersheds in Minnesota, of which 17 are in the Red River of the North Basin.

The watershed approach is intensive monitoring of the streams and lakes within a major watershed to determine the overall health of the water resources, identification of impaired waters, and of those waters in need of additional protection efforts to prevent impairments. Finally, it is a plan to provide that restoration and protection and resources needed to accomplish the plan. The foundation is the major watershed load network, which involves permanent flow and chemistry monitoring stations at the outlets (also referred to as "pour points") of each of the state's major watersheds. This partnership effort between the MPCA and the Minnesota Department of Natural Resources (DNR), involves continuous flow and water quality data collection with the computation of an annual load for each site, each year. In the Red River of the North Basin, the Red River Watershed Management Board's Water Quality Monitoring Network provides the sampling for the major watershed loads.

The load defines the amount of a parameter passing through a site per unit time. Loads determined at the outlet (pour point) of watersheds make it possible to compare watersheds across basin and ecoregion boundaries. Watershed loads can also be used to assess trends in the water quality of a specific watershed over time, and to see how data from a given year compares to the long term record for a watershed. Every 10 years, the state takes a closer look at intermediate sized (approx. 11 digit HUC) and "minor" (14 digit HUC) watersheds of the major watershed. Sites are selected near the outlet or "pour point" at all watershed scales. This approach provides robust assessment coverage of rivers and streams without monitoring every single stream reach.

The outlet of the major watershed is sampled for biology, water chemistry, and fish contaminants to allow for the assessment of aquatic life, aquatic consumption, and aquatic recreation use support. Each 11 digit HUC pour point is sampled for biology and water chemistry for the assessment of aquatic life and aquatic recreation use support. Watersheds at this scale generally consist of major tributary streams with drainage areas ranging from 75 to 150 square miles. Lastly, most minor watersheds (typically 10-20 square miles) are sampled for biology to assess for aquatic life use support.

Follow up monitoring is then done in biologically impaired subwatersheds to determine the cause(s) of the impairments (the "stressors" impacting the biological community) and to begin to identify pollutant sources. The monitoring is "intensive" because it covers all the subwatersheds. This leads to one of the significant benefits of the approach – the identification of most, if not all, of the impairment problems at one time. Consequently, there is an opportunity to address the impairments by coordinating the restoration studies and implementation plans, as well to enable resource managers to achieve the goal of considering the role of the watershed in the condition of the water quality.

The watershed approach also provides an opportunity for citizens and local government to proactively engage in the monitoring work through volunteer and local monitoring activities. This up front engagement helps set the stage for local involvement in any ensuing TMDLs or protection strategies, and enhances the information available for good planning efforts and successful implementation of restoration/protection strategies. Finally, the major watershed approach provides predictability in the monitoring schedule. By

establishing a schedule for monitoring all of the state's major watersheds every ten years, the state can accomplish the following:

- Provide advance notice to interested stakeholders, local governments and volunteers regarding monitoring plans.
- Assist local groups in ramping up their monitoring efforts to provide data in advance or in between agency monitoring efforts.
- Provide stakeholders a head's up as to when they can expect the TMDL study or protection strategy work to begin in their area.
- Ensure that comprehensive information on the status of water quality – and water quality management efforts – is collected, evaluated and provided to state and local partners at least one each decade.

In the Red River Basin of the North, intensive watershed monitoring has been conducted in the Upper and Lower Red River watersheds, is in progress in the Buffalo River watershed, and is scheduled to begin next year in the Thief, Sandhill, Bois de Sioux and Mustinka watersheds.

In response to the several legislative mandates, Minnesota Department of Agriculture has developed regionally based water quality monitoring networks for the purpose of collecting and reporting groundwater and surface water monitoring data. These ten Pesticide Monitoring Regions (PMRs) are based on areas of similar agricultural practices and hydrologic/geologic characteristics. The PMR boundaries follow county boundaries, but also generally represent different hydrologic regions of Minnesota. (map from page p. 2, 2009 report). This report provides information on PMR 1, which covers the counties draining directly to the Red River of the North in Minnesota.

The Minnesota Pollution Control Agency (MPCA) develops, through a rule-making process in Minn. R. ch. 7050, toxicity-based (for aquatic life) and human health-based enforceable chronic standards (CSs) for pollutants detected in surface water. The toxicity-based standard (protective for aquatic life exposure) is applied as a four-day average. The human health-based standard (protective for drinking water plus fish consumption) is based on an exposure duration of 30-days. The CSs also have a frequency component, where one exceedance of the average value is allowed in a three year-window. Acute standards protect aquatic life and are based on a one-day average that cannot be exceeded.

The United States Environmental Protection Agency (USEPA) provides Aquatic Life Benchmarks for surface waters for individual pesticides. Aquatic Life Benchmarks are based on toxicity values derived from data available to the USEPA's Office of Pesticide Programs (OPP) supporting registration of the pesticide. These values are derived from risk assessments developed during registration or re-registration. Toxicity values are adjusted by Levels-of-Concern established by OPP for different aquatic taxa. The methodology used by USEPA for pesticide risk assessments is outlined in detail in *"Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs (OPP), U.S. Environmental Protection Agency"*
(www.epa.gov/espp/consultation/ecorisk-overview.pdf).

In general, MPCA water quality reference values supersede other reference values because they have been reviewed for their applicability to Minnesota's water resources and because of their potential use in making water body impairment decisions under the federal Clean Water Act. USEPA benchmarks can help direct MDA in monitoring activities and can serve as screening tools for evaluating potential risks of pesticides in

the aquatic environment if an MPCA reference value is not available. The most current USEPA Aquatic Life Benchmarks are located at their website (www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm).

MDA's surface water pesticide monitoring program uses a tiered structure (defined and described in the MDA Surface Water Monitoring Design Document www.mda.state.mn.us/monitoring). Within the tiered structure, there are three different levels (tiers) of monitoring intensity (Table 2). Tier 1 site locations (Figure 3) are distributed throughout most of the agricultural areas of the state and are sampled four times during an eight week period from May 1st through June 30th. When possible, sampling is done following runoff events. The objective is to provide a general assessment of water quality during peak pesticide detection periods from watersheds throughout the state. At Tier 2 (Figure 4) and 3 site locations, the frequency of sampling increases to provide better information for duration assessment or the length of time pesticide concentrations remain at a particular level. Tier 2 sites are sampled twice following runoff events, samples being taken four days apart. Tier 3 sites are sampled by automated equipment, with samples taken hourly for four days following a detected rise in river stage.

Table 2. Surface Water Quality Data for Calendar Year 2009 – Tiers 1, 2, and 3

Surface Water Quality Sample Data for Calendar Year 2009: Pesticide Results - Tier 1 Monitoring Sites

				Base Neutral Pesticide Results [υg/L]																																						
Pesticide Monitoring Region	Sample Site	Sample Type	Sample Date	2,6-Dichlorobenzamide	Acetochlor	Alachlor	Atrazine	Boscalid	Chlorpyrifos	Cyanazine	Deisopropylatrazine	Desethylatrazine	Diazinon	Dichlobenil	Dimethenamid	Dimethoate	EPTC	Fonofos	Malathion	Metolachlor	Metribuzin	Metribuzin DA	Metribuzin DADK	Metribuzin DK	Myclobutanil	Oxadiazon	Parathion, Methyl	Pendimethalin	Phorate	Prometon	Propazine	Propiconazole	Simazine	Tebuconazole	Tebuprimiphos	Terbufos	Tetraconazole	Trifluralin
1	Grand Marais Creek	BF G	5/20/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	P	ND
1	Grand Marais Creek	BF G	5/28/2009	na	P	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Grand Marais Creek	BF G	6/9/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	P	ND
1	Grand Marais Creek	BF G	6/25/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Middle River	BF G	5/20/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Middle River	SF G	5/28/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Middle River	BF G	6/9/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Middle River	BF G	6/25/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Wild Rice River	BF G	5/13/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Wild Rice River	SF G	5/26/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Wild Rice River	BF G	6/4/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Wild Rice River	BF G	6/15/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND

Surface Water Quality Sample Data for Calendar Year 2009: Pesticide Results - Tier 2 Monitoring Sites

				Base Neutral Pesticide Results [υg/L]																																						
Pesticide Monitoring Region	Sample Site	Sample Type	Sample Date	2,6-Dichlorobenzamide	Acetochlor	Alachlor	Atrazine	Boscalid	Chlorpyrifos	Cyanazine	Deisopropylatrazine	Desethylatrazine	Diazinon	Dichlobenil	Dimethenamid	Dimethoate	EPTC	Fonofos	Malathion	Metolachlor	Metribuzin	Metribuzin DA	Metribuzin DADK	Metribuzin DK	Myclobutanil	Oxadiazon	Parathion, Methyl	Pendimethalin	Phorate	Prometon	Propazine	Propiconazole	Simazine	Tebuconazole	Tebuprimiphos	Terbufos	Tetraconazole	Trifluralin
1	Bois de Sioux River	BF G	5/13/2009	na	0.05	ND	0.05	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Bois de Sioux River	BF G	6/4/2009	na	P	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Bois de Sioux River	BF G	6/15/2009	na	P	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Bois de Sioux River	SF G	5/26/2009	na	0.06	ND	0.06	ND	ND	ND	ND	0.05	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Bois de Sioux River	SF G	5/29/2009	na	P	ND	0.06	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Snake River	BF G	5/20/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Snake River	BF G	6/9/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Snake River	BF G	6/25/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Snake River	SF G	5/26/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Snake River	SF G	5/28/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND

Surface Water Quality Sample Data for Calendar Year 2009: Pesticide Results - Tier 3 Monitoring Sites

				Base Neutral Pesticide Results [υg/L]																																						
Pesticide Monitoring Region	Sample Site	Sample Type	Sample Date	2,6-Dichlorobenzamide	Acetochlor	Alachlor	Atrazine	Boscalid	Chlorpyrifos	Cyanazine	Deisopropylatrazine	Desethylatrazine	Diazinon	Dichlobenil	Dimethenamid	Dimethoate	EPTC	Fonofos	Malathion	Metolachlor	Metribuzin	Metribuzin DA	Metribuzin DADK	Metribuzin DK	Myclobutanil	Oxadiazon	Parathion, Methyl	Pendimethalin	Phorate	Prometon	Propazine	Propiconazole	Simazine	Tebuconazole	Tebuprimiphos	Terbufos	Tetraconazole	Trifluralin
1	Buffalo River-Dilworth	SF G	3/24/2009	na	ND	ND	ND	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	P	ND
1	Buffalo River-Dilworth	SF G	4/21/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	5/11/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	5/20/2009	na	P	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	5/28/2009	na	0.44	ND	0.88	ND	ND	ND	ND	0.05	ND	na	ND	ND	ND	ND	ND	1.47	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	5/29/2009	na	0.06	ND	0.09	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	0.08	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	6/1/2009	na	0.28	ND	0.06	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	6/4/2009	na	P	ND	0.22	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	0.31	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	6/10/2009	na	ND	ND	P	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	6/18/2009	na	ND	ND	0.05	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	6/20/2009	na	0.13	ND	0.37	ND	ND	ND	ND	0.05	ND	na	0.33	ND	ND	ND	ND	0.11	0.12	ND	ND	ND	ND	na	ND	ND	ND	na	na	P	na	ND	ND	ND	P	ND
1	Buffalo River-Dilworth	SF G	6/22/2009	na	0.25	ND	0.48	ND	ND	ND	ND	0.05	ND	na	0.16	ND	ND	ND	ND	0.3	P	ND	ND	ND	ND	na	ND	ND	ND	na	na	P	na	ND	ND	ND	P	ND
1	Buffalo River-Dilworth	SF G	6/24/2009	na	0.29	ND	0.32	ND	ND	ND	ND	0.05	ND	na	0.12	ND	ND	ND	ND	0.23	P	ND	ND	ND	ND	na	ND	ND	ND	na	na	P	na	ND	ND	ND	P	ND
1	Buffalo River-Dilworth	SF G	6/25/2009	na	0.34	ND	0.25	ND	ND	ND	ND	0.05	ND	na	0.11	ND	ND	ND	ND	0.22	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	P	na	ND	ND	ND	P	ND
1	Buffalo River-Dilworth	SF G	6/29/2009	na	0.16	ND	0.15	ND	ND	ND	ND	P	ND	na	0.09	ND	ND	ND	ND	0.12	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	7/1/2009	na	0.08	ND	0.12	ND	ND	ND	ND	P	ND	na	P	ND	ND	ND	ND	0.08	P	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	BF G	7/6/2009	na	P	ND	0.07	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	BF G	7/30/2009	na	ND	ND	0.12	ND	ND	ND	ND	0.05	ND	na	ND	ND	ND	ND	ND	P	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	8/20/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	8/25/2009	na	ND	ND	0.06	ND	ND	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	BF G	9/3/2009	na	ND	ND	P	ND	P	ND	ND	P	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	10/7/2009	na	ND	ND	P	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	10/22/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	11/6/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	SF G	11/12/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND
1	Buffalo River-Dilworth	BF G	11/25/2009	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	na	ND	ND	ND	na	na	ND	na	ND	ND	ND	ND	ND

The primary goal of MDA's surface water monitoring activities is to provide information on the impact of pesticides on Minnesota's surface waters as directed by the Minnesota Pesticide Control Law, Minnesota Statutes Chapter 18B. Protection of Minnesota's citizens and water resources from agricultural chemicals is the fundamental purpose of this goal. To achieve this goal the following objectives have been identified:

1. Measure pesticide and nutrient concentrations in representative streams and rivers in agricultural and urban areas of Minnesota (Table 3);
2. Provide analysis of pesticide and nutrient concentration dynamics (magnitude, duration and frequency of detections) at locations that have demonstrated the potential to exceed standards or other relevant numeric criteria;
3. Collect other relevant information related to pesticide and nutrient fate and transport such as flow, persistence and use;
4. Compile, analyze and disseminate the information developed through the monitoring program to policy makers, scientists, and citizens.
5. Document and evaluate the effectiveness of actions taken to prevent or minimize the impacts associated with pesticides and nutrients and verify that water body impacts are, indeed, minimized or do not lead to impairments of use.

Table 3. Pesticide and Nutrient Concentrations Representative Streams and Rivers

2009 Tier	Site Code	Site Name	State Water Use class	Acres Drained	MDA Sampling History
2	BDS	Bois de Sioux River	2C	1,180,000	Tier 1: 2005-8
3	BU1	Buffalo River-Georgetown	2B	625,000	Tier 1: 2002; 2004-6; Tier 2: 2007-8; Tier 3: 2009
1	GM1	Grand Marais Creek	2B	111,000	Tier 1: 2004-8
1	MID5	Middle River	2B	184,380	Tier 1: 2007-8
2	SNA	Snake River	2B	736,000	Tier 1: 2005-8
1	WR1	Wild Rice River	2B	1,043,000	Tier 1: 2005-8

In recent years the MDA monitored surface water samples for up to 40 chemicals and degradates that are commonly used in the state and of interest to water quality managers. In 2010 the list has increased to over 100 chemicals. Samples are analyzed at the Minnesota Department of Agriculture laboratory using standard methods.

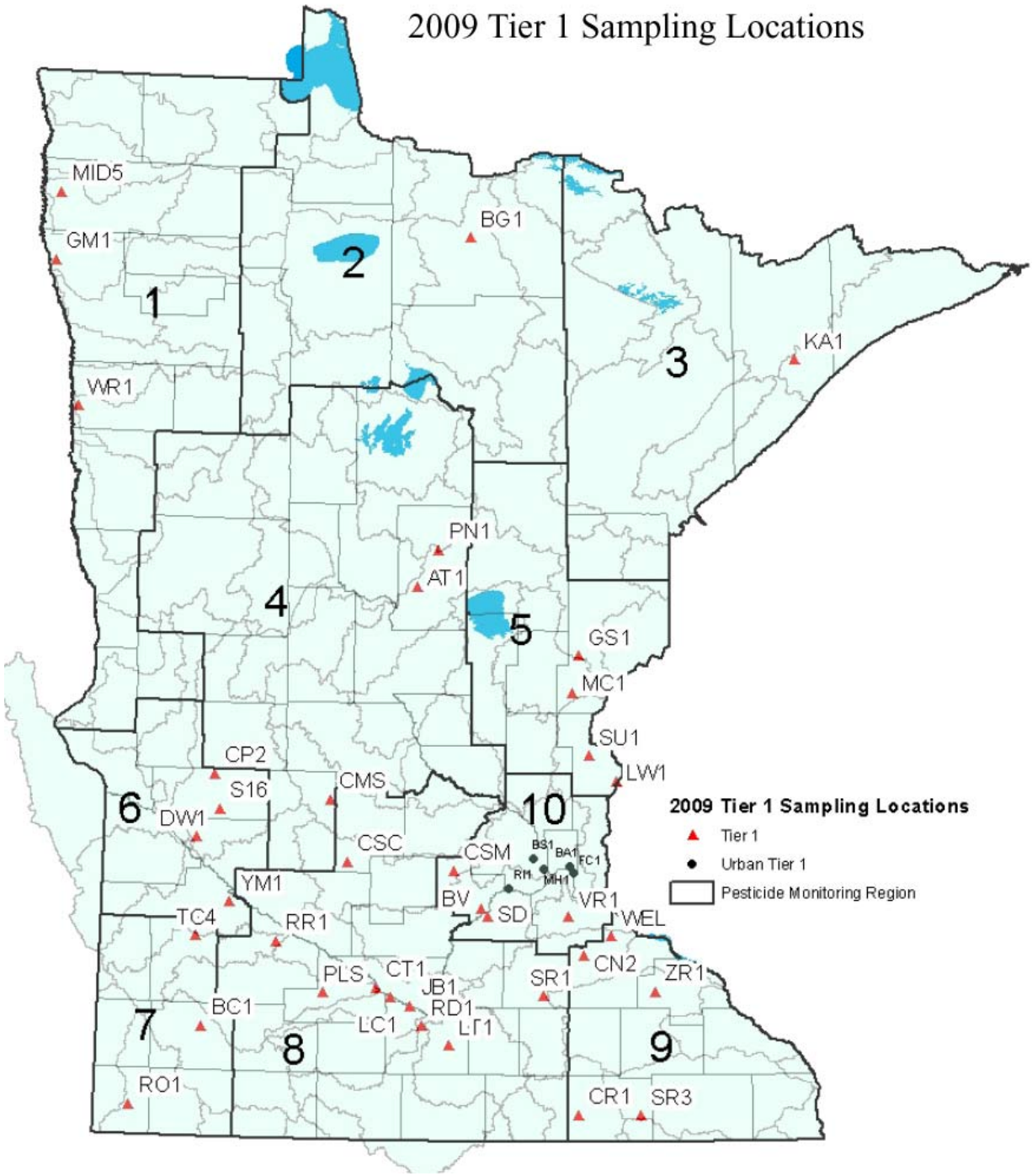


Figure 3. 2009 Tier 1 Sampling Locations

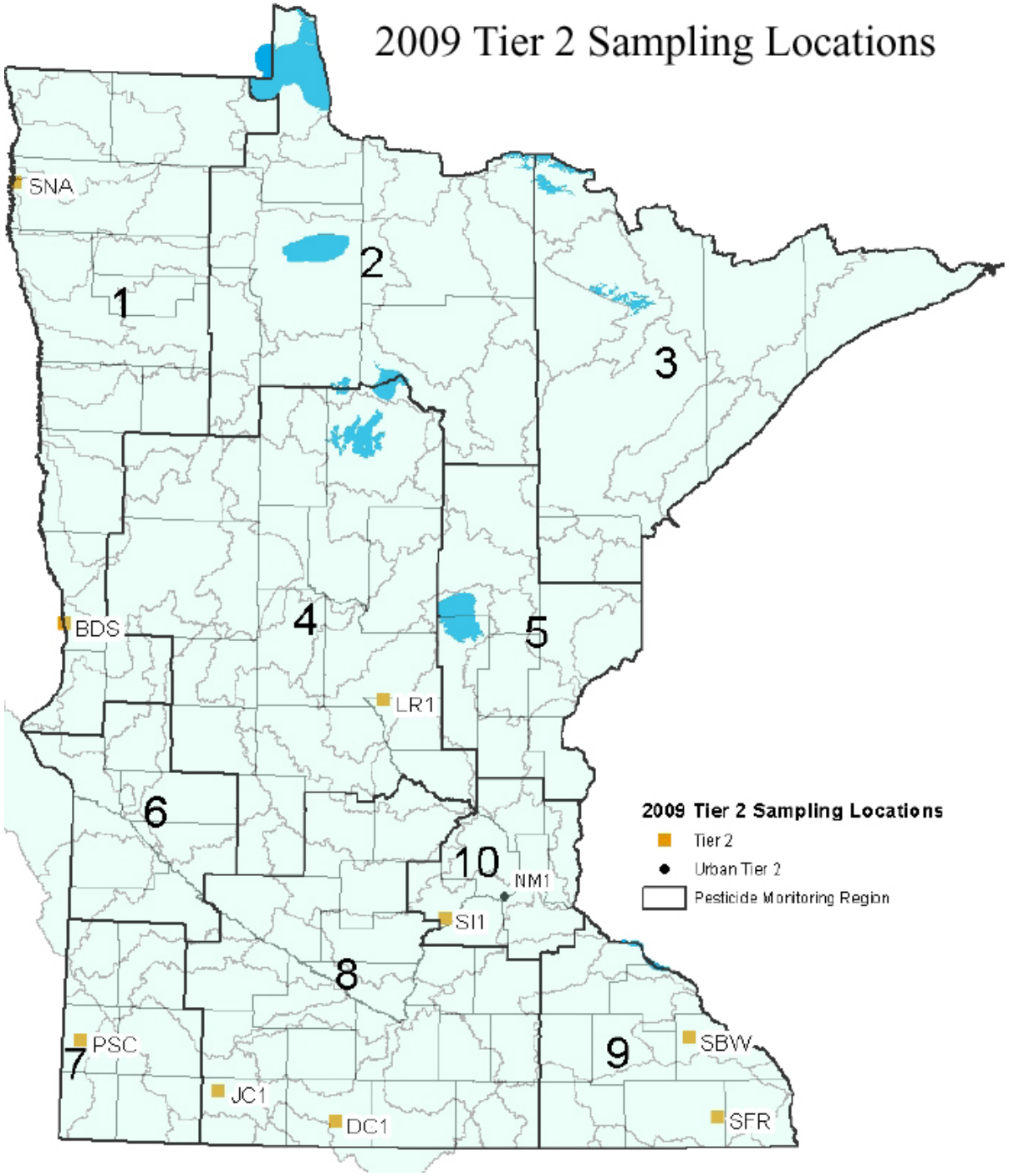


Figure 4 2009 Tier 2 Sampling Locations

In 2009 the MDA began operating a Tier 3 site at the Buffalo River near Georgetown in northwestern Minnesota. This was in response to the detection of chlorpyrifos at the "present" level in at least one sample from the Buffalo River for each of the previous three monitoring seasons. Chlorpyrifos is an organophosphate insecticide used extensively throughout the Red River Basin. The survey level sampling (Tier 1 and Tier 2) indicates it is "present" in water samples seasonally at very low levels, near the CS. No sample has exceeded either the chronic or acute water quality standards established by MPCA. However, MPCA and MDA review and discuss results and may take additional action based on continued detection especially if higher concentrations of chlorpyrifos are found or other organophosphate insecticides are measured. MPCA is also in the process of developing Indices of Biological Integrity (IBIs) to assess the health of aquatic invertebrate and fish communities in all Minnesota's watersheds. As invertebrates are highly sensitive to organophosphate insecticides, that data is an important component to determining if the Red River of North is meeting water quality standards.

In response to the several legislative mandates, Minnesota Department of Agriculture has developed regionally based water quality monitoring networks for the purpose of collecting and reporting groundwater and surface water monitoring data. These ten Pesticide Monitoring Regions (PMRs) are based on areas of similar agricultural practices and hydrologic/geologic characteristics. The PMR boundaries follow county boundaries, but also generally represent different hydrologic regions of Minnesota. (map from page p. 2, 2009 report). This report provides information on PMR 1, which covers the counties draining directly to the Red River of the North in Minnesota.

The Minnesota Pollution Control Agency (MPCA) develops, through a rule-making process in Minn. R. ch. 7050, toxicity-based (for aquatic life) and human health-based enforceable chronic standards (CSs) for pollutants detected in surface water. The toxicity-based standard (protective for aquatic life exposure) is applied as a four-day average. The human health-based standard (protective for drinking water plus fish consumption) is based on an exposure duration of 30-days. The CSs also have a frequency component, where one exceedance of the average value is allowed in a three year-window. Acute standards protect aquatic life and are based on a one-day average that cannot be exceeded.

The United States Environmental Protection Agency (USEPA) provides Aquatic Life Benchmarks for surface waters for individual pesticides. Aquatic Life Benchmarks are based on toxicity values derived from data available to the USEPA's Office of Pesticide Programs (OPP) supporting registration of the pesticide. These values are derived from risk assessments developed during registration or re-registration. Toxicity values are adjusted by Levels-of-Concern established by OPP for different aquatic taxa. The methodology used by USEPA for pesticide risk assessments is outlined in detail in *"Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs (OPP), U.S. Environmental Protection Agency"*
(www.epa.gov/espp/consultation/ecorisk-overview.pdf).

In general, MPCA water quality reference values supersede other reference values because they have been reviewed for their applicability to Minnesota's water resources and because of their potential use in making water body impairment decisions under the federal Clean Water Act. USEPA benchmarks can help direct MDA in monitoring activities and can serve as screening tools for evaluating potential risks of pesticides in the aquatic environment if an MPCA reference value is not available. The most current USEPA Aquatic Life Benchmarks are located at their website
(www.epa.gov/oppefed1/ecorisk_ders/aquatic_life_benchmark.htm).

Proposed Water Quality Standards

Minnesota's Proposed Water Quality Standards Rule Revisions include Regional Nutrient Criteria for Streams and Rivers. Every three years the federal Clean Water Act (CWA) requires states to obtain public comment on, and revise as needed, their water quality standards. The Minnesota Pollution Control Agency (MPCA) began the Triennial Review process by publishing a Request for Comments in the July 28, 2008 edition of the State Register. The proposed amendments will be to Minnesota Rules chs. 7050 and 7052 (see bottom of the page). MPCA plans to complete the current Triennial Review rulemaking process by 2012 (see Updated Schedule) and will regularly post updated information with details on the revision process and information on how to become involved.

A key part of proposing new or revised water quality standards is developing the technical foundation behind the narrative and numeric WQSs. MPCA develops this foundation based on review of scientific data, consideration of relevant rules, guidance, public comments, and consultation with topic experts at the U. S. Environmental Protection Agency (administrator of the CWA), other state agencies, and academic researchers. The product of this review will be topic-specific Technical Support Documents (TSDs) that will later be introduced in the rulemaking record as the supporting documents (exhibits) to the proposed rules and Statement of Need and Reasonableness (SONAR). The goal of publishing these documents prior to the official notice for proposing revised rules and SONAR is to obtain early comments to help MPCA refine and improve the basis for the proposed water quality standards.

TSDs will be published in Fall 2010 covering:

- the new eutrophication standards for rivers,
- revised turbidity standards,
- aquatic life criteria for nonylphenol, nitrate, cadmium, and copper,
- revisions to human health-based methods (or summary of expected approaches), and
- University of Minnesota report on the Class 3 and 4 standards.

The draft eutrophication criteria for rivers have been developed following intensive field work and analysis. Several studies have demonstrated significant and predictable relationships among summer nutrients, sestonic chlorophyll-*a*, and biochemical oxygen demand (BOD5) in several medium to large Minnesota rivers (Heiskary & Markus 2001, 2003). Diurnal dissolved oxygen (DO) flux (based on submersible data recorders) also was found to be strongly positively correlated to TP and chlorophyll-*a* concentrations. Our findings demonstrate significant relationships among several sensitive invertebrate and fish metrics and TP, TN, chlorophyll-a, and DO flux. Criteria were refined and supported by use of quartile regression and change point analysis using invertebrate and fish data. A regional approach to developing nutrient criteria was used and demonstrated that different criteria should be applied across regions.

Reports documenting the study process in developing of regional nutrient criteria for Minnesota streams and rivers can be found at the MPCA website: http://www.pca.state.mn.us/index.php/water/water-monitoring-and-reporting/biological-monitoring/stream-monitoring/stream-monitoring-algae.html?menuid=&missing=0&redirect=1 More information about Minnesota's triennial review of water quality standards can be found at the MPCA website:http://www.pca.state.mn.us/index.php/water/water-permits-and-rules/water-rulemaking/proposed-water-quality-standards-rule-revision.html

6.02 North Dakota

Ambient Water Quality Monitoring Program

During the reporting period October 1, 2008 to September 30, 2009, the North Dakota Department of Health (department) conducted or contracted with the USGS for ambient chemical monitoring at 18 sites in the Red River basin (Table 4).

Table 4. North Dakota Department of Health Ambient Water Quality Monitoring Sites in the Red River Basin.

Station Number	Station Description
385055	Bois de Sioux near Doran, MN[1]
380083	Red River at Brushville, MN[4]
380031	Wild Rice River near Abercrombie[1,4]
385414	Red River at Fargo[1,2,4]
385040	Red River near Harwood[4]
380010	Sheyenne River at Warwick[1,4]
380009	Sheyenne River 3 mi E of Cooperstown[1,3, 4]
380153	Sheyenne River below Baldhill Dam[1]
380007	Sheyenne River at Lisbon[3, 4]
385001	Sheyenne River near Kindred[1,3,4]
384155	Maple River at Mapleton[1,4]
380156	Goose River at Hillsboro[1,2,4]
384156	Red River at Grand Forks[1,2,4]
380037	Turtle River at Manvel[2,4]
380039	Forest River at Minto[1,2,4]
380157	Park River at Grafton[1,2,4]
380158	Pembina River at Neche[1,2]
384157	Red River at Pembina[1,2,4]

[1]Site co-located with USGS flow gauging station.
[2] Site sampled by the USGS under cooperative agreement with the department.
[3] Sampled for pesticides in 2008. [4] Sampled for pesticides in 2009
[4] Sampled for pesticides in 2009

Sites were sampled during the open-water period at six-week intervals beginning in April and concluding in November. In addition, one sample was collected under ice in February 2008. This schedule resulted in eight samples collected at each site during the reporting period. Stations inaccessible due to flooding/road construction or sites with no flow were not sampled.

Samples collected by the department were analyzed for major cations, anions, trace elements (total recoverable and dissolved), nutrients, total suspended solids (TSS) and pathogens (Fecal coliform and E. coli) (Table 5). In addition, field measurements for temperature, pH, dissolved oxygen and specific conductance were taken during each site visit.

The department enters all of its water quality results in the Surface Water Quality Management Program's Sample Identification Database (SID). Each year, data are exported to the U.S. Environmental Protection Agency's (EPA) STOrage and RETreival (STORET) database.

Table 5. North Dakota Department of Health Water Quality Variables Analyzed.

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

[1]Department samples are analyzed for total recoverable and dissolved metals. The USGS samples are analyzed only for dissolved metals.
[2]Nutrients are analyzed for both total and dissolved fractions.

Pesticide Monitoring Project

In 2008, the North Dakota Department of Agriculture's Pesticide Water Quality Program initiated a pesticide monitoring program for rivers and streams. The Department cooperated with the ND Department of Agriculture by collecting pesticide samples at three sites in the Red River basin located on the Sheyenne River. Two of the sites were ambient water quality monitoring sites, the Sheyenne River near Cooperstown (380009) and the Sheyenne River at Lisbon (380007) (Table 2). A third site was located on the Sheyenne River near Horace, ND. Samples were collected in 2008 during the weeks of April 21st, May 12th, June 2nd, June 23rd, July 14th, August 4th, August 25th, Sept 15th, Oct 6th and Oct 27th.

In 2009, the North Dakota Department of Agriculture's Pesticide Water Quality Program was expanded to 15 sites in the Red River basin. (Table 2). Five sites on the mainstem Red River (380083, 385414, 385040, 384156, and 384157) and four sites on the Sheyenne River (380010, 380009, 380007, and 385001) were sampled for pesticides. Other tributary sites sampled included the Wild Rice River (380031), Maple River (384155), Goose River (380156), Turtle River (380037), Forest River (380039) and Park River (380157). Sampling in 2009 was concurrent with the North Dakota Department of Health's Ambient Water Quality Monitoring Program which collects samples every six weeks beginning with ice out. Five pesticides samples were collected at each site in 2009. Sampling occurred during the weeks of June 15th, July 27th, September 7th, October 19th, and November 30th.

Samples were analyzed for 184 and 180 different pesticides and degradates in 2008 and 2009, respectively (Table 6). All sample analysis was performed by Pacific Agricultural Laboratory (Portland, OR) using the EPA standard methods (Table 7).

The goals of the monitoring study were to:

- Determine the occurrence and concentration of pesticides in rivers;
- Determine whether any pesticides may be present at concentrations that could adversely affect human health, aquatic life, or fish-eating wildlife; and
- Determine the frequency of sampling needed to assess contamination, thereby helping to refine future pesticide monitoring design.

The ND Department of Agriculture will also use the monitoring data as part of its cooperative agreement with the US EPA. Under that agreement, the ND Department of Agriculture has committed to evaluate national and local pesticides of interest that may pose a risk to water quality. Furthermore, the Department is required to demonstrate that any risks are appropriately managed. In addition, the ND Department of Agriculture administers an Endangered Species Protection Program that is focused on ensuring that pesticides do not negatively impact threatened and endangered species in North Dakota. Since most of the seven listed species in the state are found in or near surface water, the ND Department of Agriculture will also use the results of the monitoring study to identify pesticides that may pose a risk to threatened and endangered species.

Table 6. North Dakota Department of Agriculture Pesticide Variables Analyzed.

Analyte	Trade name	Type	Reporting Limit
2,4,5-T	N/A	H	0.080 ug/liter (ppb)
2,4,5-TP (fenoprop)	Silvex	H	0.080 ug/liter (ppb)
2,4-D	2,4-D, Weed-B-Gon	H	0.20 ug/liter (ppb)
2,4-DB	Butryac, Butoxone	H	0.20 ug/liter (ppb)
3-Hydroxycarbofuran	degradate	D	0.12 ug/liter (ppb)
Acetochlor	Surpass, Harnass	H	0.30 ug/liter (ppb)
Alachlor	Intrro, Lariat, Lasso	H	0.12 ug/liter (ppb)
Aldicarb	Temik	I	0.12 ug/liter (ppb)
Aldicarb sulfone	degradate	D	0.12 ug/liter (ppb)
Aldicarb sulfoxide	degradate	D	0.12 ug/liter (ppb)
Aldrin	Aldrex	I	0.12 ug/liter (ppb)
Ametryn	Evik, Gesapax	H	0.30 ug/liter (ppb)
Amitraz	Avartan, Triatox, Mitac	I	0.60 ug/liter (ppb)
Aspon	N/A	I	0.30 ug/liter (ppb)
Atrazine	Aatrex,	H	0.30 ug/liter (ppb)
Azinphos-methyl	Guthion, Bay	I	0.30 ug/liter (ppb)
Azoxystrobin	Quadris	F	0.30 ug/liter (ppb)
Bendiocarb	Dycarb, Niomil	I	0.12 ug/liter (ppb)
Benfluralin	Balan	H	0.12 ug/liter (ppb)
Bentazon	Basagran	H	0.08 ug/liter (ppb)
Bifenthrin	Talstar, Capture, Brigade	I	0.12 ug/liter (ppb)
Bolstar	Sulprofos	I	0.30 ug/liter (ppb)
Bromacil	Hyvar, Bromax	H	0.30 ug/liter (ppb)
Bromopropylate	Acarol, Folbex	I	0.60 ug/liter (ppb)
Captafol	Captafol, Sanspor	F	0.12 ug/liter (ppb)
Captan	Captanex, Orthocide	F	0.30 ug/liter (ppb)
Carbaryl	Sevin, Savit	I	0.12 ug/liter (ppb)
Carbophenothion	Trithion, Garrathion	I	0.30 ug/liter (ppb)
Carbofuran	Furadan, Carbodan	I	0.12 ug/liter (ppb)
Carfentrazone-ethyl	Aim	H	0.30 ug/liter (ppb)
Chlordane	Belt, Chlortox	I	1.2 ug/liter (ppb)
Chlorfenvinphos	N/A	I	0.30 ug/liter (ppb)
Chlorobenzilate	Akar, Acaraben	I	0.30 ug/liter (ppb)
Chloroneb	Terraneb	F	0.30 ug/liter (ppb)
Chlorothalonil	Bravo, Ole, Farben	F	0.12 ug/liter (ppb)
Chlorpropham	Furloe, Beet-kleen	H	0.30 ug/liter (ppb)
Chlorpyrifos	Lorsban, Dursban	I	0.30 ug/liter (ppb)
Chlorpyrifos-methyl	Reldan, Storcide	I	0.30 ug/liter (ppb)
Clopyralid	Stinger, Curtail	H	0.080 ug/liter (ppb)
Coumaphos	Resistox, Asuntol	I	0.30 ug/liter (ppb)
Cyanazine	Bladex	H	0.60 ug/liter (ppb)
Cyfluthrin	Tempo, Baythroid	I	1.2 ug/liter (ppb)
Cyhalothrin	Grenade, Karate	I	1.2 ug/liter (ppb)

Table 6 (cont). North Dakota Department of Agriculture Pesticide Variables Analyzed.

Analyte	Trade name	Type[1]	Reporting Limit
Cypermethrin	Ammo	I	1.2 ug/liter (ppb)
Dacthal	Dacthal	H	0.12 ug/liter (ppb)
DCPMU	degradate	D	0.12 ug/liter (ppb)
Deltamethrin	Butox, K-Othrin	I	1.2 ug/liter (ppb)
Demeton-O	N/A	I	0.30 ug/liter (ppb)
Demeton-S (Metasystox)	N/A	I	0.30 ug/liter (ppb)
Diazinon	Knox Out, Diazol	I	0.30 ug/liter (ppb)
Dicamba	Banvel	H	0.080 ug/liter (ppb)
Dichlorfenthion	Mobilawn, Gro13	I	0.30 ug/liter (ppb)
Dichlorprop	Weedone, Strike, Envert	H	0.20 ug/liter (ppb)
Dichlorvos	Vapona, DDVP	I	0.30 ug/liter (ppb)
Diclofop-methyl	Hoelon	H	0.60 ug/liter (ppb)
Dicloran	Botran	F	0.12 ug/liter (ppb)
Dicrotophos	Bidrin	I	0.30 ug/liter (ppb)
Dieldrin	Dieldrex	I	0.12 ug/liter (ppb)
Dimethenamid	Outlook	H	0.30 ug/liter (ppb)
Dimethoate	Cygon, Roxion	I	0.30 ug/liter (ppb)
Dinoseb	Aretit, Dinitro	H	0.20 ug/liter (ppb)
Disulfoton	Disyston, Dithiosystox	I	0.30 ug/liter (ppb)
Diuron	Direx, Karmex	H	0.12 ug/liter (ppb)
Endosulfan I	Thionex, Thiodan	I	0.12 ug/liter (ppb)
Endosulfan II	Thionex	I	0.12 ug/liter (ppb)
Endosulfan sulfate	degradate	D	0.12 ug/liter (ppb)
Endrin	Endrex	I	0.12 ug/liter (ppb)
Endrin aldehyde	degradate	D	0.12 ug/liter (ppb)
EPN	N/A	I	0.30 ug/liter (ppb)
Esfenvalerate	Asana, Pydrin	I	0.12 ug/liter (ppb)
Ethalfluralin	Sonalan	H	0.12 ug/liter (ppb)
Ethion	Ethiol, Cethion	I	0.30 ug/liter (ppb)
Ethofumesate	Progress, Tramat	H	0.30 ug/liter (ppb)
Ethoprop	Mocap	I	0.30 ug/liter (ppb)
Famphur	N/A	I	0.30 ug/liter (ppb)
Fenarimol	Rubigan	F	0.12 ug/liter (ppb)
Fenbuconazole	Indar	F	0.60 ug/liter (ppb)
Fenhexamid	Elevate	F	0.12 ug/liter (ppb)
Fenitrothion	Cyfen, Folithion	I	0.30 ug/liter (ppb)
Fenobucarb	Folistar, Prostar, Moncut	F	0.12 ug/liter (ppb)
Fenoxaprop-ethyl	Puma, Option, Whip	H	0.60 ug/liter (ppb)
Fensulfothion	Terracur, Dasanit	I	0.30 ug/liter (ppb)
Fenthion	Baytex	I	0.30 ug/liter (ppb)
Fenuron	Dybar, PDU	H	0.30 ug/liter (ppb)
Fenvalerate	Pydrin	I	0.12 ug/liter (ppb)
Fipronil	Regent	I	0.60 ug/liter (ppb)

Table 6 (cont). North Dakota Department of Agriculture Pesticide Variables Analyzed.

Analyte	Trade name	Type	Reporting Limit
Fluazifop-P-butyl	Fusilade	H	0.60 ug/liter (ppb)
Fludioxanil	Maxim, Celest	F	0.30 ug/liter (ppb)
Flumioxazin	Sumisoya, Valor	H	0.30 ug/liter (ppb)
Fluometuron	Cortoran, Lanex	H	0.30 ug/liter (ppb)
Fluroxypyr-meptyl	Starane	H	0.30 ug/liter (ppb)
Flutolanil	Moncoat	F	1.2 ug/liter (ppb)
Folpet	Cosan, Fungitrol	F	0.30 ug/liter (ppb)
Heptachlor	Heptamule	I	0.12 ug/liter (ppb)
Heptachlor epoxide	degradate	D	0.12 ug/liter (ppb)
Hexachlorobenzene	HCB	F	0.12 ug/liter (ppb)
Hexazinone	Velpar	H	0.30 ug/liter (ppb)
Imazamethabenz	Assert	H	0.02 ug/liter (ppb)
Imazamox[2]	Raptor	H	0.02 ug/liter (ppb)
Imazapyr[2]	Stalker	H	0.02 ug/liter (ppb)
Imazethapyr[2]	Pursuit	H	0.02 ug/liter (ppb)
Imidacloprid	Touchstone PF	I	0.30 ug/liter (ppb)
Iprodione	Rovral	F	0.12 ug/liter (ppb)
Isoxaben	Cent 7, Gallery	H	0.30 ug/liter (ppb)
Kelthane	Dicofol	I	0.30 ug/liter (ppb)
Linuron	Linex, Lorox	H	0.30 ug/liter (ppb)
Malathion	Malathion, Cythion	I	0.30 ug/liter (ppb)
MCPA	MCP	H	20 ug/liter (ppb)
MCPP	Encore, Trimec	H	20 ug/liter (ppb)
Mefenoxam	Apron, Dividend,Dynasty	F	0.30 ug/liter (ppb)
Metalaxyl	Hi-Yield, Ridomil	F	0.30 ug/liter (ppb)
Methidathion	Somonic, suprathion	I	0.30 ug/liter (ppb)
Methiocarb	Mesurol	I	0.12 ug/liter (ppb)
Methomyl	Lannate	I	0.12 ug/liter (ppb)
Methoxychlor	Methoxychlor	I	0.12 ug/liter (ppb)
Metolachlor	Dual, Magnum	H	0.30 ug/liter (ppb)
Metribuzin	Sencor, Lexone	H	0.60 ug/liter (ppb)
Mevinphos	Phosdrin	I	0.30 ug/liter (ppb)
Mirex	Ferriamicide, Dechlorane	I	0.12 ug/liter (ppb)
Monocrotophos	N/A	I	0.30 ug/liter (ppb)
Monuron	CMU, Telvar	I	0.12 ug/liter (ppb)
Myclobutanil	Rally	F	0.60 ug/liter (ppb)
Neburon	Kloben	H	0.12 ug/liter (ppb)
Norflurazon	Solicam	H	0.12 ug/liter (ppb)
Oryzalin	Surflan	H	0.30 ug/liter (ppb)
Ovex	Ovochlor, Ovotran	I	0.12 ug/liter (ppb)
Oxamyl	Vydate	I	0.12 ug/liter (ppb)
Oxyflorfen	Goal	H	0.12 ug/liter (ppb)
P,p'-DDD	N/A	I	0.12 ug/liter (ppb)
P,p'-DDE	degradate	D	0.12 ug/liter (ppb)

Table 6 (cont). North Dakota Department of Agriculture Pesticide Variables Analyzed.

Analyte	Trade name	Type	Reporting Limit
P,p'-DDT	N/A	I	0.12 ug/liter (ppb)
Parathion	Parathion, Thiophos	I	0.30 ug/liter (ppb)
Parathion-methyl	Penncap-M, Folidol-M	I	0.30 ug/liter (ppb)
PCA	degradate	D	0.12 ug/liter (ppb)
PCNB (quintozene)	Terraclor, Tritisan	F	0.12 ug/liter (ppb)
Pendimethalin	Prowl	H	0.30 ug/liter (ppb)
Pentachlorophenol	PCP	H	0.080 ug/liter (ppb)
Permethrin	Ambush, Pounce	I	1.2 ug/liter (ppb)
Phorate	Thimet	I	0.30 ug/liter (ppb)
Phosmet	Imidan	I	0.30 ug/liter (ppb)
Phosphamidon	Phosphamidon	I	0.30 ug/liter (ppb)
Picloram	Tordon	H	0.20 ug/liter (ppb)
Pirimicarb	Pirimor	I	0.30 ug/liter (ppb)
Pirimiphos-methyl	Tomahawk,Silosan	I	0.30 ug/liter (ppb)
Prodiamine	Barricade	H	0.12 ug/liter (ppb)
Prometon	Pramitol	H	0.60 ug/liter (ppb)
Prometryn	Caparol	H	0.30 ug/liter (ppb)
Pronamide	Kerb	H	0.12 ug/liter (ppb)
Propachlor	Ramrod	H	0.30 ug/liter (ppb)
Propanil	Stampede, Prop-Job	H	0.12 ug/liter (ppb)
Propargite	Comite, Omite	I	0.60 ug/liter (ppb)
Propazine	Milogard	F	0.30 ug/liter (ppb)
Propham	IPC	H	0.30 ug/liter (ppb)
Propiconazole	Banner, Tilt, Radar	F	0.30 ug/liter (ppb)
Propoxur	Baygon	I	0.12 ug/liter (ppb)
Pyraclostrobin	Cabrio, Headline	F	0.30 ug/liter (ppb)
Pyrethrins	Wilson, Mushroom House	I	1.2 ug/liter (ppb)
Pyridaben	Pyromite, Dynomite	I	0.60 ug/liter (ppb)
Quinclorac	Paramount	H	0.20 ug/liter (ppb)
Sethoxydim	Poast	H	6.0 ug/liter (ppb)
Siduron	Tupersan	H	0.12 ug/liter (ppb)
Simazine	Princep	H	0.60 ug/liter (ppb)
Simetryn	Gybon	H	0.30 ug/liter (ppb)
Sulfentrazone	Spartan	H	0.30 ug/liter (ppb)
Tebuconazole	Folicur	F	0.60 ug/liter (ppb)
Tebuthiuron	Spike	H	0.60 ug/liter (ppb)
Terbacil	Sinbar	H	0.12 ug/liter (ppb)
Terbufos	Counter	I	0.30 ug/liter (ppb)
Tetrachlorvinphos	Disvap	I	0.30 ug/liter (ppb)
Thiabendazole	Arbotect	F	0.30 ug/liter (ppb)
Thiobencarb	Bolero, Saturn, Abolish	H	0.30 ug/liter (ppb)
Toxaphene	Phenatox,Toxakil	I	6.0 ug/liter (ppb)
Triadimefon	Bayleton	F	0.60 ug/liter (ppb)
Trichlorfon	Dylox, Neguvon	I	0.60 ug/liter (ppb)

Table 6 (cont). North Dakota Department of Agriculture Pesticide Variables Analyzed.

Analyte	Trade name	Type	Reporting Limit
Triclopyr	Garlon	H	0.080 ug/liter (ppb)
Trifloxystrobin	Ronilan	F	0.12 ug/liter (ppb)
Triflumazole	Terraguard, Procure	F	0.12 ug/liter (ppb)
Trifluralin	Treflan, Trilin	H	0.12 ug/liter (ppb)
Vinclozalin	Ronilan	F	0.12 ug/liter (ppb)
A-BHC	degradate	D	0.12 ug/liter (ppb)
B-BHC	degradate	D	0.12 ug/liter (ppb)
Γ-BHC (Lindane)	Gamma BHC	I	0.12 ug/liter (ppb)
Δ-BHC	degradate	D	0.12 ug/liter (ppb)

[1] H-Herbicide, F-Fungicide, I-Insecticide, D-Degradate
[2] Not sampled in 2009.

Table 7. Description of Analytical Methods Used by Pacific Agricultural Labs (Portland, OR).

Pesticide Class	Method Description
Organochlorine pesticides	Modified EPA Method 608 (GC-ECD)
Organophosphorus pesticides	Modified EPA Method 614 (GC-FPD)
Organonitrogen pesticides	Modified EPA Method 625 (GC-MS)
Chlorinated pesticides	Modified EPA method 8321A (HPLC-MS)
Imidazolinone herbicides	American Cyanamid method (HPLC-MS)
Miscellaneous pesticides	Modified EPA Method 8321A (HPLC-MS)

Four pesticides were detected in the samples collected from the three Sheyenne River sites in 2008. 2,4-D was detected at the Sheyenne River near Lisbon and Cooperstown sites in June and at the Sheyenne River near Horace site in October (Table 6). Atrazine, bentazon, and clopyralid were each detected once (Table 6).

The majority of the samples collected and analyzed in 2009 had no detectable pesticide residues. Only four pesticides were detected, all of which were herbicides. The pesticides detected in the Red River basin in North Dakota were atrazine, bentazon, dimethenamid and MCPA (Table 7).
Atrazine and bentazon were detected four and three times, respectively, while dimethenamid and MCPA were both detected twice. All of the pesticides concentrations were less than 1 ppb.

For a complete description of the 2008 and 2009 Pesticide Water Quality Monitoring Project and the results the reader is referred to the North Dakota Department of Agriculture's web site at http://www.agdepartment.com/ .

Table 8. 2008 Pesticide Sampling Results.

Chemical	Concentration (ug/L)	Lowest EPA Aquatic Life Benchmark	Benchmark Organism	Sample Location	Date Collected
2,4-D	0.21	299.2	Acute-vascular plants	Sheyenne River near Lisbon	6/3/2008
2,4-D	0.21	299.2	Acute-vascular plants	Sheyenne River near Cooperstown	6/4/2008
2,4-D	0.25	299.2	Acute-vascular plants	Sheyenne River near Horace	10/7/2008
Atrazine	0.48	17.5	Chronic-aquatic community	Sheyenne River near Horace	6/23/2008
Bentazon	0.014	4,500	Acute-non-vascular plants	Sheyenne River near Lisbon	9/15/2008
Clopyralid	0.089	None	N/A	Sheyenne River near Horace	6/23/2008

Table 9. 2009 Pesticide Sampling Results.

Chemical	Concentration (ug/L)	Lowest EPA Aquatic Life Benchmark	Benchmark Organism	Sample Location	Date Collected
Atrazine	0.42	17.5	Chronic-aquatic community	Wild Rice River near Abercrombie	6/17/2009
Atrazine	0.46	17.5	Chronic-aquatic community	Red River near Brushville	6/17/2009
Atrazine	0.40	17.5	Chronic-aquatic community	Red River at Grand Forks	6/23/2009
Atrazine	0.45	17.5	Chronic-aquatic community	Wild Rice River nr Abercrombie	7/29/2009
Bentazon	0.38	4,500	Acute-vascular plants	Red River at Pembina	7/13/2009
Bentazon	0.54	4,500	Acute-vascular plants	Red River at Pembina	7/29/2009
Bentazon	0.70	4,500	Acute-vascular plants	Forest River near Minto	7/29/2009
dimethenamid	0.36	8.9	Acute-vascular plants	Red River near Brushville, MN	6/17/2009
dimethenamid	0.35	8.9	Acute-vascular plants	Wild Rice River nr Abercrombie	10/7/2009
MPCA	0.90	170	Acute-vascular plants	Wild Rice River nr Abercrombie	6/17/2009
MPCA	1.5	170	Acute-vascular plants	Red River near Brushville, MN	6/17/2009

6.03 Manitoba

Ambient Water Quality Monitoring Program

Water quality continues to be monitored monthly at two sites on the Red River within Manitoba by Manitoba Water Stewardship. These sites are located upstream and downstream of the City of Winnipeg (Floodway control structure and Selkirk, respectively). Variables measured include physical, general chemistry, suspended sediment, bacteria, industrial organics, trace elements, plant nutrients, and agricultural chemicals. The City of Winnipeg normally monitors six sites on a bi-weekly basis. These sites are located upstream, within, and downstream of the City of Winnipeg. Variables monitored by the City of Winnipeg include general chemistry, plant nutrients, suspended sediment, bacteria, and chlorophyll *a*. Long-term variables and sampling frequency are shown in Tables 8 and 9.

Routine monitoring is also conducted on five tributary streams to the Red River by Manitoba Water Stewardship. 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, plant nutrients, and agricultural chemicals. Locations and variables monitored are shown in Table 3. Benthic macroinvertebrates were collected from the Red River at Emerson and Selkirk in September 2009.

During the flood of 2009, the frequency of water quality monitoring was increased in the Red River watershed. Samples were collected as often as daily in the main stem of the Red River during peak flows and weekly in the tributaries to the Red River. In 2009, nutrient loads in the Red River and in the main tributaries in Manitoba exceeded mean nutrient loads for the period 1994 to 2009.

Manitoba continues to work to achieve the targets of the Lake Winnipeg Action Plan announced on February 18, 2003. The Lake Winnipeg Action Plan is a commitment to reduce nitrogen and phosphorus loads to Lake Winnipeg to pre-1970s levels. The Lake Winnipeg Action Plan recognizes that nutrients are contributed by most activities occurring within the drainage basin and that reductions will need to occur across all sectors. Progress under the Action Plan and to reduce the nitrogen and phosphorus load to Lake Winnipeg includes:

- Work continues to implement the Nutrient Management Regulation which was enacted in March 2008. Effective January 1, 2009, within urban and built up areas (Nutrient Management Zone N5, no one shall apply a fertilizer to turf containing more than 1 per cent phosphorus by weight, expressed as P_2O_5. An exception to this restriction includes newly established turf during the year of establishment as well as the year following establishment. Phosphorus-containing fertilizers can be applied provided that the soil test phosphorus level:
    - is less than 60 ppm on land used to grow grass for sale as sod,
    - is less than 30 ppm on land used as a sports facility, or
    - is less than 18 ppm on land used neither to grow grass for sale as sod or as a sports facility

  Flowerbeds, gardens, trees and shrubs are excluded from the phosphorus restrictions. In addition, no one shall apply or allow the escape of a substance containing nitrogen or phosphorus onto a paved or other impervious surface within Nutrient Management Zone N5. Should this occur, the individual must immediately take all reasonable steps to remove the substance so that it does not drain into a storm or sewage drainage system. Manitoba Water Stewardship has been working with fertilizer retailers and the public to develop signage, brochures and ad campaigns to communicate the requirements of the regulation in urban areas.

- Also, as of January 1, 2009 under the Nutrient Management Regulation, golf courses in Manitoba are required to prepare annual Nutrient Management Plans to demonstrate how nutrients will be used on their golf courses to ensure that excess nutrients do not runoff into waterways. Manitoba Water Stewardship has developed templates for nutrient management planning for golf courses and is working to achieve compliance throughout the industry.

- As of January 1, 2009, nutrients cannot be applied in the Nutrient Buffer Zone. The Nutrient Buffer Zone is a setback from waterways that varies in width depending on the type of waterway and if it is used as a drinking water source. Nutrient Buffer Zones apply to all nutrient applications including from livestock manure, inorganic fertilizer and municipal biosolids.

- More information on the *Nutrient Management Regulation* under *The Water Protection Act* is available at http://www.gov.mb.ca/waterstewardship/wqmz/index.html.

- Requirements for nutrient removal are in place for wastewater treatment facilities in the City of Winnipeg, the City of Brandon (industrial wastewater treatment facility), and for new and expanding wastewater treatment facilities serving the food processing sector and large communities. In addition, all wastewater treatment facilities in Provincial Parks are required to remove phosphorus to 1 mg/L.

- Work on integrated watershed management planning under *The Water Protection Act* also continued and included plans in four Red River tributary watersheds: the Seine, La Salle, and Pembina Rivers and the Grassmere-Netley Creek watershed. 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.

- New financial incentives under the province's Wetland Restoration Incentive Program were announced in December 2008 to help restore the condition of wetlands, improve water quality and reduce greenhouse gas emissions. Landowners who sign a conservation agreement will be provided a one-time payment to ensure natural landscapes are protected over the long-term. An additional ecological goods and services payment will also be provided that recognizes the unique value of restored wetlands and helps offset operational costs incurred by the landowner in retaining the restored wetlands on their land.

- Manitoba Water Stewardship provided support to the South Basin Mayors and Reeves to develop and launch a program to help consumers better identify products that have proven to be the best choice for the environment. The Lake Friendly Label criteria are based on Environment Canada's EcoLogo criteria. EcoLogo provides assurance that the products and services bearing the logo meet stringent standards of environmental leadership. The initial phase identifies hard surface cleaners, dish detergents (including dishwasher detergents) and laundry cleaners. These cleaners are all commonly used and can impact Lake Winnipeg. Lake Friendly Products are available at retailers across the south basin of Lake Winnipeg.

Water Quality Status of Red River in Manitoba

During this reporting period, water quality in the Manitoba reach of the Red River main stem remained relatively good and comparable to previous years. Dissolved oxygen concentrations were relatively high

with an average concentration of 7.5 mg/L upstream of the City of Winnipeg and 8.2 mg/L downstream of the City of Winnipeg. The lowest value recorded of 2.7 mg/L occurred in January 2009 upstream of the City of Winnipeg.

Densities of *Escherichia coli* bacteria downstream of the City of Winnipeg were similar to the previous reporting period. Average density downstream of the City of Winnipeg was 77 organisms / 100 mL (geomean), compared to 51 organisms / 100 mL in the previous reporting period. In comparison, the average density of *Escherichia coli* bacteria in the upstream reach was 18 organisms / 100 mL (geomean), comparable to the previous year (20 organisms / 100 mL). Densities of *Escherichia coli* bacteria exceeded the Manitoba Water Quality Standards, Objectives, and Guideline for the protection of recreation of 200 organisms / 100 mL on one occasion upstream of the City of Winnipeg. Meanwhile the exceedence rate of the Manitoba Water Quality Standards, Objectives, and Guidelines for the protection of recreation was 16 % downstream of the City of Winnipeg.

During this reporting period, four samples were analyzed for pesticides upstream of the City of Winnipeg. Eight pesticides out of the 63 monitored were detected. AMPA, atrazine, bromoxynil, dicamba, diuron, glyphosate and thifensulfuron-me were each detected once in July 2009 while tribenuron was detected once in October 2008. None of the detections of AMPA, atrazine, diuron, glyphosate, thifensulfuron-me, and tribenuron 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. However, concentrations of bromoxynil and dicamba exceeded the guidelines developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses.

Thirteen pesticides out of the 63 monitored were detected downstream of the City of Winnipeg. A total of 13 samples were analyzed for pesticides. Dursban, dicamba, and thifensulfuron-me were each detected once in July while diuron was also detected in July as well as in August and September. Atrazine was detected in July and August while 2,4-D was detected in August and September. Glyphosate was detected in May, August and September 2009, and bromoxynil was detected in March, July and August 2009. AMPA was detected in September and twice in April. Finally, imazamethabenz-methyl (April 2009), pentachlorophenol (May 2009), tribenuron (October 2008) and triclopyr (September 2009) were each detected once.

None of the detections of 2,4-D, atrazine, AMPA, diuron, dursban, glyphosate, imazamethabenz-methyl, pentachlorophenol, thifensulfuron methyl, tribenuron and triclopyr 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. However, one detection of bromoxynil and the only detection of dicamba exceeded the guidelines developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses.

Table 10. Sampling frequency of routine surface water quality monitoring by Manitoba Water Stewardship on the Red River within Manitoba, Canada over the period October 1, 2008 to September 30, 2009.

Variables	Units	Red River at Selkirk	Red River at St. Norbert
2,4,5-TP	ug/L	7	2
2,4-DB	ug/L	13	4
2,4-D	ug/L	13	4
ALACHLOR	ug/L	13	4
ALKALINITY CO3	mg/L	13	12
ALKALINITY OH	mg/L	13	12
ALKALINITY TOTAL CACO3	mg/L	13	12
ALKALINITY TOTAL HCO3	mg/L	13	12
ALUMINUM DISSOLVED	mg/L	13	4
ALUMINUM TOTAL	mg/L	46	10
AMMONIA DISSOLVED	mg/L	47	18
AMPA(AMINOMETHYLPHOSPHONIC ACID)	ug/L	13	4
ANTIMONY TOTAL	mg/L	46	10
ARSENIC TOTAL	mg/L	46	10
ATRAZINE DESETHYL	ug/L	7	2
ATRAZINE	ug/L	13	4
AZINPHOS METHYL	ug/L	7	2
BARIUM TOTAL	mg/L	46	10
BENOMYL	ug/L	12	3
BERYLLIUM TOTAL	mg/L	46	10
BISMUTH TOTAL	mg/L	46	10
BORON TOTAL	mg/L	46	10
BROMACIL	ug/L	13	4
BROMOXYNIL	ug/L	13	4
CADMIUM TOTAL	mg/L	46	10
CALCIUM TOTAL	mg/L	46	10
CAPTAN	ug/L	7	2
CARBOFURAN	ug/L	13	4
CARBON TOTAL INORGANIC	mg/L	47	18
CARBON TOTAL ORGANIC (TOC)	mg/L	9	6
CARBON TOTAL	mg/L	47	18
CARBOXIN (CARBATHIN)	ug/L	12	4
CESIUM TOTAL	mg/L	46	10
CHLORDANE-CIS	ug/L	13	4
CHLORDANE-TRANS	ug/L	13	4
CHLORIDE DISSOLVED	mg/L	43	10
CHLOROPHYLL A	ug/L	43	13
CHLOROTHALONIL	ug/L	10	3
CHLORPYRIFOS-ETHYL (DURSBAN)	ug/L	13	4
CHROMIUM HEXAVALENT DISSOLVED	mg/L	13	4
CHROMIUM TOTAL (CR)	mg/L	46	10
COBALT TOTAL	mg/L	46	10
COLOUR TRUE	CU	13	12
CONDUCTIVITY (AT 25C)	uS/cm	47	18
COPPER TOTAL (CU)	mg/L	46	10
CYANAZINE	ug/L	7	2
DELTAMETHRIN	ug/L	12	3
DIAZINON	ug/L	13	4
DICAMBA (BANVEL)	ug/L	13	4
DICHLOROPROP(2,4-DP)	ug/L	13	4
DICLOFOP-METHYL	ug/L	13	4
DIMETHOATE (CYGON)	ug/L	13	4
DINOSEB	ug/L	13	4
DIURON (DCMBU)	ug/L	7	4

Table 10. Continued….

Variables	Units	Red River at Selkirk	Red River at St. Norbert
DIURON	ug/L	5	0
EPTAM	ug/L	12	4
ESCHERICHIA, COLI	CFU/100 mL	38	15
ETHALFLURALIN (EDGE)	ug/L	13	4
FENOXAPROP	ug/L	12	4
GAMMA-BENZENEHEXACHLORIDE (LINDANE)	ug/L	7	2
GLYPHOSATE (ROUNDUP)	ug/L	13	4
HARDNESS TOTAL CACO3	mg/L	13	4
IMAZAMETHABENZ-ME	ng/L	7	2
IMAZAMETHABENZ-METHYL	ug/L	2	1
IRON TOTAL (FE)	mg/L	46	10
LEAD TOTAL	mg/L	46	10
LITHIUM TOTAL	mg/L	46	10
MAGNESIUM TOTAL	mg/L	46	10
MALATHION	ug/L	13	4
MANGANESE TOTAL (MN)	mg/L	46	10
MCPA	ug/L	13	4
MCPP (MECOPROP)	ug/L	13	4
METASULFURON-ME	ng/L	7	2
METHOXYCHLOR (P,P'-METHOXYCHLOR)_	ug/L	13	4
METRIBUZIN	ug/L	13	4
METSULFURON-METHYL	ug/L	5	2
MOLYBDENUM TOTAL	mg/L	46	10
NICKEL TOTAL	mg/L	46	10
NITROGEN DISSOLVED NO3 & NO2	mg/L	47	18
NITROGEN TOTAL KJELDAHL (TKN)	mg/L	47	18
OXYGEN BIOCHEMICAL DEMAND	mg/L	47	14
OXYGEN DISSOLVED	mg/L	11	12
PARATHION ETHYL	ug/L	7	2
PARATHION METHYL	ug/L	7	2
PENTACHLOROPHENOL	ug/L	13	3
PHEOPHYTIN A	ug/L	48	11
PHOSPHOROUS-ACID HYDROLYZABLE	mg/L	47	10
PHOSPHOROUS-TOTAL-ORTHO	mg/L	8	2
PHOSPHORUS DISSOLVED ORTHO	mg/L	39	8
PHOSPHORUS PARTICULATE	mg/L	14	12
PHOSPHORUS TOTAL (METALS SCAN)	mg/L	40	8
PHOSPHORUS TOTAL (P)	mg/L	47	18
PHOSPHORUS TOTAL DISSOLVED	mg/L	47	18
PHOSPHORUS TOTAL INORGANIC	mg/L	39	8
PH	pH units	47	18
PICLORAM (TORDON)	ug/L	13	4
POTASSIUM TOTAL	mg/L	46	10
PROPACHLOR	ug/L	7	2
PROPANIL	ug/L	12	4
PROPOXUR	ug/L	12	4
QUIZALOFOP	ug/L	12	4
RUBIDIUM TOTAL	mg/L	46	10
SELENIUM TOTAL	mg/L	46	10
SETHOXYDIM	ug/L	8	3
SETHOXYDIM	ug/L	5	1
SILICON TOTAL	mg/L	40	8
SILVER TOTAL	mg/L	46	10
SIMAZINE	ug/L	13	4
SODIUM TOTAL	mg/L	46	10

Table 10. Continued….

Variables	Units	Red River at Selkirk	Red River at St. Norbert
SULPHATE DISSOLVED	mg/L	13	4
TEBUTHIURON	ug/L	7	2
TELLURIUM TOTAL	mg/L	46	10
TERBUFOS	ug/L	13	4
THALLIUM TOTAL	mg/L	46	10
THIFENSULFURON METHYL	ug/L	5	2
THIFENSULFURON-ME	ng/L	7	2
THORIUM TOTAL	mg/L	46	10
TIN TOTAL	mg/L	46	10
TITANIUM TOTAL	mg/L	46	10
TOTAL DISSOLVED SOLIDS	mg/L @180C	13	12
TOTAL SUSPENDED SOLIDS	mg/L	47	18
TRALKOXYDIM	ug/L	8	3
TRALKOXYDIM	ug/L	4	1
TRIALLATE (AVADEXBW)	ug/L	13	4
TRIBENURON	ng/L	9	3
TRICLOPYR	ug/L	5	1
TRICLOPYR	ug/L	13	4
TRIFLURALIN(TREFLAN)	ug/L	13	4
TUNGSTEN TOTAL	mg/L	39	8
TURBIDITY	Ntu	13	12
URANIUM TOTAL	mg/L	46	10
VANADIUM TOTAL	mg/L	46	10
ZINC TOTAL (ZN)	mg/L	46	10
ZIRCONIUM TOTAL	mg/L	46	10

Table 11. Sampling frequency of routine surface water quality monitoring by City of Winnipeg on the Red River within Manitoba, Canada over the period October 1, 2008 to September 30, 2009.

Variables	Red River at Floodway Control	Red River at Fort Garry Bridge	Red River at Norwood Bridge	Red River at Redwood Bridge	Red River at Chief Peguis Bridge	Red River at Lockport
Chlorophyll a	13 times	13 times	13 times	13 times	13 times	13 times
Escherichia coli	13 times	13 times	13 times	13 times	13 times	13 times
Fecal Coliform	13 times	13 times	13 times	13 times	13 times	13 times
Dissolved Oxygen	13 times	13 times	13 times	13 times	13 times	13 times
Oxygen Saturation	13 times	13 times	13 times	13 times	13 times	13 times
pH	13 times	13 times	13 times	13 times	13 times	13 times
Soluble Phosphorus	13 times	13 times	13 times	13 times	13 times	13 times
Temperature	13 times	13 times	13 times	13 times	13 times	13 times
Total Kjeldahl Nitrogen	13 times	13 times	13 times	13 times	13 times	13 times
Total Nitrogen	13 times	13 times	13 times	13 times	13 times	13 times
Ammonia Nitrogen	13 times	13 times	13 times	13 times	13 times	13 times
Nitrate Nitrogen	13 times	13 times	13 times	13 times	13 times	13 times
Total Organic Carbon	13 times	13 times	13 times	13 times	13 times	13 times
Total Phosphorus	13 times	13 times	13 times	13 times	13 times	13 times
Total Solids	13 times	13 times	13 times	13 times	13 times	13 times
Total Suspended Solids	13 times	13 times	13 times	13 times	13 times	13 times
Turbidity	13 times	13 times	13 times	13 times	13 times	13 times

Table 12. Sampling frequency of surface water quality monitoring activities on tributaries to the Red River within Manitoba, Canada over the period October 1, 2008 to September 30, 2009.

Parameter	Units	Boyne River PTH 13, Carman	La Salle River At La Barriere Park Dam	Rat River PR 303 near Otterborne	Roseau River PR 200, near Dominion City	Seine River PTH 100 (Perimeter Highway)	Seine River South East of Ste. Anne
2,4,5-TP	ug/L	2	2	3	2	2	2
2,4-DB	ug/L	4	3	5	4	4	3
2,4-D	ug/L	4	3	5	4	4	3
ALACHLOR	ug/L	4	3	5	4	4	3
ALKALINITY CO3	mg/L	4	3	5	4	5	3
ALKALINITY OH	mg/L	4	3	5	4	5	3
ALKALINITY TOTAL CACO3	mg/L	4	3	5	4	5	3
ALKALINITY TOTAL HCO3	mg/L	4	3	5	4	5	3
ALUMINUM DISSOLVED	mg/L	4	3	5	4	5	3
ALUMINUM TOTAL	mg/L	10	9	11	11	10	3
AMMONIA DISSOLVED	mg/L	10	9	11	11	10	3
AMPA(AMINOMETHYLPHOSPHONIC ACID)	ug/L	4	3	5	4	5	3
ANTIMONY TOTAL	mg/L	10	9	11	11	10	3
ARSENIC TOTAL	mg/L	10	9	11	11	10	3
ATRAZINE DESETHYL	ug/L	2	2	3	2	2	2
ATRAZINE	ug/L	4	3	5	4	4	3
AZINPHOS METHYL	ug/L	2	2	3	2	2	2
BARIUM TOTAL	mg/L	10	9	11	11	10	3
BENOMYL	ug/L	3	2	4	3	4	2
BERYLLIUM TOTAL	mg/L	10	9	11	11	10	3
BISMUTH TOTAL	mg/L	10	9	11	11	10	3
BORON TOTAL	mg/L	10	9	11	11	10	3
BROMACIL	ug/L	4	3	5	4	4	3
BROMOXYNIL	ug/L	4	3	5	4	4	3
CADMIUM TOTAL	mg/L	10	9	11	11	10	3
CALCIUM TOTAL	mg/L	10	9	11	11	10	3
CAPTAN	ug/L	2	2	3	2	2	2
CARBOFURAN	ug/L	4	3	5	4	4	3
CARBON TOTAL INORGANIC	mg/L	10	9	11	11	10	3
CARBON TOTAL ORGANIC	mg/L	8	7	8	9	8	1
CARBON TOTAL ORGANIC (TOC)	mg/L	2	2	3	2	2	2
CARBON TOTAL	mg/L	10	9	11	11	10	3
CARBOXIN (CARBATHIN)	ug/L	4	3	5	4	5	3
CESIUM TOTAL	mg/L	10	9	11	11	10	3
CHLORDANE-CIS	ug/L	4	3	5	4	4	3
CHLORDANE-TRANS	ug/L	4	3	5	4	4	3
CHLORIDE DISSOLVED	mg/L	10	9	10	11	10	3
CHLOROPHYLL A	mg/L	9	8	9	10	9	3
CHLOROPHYLL A	ug/L	1	1	2	1	1	0
CHLOROTHALONIL	ug/L	3	2	4	3	4	2
CHLORPYRIFOS-ETHYL (DURSBAN)	ug/L	4	3	5	4	4	3
CHROMIUM HEXAVALENT DISSOLVED	mg/L	4	3	5	4	5	3
CHROMIUM TOTAL (CR)	mg/L	10	9	11	11	10	3
COBALT TOTAL	mg/L	10	9	11	11	10	3
COLOUR TRUE	CU	2	2	3	2	2	3
COLOUR TRUE	rel units	2	1	2	2	3	0
CONDUCTIVITY (AT 25C)	uS/cm	10	9	11	11	10	3
COPPER TOTAL (CU)	mg/L	10	9	11	11	10	3
CYANAZINE	ug/L	2	2	3	2	2	2
DELTAMETHRIN	ug/L	3	2	4	3	4	2
DIAZINON	ug/L	4	3	5	4	4	3

Table 12. Continued….

Parameter	Units	Boyne River PTH 13, Carman	La Salle River At La Barriere Park Dam	Rat River PR 303 near Otterborne	Roseau River PR 200, near Dominion City	Seine River PTH 100 (Perimeter Highway)	Seine River South East of Ste. Anne
	ug/L	4	3	5	4	4	3
DICHLOROPROP(2,4-DP)	ug/L	4	3	5	4	4	3
DICLOFOP-METHYL	ug/L	4	3	5	4	4	3
DIMETHOATE (CYGON)	ug/L	4	3	5	4	4	3
DINOSEB	ug/L	4	3	5	4	4	3
DIURON (DCMBU)	ug/L	2	2	3	2	2	3
DIURON	ug/L	2	1	2	2	3	0
EPTAM	ug/L	4	3	5	4	5	3
ESCHERICHIA, COLI	CFU/100 mL	8	6	7	7	7	1
ETHALFLURALIN (EDGE)	ug/L	4	3	5	4	4	3
FENOXAPROP	ug/L	4	3	5	4	5	3
GAMMA-BENZENEHEXACHLORIDE (LINDANE)	ug/L	2	2	3	2	2	2
GLYPHOSATE (ROUNDUP)	ug/L	4	3	5	4	5	3
HARDNESS TOTAL CACO3	mg/L	4	3	5	4	5	3
IMAZAMETHABENZ-ME	ng/L	2	2	3	2	2	3
IMAZAMETHABENZ-METHYL	ug/L	1	1	1	1	2	0
IRON TOTAL (FE)	mg/L	10	9	11	11	10	3
LEAD TOTAL	mg/L	10	9	11	11	10	3
LITHIUM TOTAL	mg/L	10	9	11	11	10	3
MAGNESIUM TOTAL	mg/L	10	9	11	11	10	3
MALATHION	ug/L	4	3	5	4	4	3
MANGANESE TOTAL (MN)	mg/L	10	9	11	11	10	3
MCPA	ug/L	4	3	5	4	4	3
MCPP (MECOPROP)	ug/L	4	3	5	4	4	3
METASULFURON-ME	ng/L	2	2	3	2	2	3
METHOXYCHLOR (P,P'-METHOXYCHLOR)_	ug/L	4	3	5	4	4	2
METRIBUZIN	ug/L	4	3	5	4	4	3
METSULFURON-METHYL	ug/L	2	1	2	2	3	1
MOLYBDENUM TOTAL	mg/L	10	9	11	11	10	3
NICKEL TOTAL	mg/L	10	9	11	11	10	3
NITROGEN DISSOLVED NO3 & NO2	mg/L	10	9	11	11	10	3
NITROGEN TOTAL KJELDAHL (TKN)	mg/L	10	9	11	11	10	3
OXYGEN BIOCHEMICAL DEMAND	mg/L	10	9	11	11	10	3
OXYGEN DISSOLVED	mg/L	4	3	5	4	5	3
PARATHION ETHYL	ug/L	2	2	3	2	2	2
PARATHION METHYL	ug/L	2	2	3	2	2	2
PENTACHLOROPHENOL	ug/L	4	3	5	4	4	3
PHEOPHYTIN A	mg/L	9	8	9	10	9	1
PHEOPHYTIN A	ug/L	1	1	2	1	1	2
PHOSPHOROUS-ACID HYDROLYZABLE	mg/L	10	9	11	11	10	3
PHOSPHOROUS-TOTAL-ORTHO	mg/L	2	2	3	2	2	2
PHOSPHORUS DISSOLVED ORTHO	mg/L	8	7	8	9	8	1
PHOSPHORUS PARTICULATE	mg/L	4	3	5	4	5	3
PHOSPHORUS TOTAL (METALS SCAN)	mg/L	8	8	9	9	7	2
PHOSPHORUS TOTAL (P)	mg/L	10	9	11	11	10	3
PHOSPHORUS TOTAL DISSOLVED	mg/L	10	9	11	11	10	3
PHOSPHORUS TOTAL INORGANIC	mg/L	8	7	8	9	8	1
PH	pH units	10	9	11	11	10	3
PICLORAM (TORDON)	ug/L	4	3	5	4	4	3

Table 12. Continued…

Parameter	Units	Boyne River PTH 13, Carman	La Salle River At La Barriere Park Dam	Rat River PR 303 near Otterborne	Roseau River PR 200, near Dominion City	Seine River PTH 100 (Perimeter Highway)	Seine River South East of Ste. Anne
POTASSIUM TOTAL	mg/L	10	9	11	11	10	3
PROPACHLOR	ug/L	2	2	3	2	3	2
PROPANIL	ug/L	4	3	5	4	5	3
PROPOXUR	ug/L	4	3	5	4	5	3
QUIZALOFOP	ug/L	4	3	5	4	5	3
RUBIDIUM TOTAL	mg/L	10	9	11	11	10	3
SELENIUM TOTAL	mg/L	10	9	11	11	10	3
SETHOXYDIM	ug/L	3	2	3	3	4	3
SETHOXYDIM	ug/L	1	1	2	1	1	2
SILICON TOTAL	mg/L	8	8	9	9	7	2
SILVER TOTAL	mg/L	10	9	11	11	10	3
SIMAZINE	ug/L	4	3	5	4	4	3
SODIUM TOTAL	mg/L	10	9	11	11	10	3
TIN TOTAL	mg/L	10	9	11	11	10	3
TITANIUM TOTAL	mg/L	10	9	11	11	10	3
TOTAL DISSOLVED SOLIDS	mg/L @180C	4	3	5	4	5	3
TOTAL SUSPENDED SOLIDS	mg/L	10	9	11	11	10	3
TRALKOXYDIM	ug/L	3	2	3	3	4	1
TRALKOXYDIM	ug/L	1	1	2	1	1	2
TRIALLATE (AVADEXBW)	ug/L	4	3	5	4	4	3
TRIBENURON METHYL	ug/L	2	1	2	2	2	1
TRIBENURON	ng/L	2	2	3	2	2	2
TRICLOPYR	ug/L	4	3	5	4	4	3
TRIFLURALIN(TREFLAN)	ug/L	4	3	5	4	4	3
TUNGSTEN TOTAL	mg/L	8	7	8	9	8	1
TURBIDITY	Ntu	4	3	5	4	5	3
URANIUM TOTAL	mg/L	10	9	11	11	10	3
VANADIUM TOTAL	mg/L	10	9	11	11	10	3
ZINC TOTAL (ZN)	mg/L	10	9	11	11	10	3
ZIRCONIUM TOTAL	mg/L	10	9	11	11	10	3

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 exceedences 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.

The contingency plan, presently finalized, is available from the IRRB Secretariat.

7.02 Spills and Releases

Minnesota

In Minnesota's portion of the Red River Basin, 38 permitted wastewater dischargers received permit renewals or modifications in water year 2008. Of these, 35 were municipal operators and one was industrial. There were 59 water quality enforcement actions in water year 2008, of which four were industrial permitted facilities; 14 were municipal waster plants, nine were feedlots, five were construction storm water permits and three were industrial stormwater permits. On March 23, 2009, unusual conditions led to multiple bypasses, during which operators followed procedures, MPCA staff followed up and no enforcement action was taken. All actions have been resolved.

Stormwater

In water year 2008, 148 construction stormwater permits were granted in the northwest region of Minnesota; this amounted to 13 percent of the 1,116 permits granted statewide.

Feedlots

In water year 2008, 1,394 feedlot registrations were completed in the northwest region of Minnesota, approximately 15 percent of the 9,314 registrations statewide. This amounted to 33,082 animal units at 494 feedlots limited to either 500 animal units, 500-101 animal units of fewer than 100 animal units, and 57 confined animal feeding operations of 1,000 animal units or more.

North Dakota

Above average precipitation during this reporting period resulted in extensive flooding throughout the state during the spring melt. Several communities along the Sheyenne and Red Rivers experienced considerable infrastructure damages as a result of the spring flooding. This led to a high number of reported spills/releases associated with excessive precipitation/flooding. The North Dakota Pollutant Discharge Elimination System (NDPDES) program requires all permitted facilities (industrial and municipal) to report spills and by-pass

releases of wastewater. During this reporting period, there were 36 spills/releases reported to the department in the Red River basin. These releases were all related to pipe break/mechanical failure and lift station overflows/bypasses due to the flooding that occurred.

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.

Manitoba Water Stewardship tracks incidents that have the potential to impact water quality in Lake Winnipeg on the Department web site at www.manitoba.ca/lakewinnipeg. One incident occurred in the Red River watershed during the reporting period involving the discharge of partially treated wastewater effluent to the Red River.

On April 16 to 17, 2008, water levels in the Emerson wastewater treatment lagoon rose significantly as a result of spring runoff and caused a hydraulic overload. To avoid an uncontrolled spill, Manitoba Conservation authorized an emergency release from the facility. Wastewater began discharging to the Red River on April 16 and continued until early morning April 17. The total volume of sewage discharged was approximately 19,000 cubic metres. Given the flow rate of the Red River, the wastewater discharge made up about 0.056 per cent of the flow in the Red River at Emerson. Given the high dilution in the Red River, no water quality impacts were expected.

7.03 Pollution Abatement and Advisories

Point sources

North Dakota

Point Source Control Program

The North Dakota Pollutant Discharge Elimination System (NDPDES) program regulates the release of wastewater and stormwater from point sources into waters of the state. Permitted municipal and industrial point source dischargers must meet technology and water quality based limits. Toxic pollutants in wastewater discharges are an important concern, particularly for the larger cities and industries in North Dakota. They are regulated through the industrial pretreatment program which is administered by the department. The cities of Grand Forks, Fargo, and West Fargo have approved Pretreatment programs in the Red River Basin.

All waters of the state shall be free from substances attributable to municipal, industrial, or other discharges in concentrations or combinations which are toxic or harmful to humans, animals, plants, or resident biota. This standard is enforced in part through appropriate whole effluent toxicity (WET) requirements. All major municipal and industrial permittees must monitor their discharge for WET on a regular basis.

The Department of Health presently has 152 facilities with a NDPDES permit in the Red River Basin. Of these, there are 30 industrial wastewater permits and 122 domestic/municipal wastewater permits. Most of the domestic/municipal wastewater permits are for small lagoon systems which discharge a couple times a year.

Wastewater discharge data for the eleven largest permitted facilities during the reporting period October 1, 2008 to September 30, 2009 are presented in Table 13. In addition, the average BOD_5 and TSS values from permitted facilities for the years 1985 to 2009 are presented in Figure 5.

Stormwater Permits

A major portion of the NDPDES program involves permits for stormwater discharges from industrial sites, construction sites and larger municipalities. The department has issued four separate general permits for stormwater discharges. The general permits outline requirements for stormwater discharges from construction activities, industrial activities, mining operations, and municipal separate storm sewer systems (MS4's). The cities of Grand Forks, Fargo, West Fargo and their urbanized area continue to implement the MS4 permits during this reporting period.

The department remains actively involved with implementing the stormwater program at regulated facilities in the Red River Valley. The department went through public comment and re-issued the MS4 permit and the industrial permit for mining and paving facilities. Toward the end of the reporting period the department provided a draft construction permit for public comment. The construction permit would be re-issued early in the next reporting period.

Animal Feeding Operations (AFOs)

The North Dakota Pollutant Discharge Elimination System (NDPDES) program regulates animal feeding operations (livestock) in the state. The department rules pertaining to animal feeding operations and the NDPDES program were updated and finalized January 2005 as a result of the changes to the 2003 federal CAFO rules.

The U.S. Court of Appeals for the Second Circuit vacated key portions of the CAFO rule (Waterkeeper Alliance v. EPA, 2nd Cir. 2005). As a result, there were revisions to the federal CAFO regulations in 2006 and again in 2008. The department will continue to regulate animal feeding operations under its state approved permitting program until our NDPDES rules are updated to incorporate the 2008 federal revisions.

All large CAFOs are inspected annually by the department. Medium and small AFOs are inspected on an as-needed basis. There are 219 AFOs permitted by the department in the Red River basin. Of these, there are 36 designated as large CAFOs (over 1000 animals).

Table 13. Waste Discharge Data for North Dakota During the Reporting Period October 1, 2008 to September 30, 2009

Source*	Length of Discharge (Days)	Total Flow (Meters^3)	Discharge Quality - mg/L						Average Discharge Rate (Meters^3/day)	Average BOD-5 Loading (kg/day)	Average TSS Loading (kg/day)	Time in Permit Compliance (Percent)
			BOD-5			TSS						
			High	Low	Avg.	High	Low	Avg.				
Drayton	12	89031	11.5	5.5	8.5	25.0	6.0	15.5	7419.2	63.0	115.0	100.0
Fargo	340	16007522	17.0	2.0	8.1	35.5	2.3	14.3	47080.9	380.1	675.5	100.0
Grafton	16	711580	14.3	4.0	9.9	67.0	5.0	27.4	44473.8	439.2	1218.6	99.2
Grand Forks	91	9602783	16.2	2.9	7.2	26.2	5.0	12.5	105525.1	764.8	1313.8	100.0
Grand Forks AFB	20	454200	6.7	2.5	4.8	7.6	5.0	5.7	22710.0	109.7	128.5	100.0
Wahpeton	34	1951168	17.4	2.4	7.6	74.0	3.5	25.6	57387.3	436.8	1466.8	98.1
West Fargo	123	3604266	42.9	2.0	12.6	28.8	4.3	18.7	29303.0	369.0	546.7	97.8
ACS-Drayton	72	671838	20.0	3.0	8.5	27.2	18.0	16.3	9331.1	79.3	151.9	100.0
ACS-Hillsboro	198	808060	24.0	2.0	7.1	48.4	4.5	16.1	4081.1	29.1	65.8	97.3
Minn Dak	57	2090418	20.3	8.1	16.0	34.7	18.0	26.5	36674.0	586.5	971.4	100.0
Cargill Inc	365	1500438	33.1	2.0	9.4	40.0	1.0	11.7	4110.8	38.6	48.1	98.1

* Source -- Population greater than 1,000 or P.E. greater than 1,000

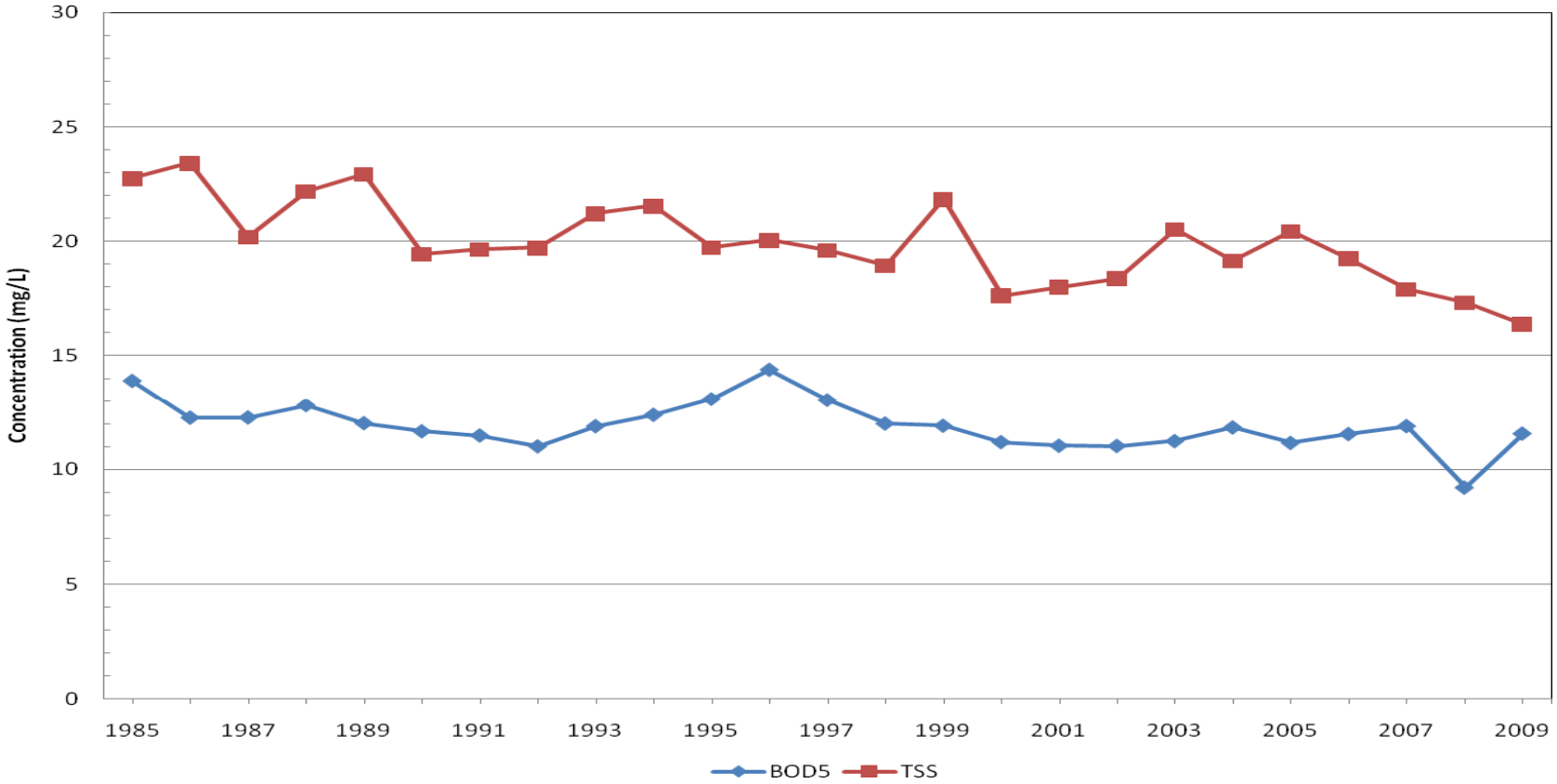


Figure 5. Average BOD-5 day and TSS Concentrations in the North Dakota Portion of the Red River Basin (1985-2009).

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.

Manitoba

Manitoba Water Quality Standards, Objectives, and Guidelines are applicable to streams within the Red River basin. In addition, site-specific water quality objectives have been established for the Red River within and downstream of the City of Winnipeg. 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. Manitoba intends to enshrine the Manitoba Water Quality Standards, Objectives, and Guidelines into legislation under *The Water Protection Act*.

Treated municipal effluents discharged to tributary streams within the Red River basin 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).

8.0 BIOLOGICAL MONITORING IN THE RED RIVER BASIN

8.01 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). It is expected that this species will be listed under the Species at Risk Act in 2010/2011.

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 September, 2009, zebra mussels (*Dreissena polymorpha*) were found in Pelican Lake, Minnesota, approximately 50 km south-east of Fargo, North Dakota and Moorhead Minnesota. This is the first occurrence of zebra mussels establishing in Red River watershed. Consequently, Manitoba Water Stewardship in cooperation with Environment Canada began collecting weekly water samples during the fall months for the presence of zebra mussel veligers (larval zebra mussels) in the Red River at Emerson. No veligers have been found to date.

In conjunction with expansion of the Red River Floodway, studies have been completed with regards to fish movements, fish passage, and fish abundance in the Red River upstream and downstream of the floodway inlet control structure. Under the direction of the Manitoba Floodway Authority, consultants under took an acoustic telemetry study of fish movements in relation to the floodway inlet control structure. Channel Catfish (*Ictalurus punctatus*), Northern Pike (*Esox lucius*), Walleye (*Sander vitreus*), and Sauger (*Sander canadensis*) were tagged with tracking devices. Study results at the floodway control structure indicates successful upstream passage of tagged fish during the spring, summer, fall and winter periods when the floodway control structure is not in operation. However, fish passage is impeded during the spring freshet and high summer flows when the control structure is in operation.

Large fish species collected at the floodway control structure for the abundance study have included Bigmouth Buffalo, Brown Bullhead (*Ameiurus nebulosus*), Common Carp, Freshwater Drum (*Aplodinotus grunniens*), Goldeye (*Hiodon alosoides*), Lake Sturgeon, Northern Pike, Quillback Sucker (*Carpiodes cyprinus*), Shorthead Redhorse Sucker (*Moxostoma macrolepidotum*), Silver Redhorse Sucker (*Moxostoma anisurum*), White Sucker (*Catostomus commersoni*), Stonecat (*Noturus flavus*), Walleye, Sauger, and Channel Catfish. Results showed that catches were greater downstream of the control structure however, this may have been related to seasonal changes in abundance. Condition factors of the fish collected appeared to be similar. Preliminary results from this study also suggest upstream movement of fish is blocked by operation of the gates during high water flows.

In 2008/09 work began on a habitat compensation plan to mitigate harmful alteration and destruction to fish habitat due to the Red River Floodway expansion project. Some of the initial compensation projects being considered

include fish habitat enhancement work on Red River tributaries (Seine River, La Salle River, Sturgeon Creek, and Normand Creek) which are in close proximity to the Red River Floodway.

An instream flow study has been completed 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 draft report on the study was submitted for review in 2008 and a final report draft is expected in 2010/11.

In 2009, the Instream Flow program within Manitoba Fisheries Branch coordinated its activities with a committee from DFO – Science. The intention of this collaboration was to seek intellectual partnerships that could promote the development of instream flow needs (IFN) 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 hydrology would be linked to the environmental impact of changed hydrology. As such, the Provincial Instream Flow Biologist was consulted to explain conceptual and methodological linkages between the hydrology and the other aspects of the IFN 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 IFN 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 will again be participating in a National Recreational Angling Survey. These surveys remain the only source of harvest and economic information related to recreational fishing in Canada. The 2010 survey will provide vital information of recreational fishing activities on the Red River.

The fishery attracts non-residents 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 lively hood.

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 the city.

A creel census survey proposal was developed by Manitoba Water Stewardship for the lower portion of the Red River in 2007. The survey was conducted from May 2008 through March 2009 to: 1) determine how the fishery has changed since the last survey in 1982-1983, 2) provide current information for fisheries management decisions, and 3) estimate the current value of the fishery. The summer and fall portion of the survey concentrated on angling activity near Lockport and Selkirk, while the winter portion concentrated on anglers from Lockport to Breezy Point. The methodology of the survey included direct counts of shore anglers and fishing boats to estimate fishing pressure, as well as angler interviews which included catch information as well as demographics of the anglers. The creel survey was conducted on approximately 50% of the days from May through August and approximately 25% days in September and October, and January through March. Some highlights of the preliminary results available from the open water portion of the survey include: 1) over 2,500 groups of anglers surveyed between May and October 2008, representing almost 6,000 anglers, 2) a catch rate of 0.95 fish/hour, and 3) a fish retention rate of 12.5%. The winter portion of the survey is currently being analyzed and a report of the entire survey will be made available at a future date. The collected information will ensure this valuable resource is sufficiently protected and sustainable for future generations.

Table 14. 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

8.02 Assessment of Red River Basin Tributary Streams

During this reporting period, water quality in the tributaries to the Red River main stem remained relatively comparable to past years. Average dissolved oxygen concentrations for each tributary ranged between 5.9 and 9.03 mg/L. At four tributaries, dissolved oxygen concentrations dropped below the minimum instantaneous dissolved oxygen objective in July 2009 (Boyne, Rat, Roseau and Seine Rivers). Densities of *Escherichia coli* bacteria were below the Manitoba Water Quality Objective for the protection of recreation at all five Red River tributaries during the entire reporting period.

Eleven pesticides were detected in samples collected from the five main tributaries to the Red River within Manitoba including 2-4-D, AMPA, imazamethabenz-ME, pentachlorophenol, MCPA, glyphosate, thifensulfuron methyl, tribenuron methyl, dicamba, bromoxynil and triclopyr.

AMPA was detected in all five tributaries during April 2009 and in the Rat and Seine Rivers in July 2009. 2,4-D was detected in the Boyne and Seine Rivers in July 2009 and in the Roseau River in April 2009. Imazamethabenz-ME was detected in the Boyne, Seine and La Salle Rivers in April 2009. Pentachlorophenol was detected in the Boyne and Rat Rivers in April 2009. MCPA was detected in the Rat and Roseau Rivers in July 2009. Dicamba was detected in the Roseau and Seine Rivers in July 2009. Concentrations of dicamba exceeded the guideline developed by the Canadian Council of Ministers of the Environment for protection of irrigation uses. Glyphosate and triclopyr were detected in the La Salle River in April and January, respectively. Glyphosate was also detected in the Seine River in April and July 2009. Finally, bromoxynil, thifensulfuron methyl and tribenuron methyl were each detected in the Seine River in July 2009.

Other Red River Water Quality / Biota Issues

Beach Monitoring in Lake Winnipeg

Manitoba monitored eighteen recreational beaches within the south basin of Lake Winnipeg for levels of *Escherichia coli* during 2009 (Table 13). Sampling began in early May and continued weekly until late August. Two beaches were monitored daily to provide sufficient data in support of developing a real-time predictive model for *E. coli* levels. Bathing water, sand, and sand water near the shoreline were collected for densities of *E. coli*.

While some beaches occasionally exceeded Manitoba's recreational water quality guideline for fecal indicator bacteria, in general 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 the 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 2009 beach monitoring program, Manitoba Water Stewardship also monitored beaches on Lake Winnipeg for the presence of algae blooms. Relatively cool weather conditions in 2009 likely contributed to a lack of algae blooms in the summer of 2009 in the south basin of Lake Winnipeg. No algae advisory signs were posted on the south basin of Lake Winnipeg in 2009.

Table 15. Recreational beaches in Lake Winnipeg south basin monitored in 2009.

Locations	*E. coli* in bathing water	Sand and Sand water Samples
Victoria Beach (2 sites)	Weekly	
Hillside Beach	Weekly	
Albert Beach	Weekly	
Lester Beach	Weekly	
East Grand Beach	Weekly	
West Grand Beach	Daily	Daily
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	Daily	Daily
Sandy Hook Beach	Weekly	
Winnipeg Beach	Weekly	
Matlock Beach	Weekly	

Macroinvertebrates of the Red River in Manitoba

Benthic macroinvertebrates were collected at two sites on the Red River in September 2009: Emerson and Selkirk, Manitoba. At each site, three transects of five Ponar© dredge grab samples were collected at equidistant locations along the width of the river starting at the west or east bank. Each Ponar© dredge grab covered an area of 0.05 square metres. For each transect, 0.25 m^2 of sediment was collected. The dredge samples were washed through a 500 µm Nitex© nylon net. River water was used to remove organisms and sediment from the nylon net into a 500 µm mesh sieve. Samples were then sieved to remove macroinvertebrates from the sediment matrix. 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 practical taxonomic level, typically genus and species, by ALS Laboratories, Winnipeg, Manitoba.

In 2009, Ponar© dredge samples collected at Emerson yielded 114, 126, and 112 organisms per square metre in Transects 1, 2, and 3, respectively (Table 14). Richness ranged between five and twelve taxa, with the most downstream transect (Transect 1) having the greatest number of genera represented. Most macroinvertebrates enumerated along each of the three transects were from the Family Hydropsychidae (Order Trichoptera). The most downstream transect was represented predominantly by organisms from the Genus *Hydropsyche* (64 %), while the remaining two transects had species from the Genus *Potamyia* (93 % and 87 %, respectively). The macroinvertebrates collected from Transect 1, or the most downstream of the three transects, also included fingernail clams (22 %).

Macroinvertebrates collected at Selkirk, Manitoba, along three transects yielded 127, 186, and 176 organisms, respectively (Table 15). The Selkirk site showed greater richness and taxonomic diversity than the Emerson site. The number of distinct taxonomic groupings enumerated along the three transects ranged from 14 to 17 taxa. Over 52 % of the macroinvertebrates collected along the first transect were classified as fingernail clams

(*Sphaerium* sp.) with some gastropods and aquatic worms contributing to the total abundance. Macroinvertebrate abundances for the remaining two transects were comprised primarily of chironomids, nematodes, and fingernail clams.

The taxa identified at the Emerson and Selkirk sites in 2009 are similar to those found in previous years. Historically, taxonomic richness has typically been lower at the Emerson site. The results from 2009 are consistent with this finding. The abundance of macroinvertebrates found along all six transects fell between 100 and 200 organisms. Since the substrate at both sites is clay and mud, it has limited the macroinvertebrates found to those taxa that do not require well-oxygenated environments for survival. Several of the macroinvertebrate taxa represented are known for their burrowing tendencies.

Table 16. Summary of macroinvertebrates collected per square meter in pooled Ponar© dredge samples from three transects on the Red River at Emerson, Manitoba in September 2009.

Class	Order	Family	Genus	Species	Transect 1 Numbers / m^2	Transect 2 Numbers / m^2	Transect 3 Numbers / m^2
Annelida	Oligochaeta	Tubificidae	Unidentified		3	0	0
Gastropoda	Basommatophora	Ancylidae	*Ferrissia*	sp.	0	0	2
Insecta	Diptera	Ceratopogoniidae			0	1	0
Insecta	Diptera	Chironomidae	*Ablabesmyia*	sp.	0	0	1
Insecta	Diptera	Chironomidae	*Procladius*	sp.	2	0	0
Insecta	Diptera	Chironomidae	*Thienemannimyla*	sp.	3	0	0
Insecta	Diptera	Chironomidae	*Xenochironomus*	sp.	1	0	0
Insecta	Diptera	Empididae	*Chelifera*	sp.	1	1	0
Insecta			Unidentified		1	0	0
Insecta	Trichoptera	Hydropsychidae	*Cheumatopsyche*	sp.	1	0	0
Insecta	Trichoptera	Hydropsychidae	*Hydropsyche*	sp.	73	1	5
Insecta	Trichoptera	Hydropsychidae	*Potamyia*	sp.	0	117	97
Insecta	Trichoptera	Leptoceridae	*Mystacides*	sp.	0	0	2
Insecta	Trichoptera	Leptoceridae	*Oecetis*	sp.	1	0	0
Insecta	Trichoptera	Leptoceridae	*Triaenodes*	sp.	0	0	1
Nematoda			Unidentified		2	0	0
Pelecypoda	Veneroida	Sphaeridae	*Musculium*	sp.	1	0	0
Pelecypoda	Veneroida	Sphaeridae	*Sphaerium*	sp.	25	6	4
Total Number of Organisms/m^2:					114	126	112
Total Number of Taxa:					12	5	7

Table 17. Summary of macroinvertebrates collected per square meter in pooled Ponar© dredge samples from three transects on the Red River at Selkirk, Manitoba in September 2009.

Class	Order	Family	Genus	Species	Transect 1 Numbers / m^2	Transect 2 Numbers / m^2	Transect 3 Numbers / m^2
Annelida	Oligochaeta	Tubificidae	Unidentified		11	12	0
Arachnoidea	Trombidiformes	Limnocharidae	Limnochares	sp.	0	1	0
Crustacea	Ostracoda				2	8	0
Gastropoda	Neotaenioglossa	Hydrobiidae	*Amphicola*	*limosa*	16	7	12
Insecta	Coleoptera	Elmidae	*Dubiraphia*	sp.	1	0	0
Insecta	Coleoptera	Elmidae	*Stenelmis*	sp.	0	0	4
Insecta	Diptera	Ceratopogoniidae			1	19	2
Insecta	Diptera	Chironomidae	*Ablabesmyia*	sp.	2	11	13
Insecta	Diptera	Chironomidae	*Ceoltanypus*	sp.	0	7	7
Insecta	Diptera	Chironomidae	*Chironomus*	sp.	8	9	5
Insecta	Diptera	Chironomidae	*Cryptochironomus*	sp.	0	1	0
Insecta	Diptera	Chironomidae	*Glyptotendipes*	sp.	1	0	0
Insecta	Diptera	Chironomidae	*Procladius*	sp.	5	28	36
Insecta	Diptera	Chironomidae	*Thienemannimyla*	sp.	0	0	6
Insecta	Diptera	Chironomidae	*Xenochironomus*	sp.	3	0	28
Insecta	Ephemeroptera	Ephemeridae	*Hexagenia*	*limbata*	1	11	20
Insecta	Ephemeroptera	Palingeniidae	*Pentagenia*	*vittegera*	1	0	3
Insecta	Hemiptera	Corixidae	*Sigara*	*lineata*	0	1	0
Insecta	Megaloptera	Sianlidae	*Sialis*	sp.	0	0	2
Insecta	Trichoptera	Leptoceridae	*Oecetis*	sp.	4	1	1
Nematoda			Unidentified		4	37	0
Pelecypoda	Veneroida	Sphaeridae	*Musculium*	sp.	0	4	0
Pelecypoda	Veneroida	Sphaeridae	*Pisidium*	sp.	0	1	0
Pelecypoda	Veneroida	Sphaeridae	*Sphaerium*	sp.	67	28	37
Total Number of Organisms/m^2:					127	186	176
Total Number of Taxa:					15	17	14

Biological Sampling and Water Quality Sampling in Minnesota

The majority of the sites in the watershed design are termed biological (signified by red dots). A single water chemistry sample is taken at each of these sites during the sampling season. Fish are sampled through electro-shocking, and invertebrates are sampled with dip nets. Sites are placed at the nearest road crossing to the end of each minor watershed throughout the larger watershed to be able to assess the watershed for biology. Sampling does not take place in a minor watershed if a lake, wetland, or larger stream is within one mile of the planned site location.

Water Chemistry Sampling

At the mouth of each minor watershed, a water chemistry site is placed (signified by green dots). These sites are sampled for biology, along with additional water chemistry parameters. Sites are sampled ten times throughout the summer, and depending on the watershed, may be sampled for nitrates-nitrites, ammonia, dissolved oxygen, pH, conductivity, temperature, total phosphorus, Kjeldahl nitrogen, chlorides, sulfates, calcium, magnesium, total suspended solids, total volatile solids, E. coli, chlorophyll-a, pheophytin, and transparency data. E. coli data makes it possible to assess the stream for aquatic recreation, and dissolved oxygen, transparency, and suspended solids data makes it possible to assess the stream for aquatic life.

Fish Contaminants Sampling

At the pour point of each of the major watersheds, fish are collected for the analysis of contaminants (mercury and PCBs) to assess whether or not the surface water is meeting the beneficial use of aquatic consumption. Additional stream reaches within the watershed may also be sampled and analyzed, such as collecting trout for mercury testing in coldwater reaches. Mercury and PCB analysis will be conducted on fish tissue. Top carnivore species are particularly important for mercury analysis while rough fish species are important for PCB analysis. Species preferences for top carnivores are: walleye, northern pike, smallmouth bass, channel catfish, and bluegill. Species preferences for rough fish are: common carp, redhorse sucker, and white sucker. It is important to collect an appropriate age/length range of these individuals, preferably of edible size. In general as the age/length increases so do the concentrations of these contaminants. An adequate distribution of size classes is critical to characterize or assess the contamination level of these parameters.

Preliminary Report on Upper Red River and Lower Red River Watershed Monitoring

In Summer 2008, low water in the north and high water in the south challenged monitoring crews conducting the basin's first Intensive Watershed Monitoring in the Upper Red River Watershed, which includes Wolverton Creek, and Whisky Creek, and the Lower Red River Watershed, which includes the Two Rivers and Joe River watersheds. In the Upper Red watershed, three sites were assessed for biological conditions. Generally, the monitoring team found that conditions at those sites were acceptable. However, monitoring for water chemistry found that pollutant levels exceeded state standards in many locations. Further monitoring will be planned to diagnose the water chemistry exceedances.

For the Lower Red River Watershed, 44 biological monitoring sites were identified, but of these, 25 sites had no visits due to low water (determined when less than 50 percent of reach has water). Nineteen sites had visits but 11 were channelized, therefore could not be assessed. Of these, two sites were considered impaired for fish. Water chemistry exceeded standards at those monitoring sites. Follow-up monitoring in Water Year 2009 will address the limitations for fish and the water chemistry exceedances.

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 effect 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 and 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.

Northwest Area Water Supply Project

In March 2006, Reclamation initiated preparation of an environmental impact statement (EIS) to evaluate water treatment techniques to further reduce the risks of transfer of non-native species from the Missouri River Basin into the Hudson Bay Basin. The final EIS was released to the public in December 2008. Reclamation signed a Record of Decision (ROD) for the EIS on January 15, 2009. In February 2009, the Department of Justice notified the U.S. District Court that Reclamation had completed the final EIS and ROD. Shortly thereafter the Province of Manitoba filed a Supplemental Complaint arguing that the final EIS was insufficient. A day later the State of Missouri filed a complaint against the Department of the Interior and the U.S. Army Corps of Engineers in the same District Court in Washington D.C. In March 2009, the court combined the Missouri suit with the Manitoba suit. Numerous briefs from all parties involved in the litigation were filed with the court throughout 2009. On March 5, 2010, the District Court remanded the case to Reclamation for further analysis.

Reclamation has decided to prepare a supplemental EIS. A notice of intent was published in the Federal Register on August 12, 2010. Public scoping meetings are scheduled for September 13-16, 2010, in four locations throughout the project service area. Reclamation will address the areas of concern identified by the court as well as other issues identified during public scoping.

9.02 Devils Lake Sub-Basin

DEVILS LAKE UPDATE

Hydrology

The watershed experienced an extremely wet fall in 2008, receiving approximately 300 percent of normal precipitation. This precipitation saturated the soil profile, and filled the potholes and sloughs. Heavy snowfall, combined with spring rainfall, caused very large runoff to the lake this spring.

The level of Devils Lake peaked in 2009 at an elevation of 1450.7 msl on June 27, the maximum lake level for the period of record (1901-2009). This is an increase of 3.6 feet from the January 1, 2009 lake level elevation. The December 31, 2009 level of Devils Lake was 1449.9 msl, while Stump Lake was 1450.1 msl. This is about 2.9 feet higher than the lake level on January 1, 2009. The combined storage of Devils Lake and Stump Lake was 2.94 million acre-ft on January 1, 2009 and 3.36 million acre-feet on December 31, 2009. This is an increase of 424,000 acre feet since the beginning of the year. The surface area of the lakes was 139,700 acres on January 1 and was 161,700 acres on December 6, 2009. This is an increase of 22,000 acres since the beginning of 2009.

In 2010, the level of Devils Lake recorded another record high of 1452.05 msl on June 27, 2010, while Stump Lake peaked at 1452.09 msl on June 28, 2010. This is about 1.4 feet higher than the previous record on June 27, 2009. The surface area for the combined lakes was about 182,800 acres at that time, an increase of about 21,100 acres from December 6, 2009. The combined volume at the peak was about 3.73 million acre-feet, an increase of 370,000 acre-feet since December 6, 2009. As of September 1, 2010, the water level was about 1451.5 msl.

State Emergency Outlet Project Update:

The 2009 releases from the outlet into the Sheyenne River began on May 22. Discharge continued until November 4, 2090, at various amounts. The extent of discharge was limited for a portion of May and June to low flows and higher sulfate concentrations in the Sheyenne River.

In 2010, discharge from the outlet into the Sheyenne River began on May 2110, at about 50 cfs. The discharge was stopped within a few days when heavy rains caused the flows in the Sheyenne River to approach 600 cfs. A discharge of about 100 cfs started near the middle of June. With the increased pump capacity, a discharge around 200 cfs started on June 25. The discharge rate varied between 150 cfs to 200 cfs for a few days, then reached 250 cfs on June 28. With a few exceptions, the discharge rate has remained near 250 cfs since that time until early September. The following table (Table 16) summarizes the extent of discharge from the outlet in 2009 and so far in 2010.

Table 18. Summary of the Extent of Discharge from the Outlet in 2009 and so far in 2010

Month	Dates Discharge Occurred	Range of Discharge (cfs)	Monthly Average (cfs)	Total Daily Volume (acre-feet)
May 2009	22 – 31	6 – 100	40	810
June	1 – 30	23 – 99	69	4,083
July	1 - 31	8-100	80	4,919
August	1 – 31	21 – 107	96	5, 898
September	1 – 30	92 – 106	100	5,991
October	1 – 31	42 – 110	97	5,941
Nov. 2009	1 – 4	0 – 4	1	11
TOTAL for 2009				27,653
May 2010	21 – 26	0.1 – 24	12	148
June 2010	3 – 30	12 – 221	97	5,414
July 2010	1 – 31	3 – 265	207	12,728
August				

After reviewing requests from the City of Devils Lake and the North Dakota Water Commission, the North Dakota Department of Health – acting under the provisions of North Dakota Century Code 28-32-02 – has implemented an emergency rule for a segment of the Sheyenne River.

A recent federal appeals court ruling on a Florida case, found that "water to water" transfers do not need a Section 402 Pollutant Discharge Elimination System permit. Because of this ruling, the North Dakota Department of Health was requested to terminate the permit and allow the operation of the Devils Lake outlet be based upon the water quality standards set for the Sheyenne River. The Health Department approved this request on June 25, 2009.

After reviewing requests from the City of Devils Lake and the North Dakota Water Commission, the North Dakota Department of Health – acting under the provisions of North Dakota Century Code 28-32-02 – has implemented an emergency rule for a segment of the Sheyenne River. The department has amended the sulfate concentration level from 450 milligrams per liter to 750 mg/L for the segment of the river from the Sheyenne headwaters to a point just downstream of the Baldhill Dam. The Sheyenne River below Baldhill Dam is still limited to the existing 450 mg/l standard for sulfates. The emergency rule stipulates that a modeling method must be in place to accurately predict the level of sulfates in the Sheyenne River as a result of the outlet operations. This includes the Sheyenne River from Bremen, through Lake Ashtabula, and below Baldhill Dam.

The United States Geological Survey (USGS) has developed a two dimensional model to predict movements of sulfate concentrations within Lake Ashtabula. Sampling locations on Lake Ashtabula have been determined in order to provide for accurate data on water quality for the reservoir. The water samples will provide for accurate calibration of the model.

A stochastic simulation model will also be developed to evaluate the effects of the Devils Lake outlet on Lake Ashtabula and the Sheyenne River below Baldhill Dam. The model would provide information to: 1)

develop and calibrate a two-dimensional hydrodynamic and water quality (CE-QUAL-W2) model of Lake Ashtabula; 2) link the reservoir model to continuous, real-time water quality and stream flow data to provide a near real-time simulation of the reservoir for use as a decision-support tool for the operation of the Devils Lake outlet; 3) extend the existing stochastic simulation model for the Devils Lake outlet and upper Sheyenne River to include flows and sulfate concentrations for key locations in the Sheyenne River downstream of Baldhill Dam; and 4) use the model for Lake Ashtabula along with the stochastic model simulations to determine the affects of the increased capacity of the Devils Lake outlet on stream water quality along the Sheyenne River.

Construction has been completed to increase the capacity of the pumped outlet from 100 cfs to 250 cfs. Two additional 75 cfs pumps are being installed at the Round Lake pump site and at the Josephine pump site. A gravel filter/transition structure has been installed. The plunge pool construction at the outlet of the terminal structure was delayed due to high stages in the Sheyenne River, but it has been completed. The project also involved several miles of power poles and power line construction, which has been completed by Central Power. An operator's building has been constructed.

Red River Retention Authority

The Red River Joint Water Resource District (RRJWRD) of ND and the Red River Water Management Board (RRWWB) of MN formed the Red River Retention Authority in August 2010. The Authority will provide the two entities with a better opportunity to jointly coordinate aggressive pursuit of retention projects within the watershed. The Red River Retention Authority will prioritize retention projects; facilitate interaction with federal agencies; provide assistance to member districts in obtaining regulatory approvals; seek federal, state, and other cost-share assistance; develop long-term watershed goals; and otherwise seek reduction of peak flows on the Red River.

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

Ada, Minnesota

A Section 205 flood risk management feasibility study is under way for the city of Ada in the Marsh River watershed. The study is scheduled to be completed in early 2010. Flooding at Ada typically occurs when the Wild Rice River breaks out of its banks and flows into the Marsh River. Judicial Ditch 51 flows through the city, complicating flood control measures. Preliminary analyses indicate that the National Economic Development (NED) plan will be diversion of a portion of Judicial Ditch 51 combined with a levee system built to withstand the 200-year flood. A draft feasibility report and environmental assessment were released for public review in January 2009.

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 to 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 would protect all of Breckenridge. Construction of the diversion was completed in 2005. The first two of four stages of levee construction were awarded in April 2009. The total estimated cost for the Breckenridge project is $39.4 million. Stage 2b3 construction began in spring 2010 and Stage 2a will be ready for a construction start in 2010 pending Federal funding. The project was reauthorized at a higher cost in the 2010 Energy and Water Appropriation Act.

The Wahpeton project, authorized under the Corps' Section 205 Continuing Authority, consists of a permanent levee system and flood easements. Construction of the Wahpeton project began in 2003 with interior flood control features, which are now complete. The first of three stages of levee construction began in June 2008. The second stage began in June 2009. Stage 3b, the third and final in-town levee reach, will be ready for a construction start in 2010. Additional work on existing levees will be incorporated as needed for compliance with levee standards. The total estimated cost for the Wahpeton project is $18.8 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. A base contract could be awarded in fall 2010 contingent on receipt of funding. Construction would then be completed in spring 2011.

Devils Lake Embankment, North Dakota

Construction is scheduled to begin in fall 2009 to raise the Devils Lake, North Dakota embankment from elevation 1460 to 1465. The Corps was developing a plan for additional flood risk management measures for the city when unprecedented inflows in the spring of 2009 triggered the decision to proceed to construction. With the wettest fall on record and more than 24 inches of snowfall in December 2008 alone, lake flooding was forecast to be severe. As of 25 May 2010, Devils Lake reached a record peak stage of 1452.10 (NGVD 1929). This first phase of construction will be along the most critical reach of the embankment where the wave run-up is the greatest. The work involves raising approximately 8,800 feet of embankment 5 feet and replacing an interior flood control pump station. Future phases of construction to complete the embankment raise are scheduled to begin in 2010. The construction contract for the third phase, the Lakewood area, is scheduled to be advertised in winter 2011. When the raise is complete, the embankments will increase in length from 8 miles to 12 miles. The cost to complete the raise to elevation 1465 is estimated at approximately $100 million. The Corps will continue to work with the other communities and the Spirit Lake Nation that are also being impacted by the record lake levels.

Drayton Dam, Drayton, North Dakota

A Section 206 aquatic ecosystem restoration feasibility study of the Drayton Dam began in July 2008. The study will assess ways to provide fish passage and eliminate dangerous hydraulic conditions at the dam while maintaining the pool for water supply and bank stability.

Emergency Actions

The spring flood of 2009 set record stages in six basin cities, including Abercrombie, Fargo, Lisbon and Valley City in North Dakota and Moorhead and Oakport Township in Minnesota. The Corps' St. Paul District provided emergency assistance as part of a large force made up of local, state and federal responders and thousands of volunteers who worked together for more than a month-and-a-half to prevent flood damages throughout the basin. By the end of the fight, the district had distributed 11.3 million sandbags, 4,201 rolls of plastic and 136 pumps, awarded 50 contracts to build approximately 70 miles of emergency levee, and spent more than $32 million. More than 125 Corps personnel were on the ground in the Red River Valley throughout the fight, and more supported the flood fight from the district's headquarters in St. Paul, Minn. Following the flood fight, the Federal Emergency Management Agency tasked the Corps of Engineers with cleaning up temporary flood protective measures used during the spring flood fight in communities along the Red River valley. In Fargo alone, that involved cleaning up 31 miles of clay and secondary levees, 10 miles of HESCO Bastion Container(r) secondary levees and 2.5 million sandbags.

Fargo-Moorhead Metropolitan Area, North Dakota and Minnesota

A feasibility study of flood risk management measures for the entire Fargo-Moorhead metropolitan area began in September 2008. The primary goal is to develop a regional system to reduce flood risk in the entire metropolitan and surrounding area and assess the feasibility of Federal implementation. An array of potential alternatives were considered, including nonstructural flood proofing, diversion channels, levee/floodwall systems, and flood storage. Only the diversion channel concept survived initial screening. Preliminary results of the diversion optimization were released at public meetings in February 2010. Agency Technical Review of the draft feasibility report and environmental impact statement will be completed in March 2010.

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

This feasibility study is 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 and 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 is 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. Scoping for Phase 2 of the study is under way; Phase 2 will include more detailed investigations of environmental benefits and site-specific economic benefits.

Fargo, North Dakota (Ridgewood Addition)

Construction of a floodwall at the Department of Veterans Affairs hospital is substantially complete. Levee and floodwall construction upstream of the hospital began in October 2008 and will be cost-shared with the city of Fargo under the Section 205 Continuing Authority. The project will reduce flood risk for the Department of Veterans Affairs hospital and the portion of Fargo between 15th Avenue North and 22nd Avenue North. Levees and floodwalls required for the line of protection were completed in December 2009, when the Elm Street Closure was completed. Work continued in 2010 to complete installation of pumps, stain architectural treatment on walls, place topsoil, seed and closeout construction.

Fort Abercrombie, North Dakota

A Section 14 Emergency Streambank Protection study began in September 2008.
Erosion along the Red River of the North is threatening the historic Fort Abercrombie site. A feasibility study is scheduled to be completed in fall 2010.

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 has now been completed to a 250-year level of protection. Project close out and miscellaneous repairs remain to be completed. The project consists of 30 miles of levees and 3 miles of floodwall set back from the river. The levees and floodwalls form rings around the communities. The project also includes stabilization of an existing dam, removal of a former railroad bridge, construction of interior flood control features, 24 pump stations, numerous road and railroad closures, and two diversion channels. The project was also authorized to provide recreation features including 24 miles of trails and seven trailheads constructed in the new river greenway. The design level of protection is equivalent to the peak discharge experienced during the 1997 flood. Total estimated project cost is $409,300,000.

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 program authorizes the Corps to provide assistance to North Dakota public entities in the form of "design and construction assistance for water-related environmental infrastructure and resource protection and development projects in North Dakota, including projects 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." The program was authorized in the Consolidated Appropriations Act (CAA) of 2008 which amended Section 594 of the Water Resources Act of 1999 and established a program authorization of $100,000,000 for North Dakota. In 2008 and 2009, funds were appropriated for projects at the cities of Devils Lake and Parshall, North Dakota. In 2009, American Recovery and Reinvestment Act (ARRA) funds allowed for new projects with the Southeast Water Users District, the Cass Rural Water Users, and Valley City in the St. Paul District and with Zeeland, North Central Rural Water Consortium (two projects), State Line Water Coop, and the McKenzie County Water Resource District in the Omaha District. In 2010, seven new rural water supply projects were funded including the Barnes, Langdon, North Prairie, Greater Ramsey and Traill Rural Water Districts in the St. Paul District, and the North Central and Williams Rural Water Districts in Omaha District.

Pembina River Basin, North Dakota

The Corps and the State of North Dakota began a study of the Pembina River in August 2008 under the Section 22 Planning Assistance to States program. The study will develop a HEC-RAS unsteady flow model of the lower Pembina River and the Red River of the North from Drayton, ND to the international border. The HEC-RAS Unsteady flow model of the Red River from Halstad to Pembina will be completed by December 2010.

Project Operations

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

Red River Basin Watershed Study

The Corps began a basin-wide watershed study in June 2008. The first phase of study will use LIDAR to collect detailed topographic information and develop a digital elevation model of the entire watershed in cooperation with the International Water Institute. Subsequent phases are planned to build and refine basin-wide hydraulic and hydrologic models, develop a decision support system, and prepare a Comprehensive Watershed Management Plan.

Roads Serving as Water Barriers (Devils Lake, North Dakota)

The Corps was tasked with providing dam design expertise to the Federal Highway Administration, the Bureau of Indian Affairs, and the Spirit Lake Nation. The Corps has completed their interagency agreement for this phase of the work. The work included obtaining geotechnical borings and testing to support the design effort. Roads in some areas near Devils Lake are providing barriers to the rising and expanding waters of Devils Lake. Because the roads serving as water barriers were not constructed to function as dams, they pose potential safety problems to road users and to people living in the areas sheltered by the barriers. The 2006 Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) provides authority for the Federal Highway Administration to address this problem.

Roseau, Minnesota

A flood risk management project for the city of Roseau, Minnesota was authorized in the Water Resources Development Act of 2007. As part of the project, the city is constructing two highway bridges which will be completed in early 2010. The Corps is completing plans and specifications for the remaining portions of the project to be ready for construction in the spring of 2010. Construction of this project could be completed in 3 years, with minimal construction in year 3. The project will include a diversion channel with associated recreation features. The estimated project cost is $29.8 million.

Sheyenne River, West Fargo, North Dakota

Construction to repair the diversion channel that was damaged by erosion and sloughing in 2005 is scheduled to be complete in December 2009. Construction of the West Fargo project was essentially completed in 1994.

Stream Gaging

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

Wild Rice River Basin, Minnesota

A feasibility study for flood risk management and ecosystem restoration in the Wild Rice River watershed is under way. Measures that are being investigated include setback levees along the Wild Rice River, restoration of the river channel, and off-channel storage. The Corps met with an interagency team in February 2009 to define the ecosystem restoration goals, objectives and constraints to be used in the formulation of alternatives. In December 2009, the Wild Rice Watershed Board of managers passed a resolution to terminate the study. This decision is based on the anticipated costs to complete the study and higher priorities in the watershed. The Corps is completing terrestrial surveys. The study will be closed out in late 2010.

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 <file://www.mvp.usace.army.mil>

9.04 USGS Water Resource Investigations and Activities

Monitoring activities related to the 2010 flooding

Flooding on the Red River in the spring of 2010 was not as severe as the previous year; however, the flooding was still significant. The early occurrence of the peak was the big story for the 2010 flood—the largest magnitude flood to occur this early on the Red River at Fargo. The March 21, 2010, peak on the Red River at Fargo occurred 7 days earlier than the peak of 2009, 15 days earlier than 2006, 24 days earlier than 2001, and 27 days earlier than 1997 (see Figure 6 below).

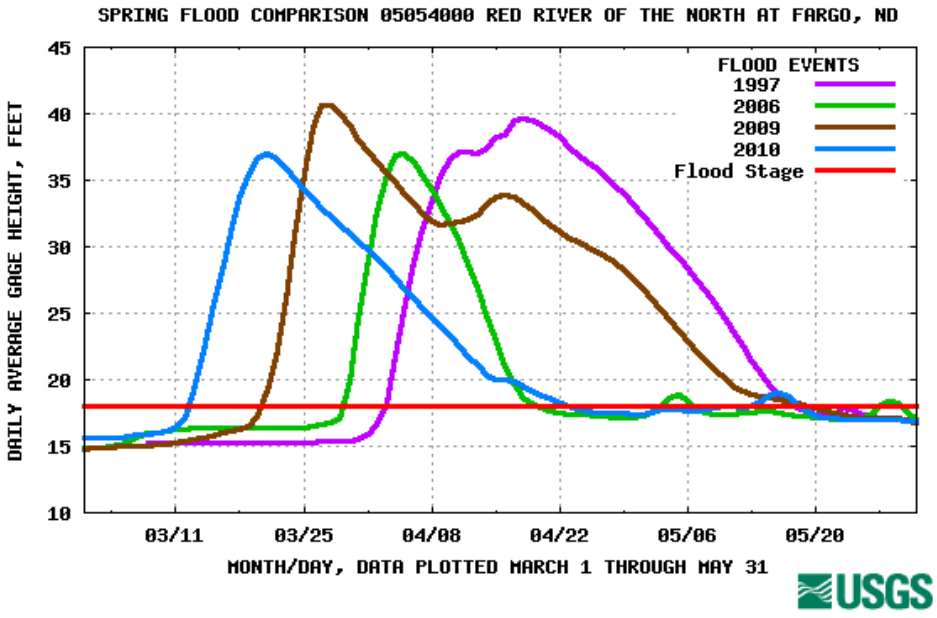


Figure 6. Spring Flood Comparison - Red River at Grand Forks, North Dakota

An unusual warming trend resulted in a melt pattern from east to west across the basin. The east to west pattern resulted in Minnesota tributaries melting first, while tributaries in North Dakota stayed frozen with snow cover intact. The melt pattern was favorable and most likely lessened the impact of the spring flood. Comparisons of large floods since 1997 show that the 2010 peak was equivalent to the peaks in 2006 and 2001 (Table 17). However, as the flood moved north the peak discharges were less in magnitude for all major floods, except for 2001. The 2010 peak discharge at Fargo ranks 5th in 109 years of record, and the 2010 peak discharge at Grand Forks ranks 7th in 128 years of record.

Table 19. Comparison of Red River Flood Peaks at Selected Locations in the U.S.

Peak Discharges for Selected Years on the Red River at Fargo, ND					
	2010	2009	2006	2001	1997
Discharge (cfs)	21,300	29,500	19,900	20,300	28,000
Elevation (ft)	36.99	40.84	37.13	36.69	39.57
Peak Discharges for Selected Years on the Red River at Grand Forks, ND					
	2010	2009	2006	2001	1997
Discharge (cfs)	61,400	76,700	72,800	57,800	137,000
Elevation (ft)	46.06	49.33	47.93	44.87	52.04
Peak Discharges for Selected Years on the Red River at Drayton, ND					
	2010	2009	2006	2001	1997
Discharge (cfs)	65,900	85,500	78,800	55,300	124,000
Elevation (ft)	42.19	43.61	42.89	41.33	45.55

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 during the time of flooding helped to mitigate loss of life and damages to property in the Red River Basin during the 2009 and 2010 spring floods.

Real-time water-quality monitoring station

Continuous real-time water-quality monitoring stations have been operated at the U.S. Geological Survey gauging station Red River at Fargo since March 2003 and at the gauging station Red River at Grand Forks since March 2007. The water-quality monitors measure specific conductance, water temperature, pH, dissolved oxygen, and turbidity. Water-quality samples and continuously-recorded data will be used to develop statistical regression relations between properties of water that can be measured continuously in real time and chemical

constituents of concern such as dissolved solids, sulfate, chloride, total nitrite plus nitrate, total nitrogen, total phosphorus, and suspended sediment to estimate loads and continuous concentrations.

Devils Lake three-dimensional hydraulic modeling

As Devils lake continues to rise and economic losses increase, the need for hydrologic tools that can be used in planning flood mitigation measures has grown. The three-dimensional UnTRIM model is being developed for Devils Lake to evaluate the effects of different inflow scenarios on water levels throughout the lake, circulation, and solute transport. The magnitude of the differential lake levels and their effects on flooding, water circulation, and solute transport were simulated by using the UnTRIM model. Continuous data were collected throughout the lake, including streamflow at all of the major inflows and the outflow to Stump Lake. Weather data were measured at 3 sites around the lake, lake level was recorded at 8 sites, and acoustic Doppler velocity meters were deployed at 3 sites in the lake. The model grid was developed for a shoreline elevation of 1,453 ft above NGVD29 and 1,465 ft above NGVD29 to account for possible future flooding. The model was calibrated for existing conditions, and scenarios will be conducted using stochastically-generated inflow to investigate effects of various inflow conditions on flooding and solute transport. The project began in October 2007 and the final report describing the model development, calibration, and scenarios will be completed in December 2010.

Simulation of the Effects of the Devils Lake Outlet on Hydrodynamics and Water Quality in Lake Ashtabula

The recent (2010) changes in the capacity of the Devils Lake outlet to 250 ft^3/s needed to be evaluated to determine the impacts on downstream waters in the Sheyenne River, including Lake Ashtabula. In 2010, a two-dimensional hydrodynamic and water-quality model of Lake Ashtabula was developed by the USGS in cooperation with the NDSWC to understand the dynamics of chemical constituents in Lake Ashtabula and to provide a tool for the management and operation of the Devils Lake State Outlet in meeting the water-quality standards below Baldhill Dam (Lake Ashtabula).

The purpose of the model is to simulate the hydrodynamics and water quality in Lake Ashtabula to provide a better understanding of how discharge from the Devils Lake State Outlet upstream in the Sheyenne River may affect the hydrology and water quality in Lake Ashtabula. Hydrodynamics and water-quality characteristics in Lake Ashtabula were simulated using the U.S. Army Corps of Engineers CE-QUAL-W2 modeling software. The laterally averaged, two-dimensional model was calibrated using ambient data collected from June 2006 through June 2010 when measured water-quality data were available in the reservoir. Scenarios also were conducted using the Lake Ashtabula model to simulate the possible effects of the current Devils Lake outlet operation, possible future changes to the outlet, and additional outlets from Devils Lake on the water quality in Lake Ashtabula. The project began in October 2009 and the final report describing the model development, calibration, and scenarios will be completed in December 2010.

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

Natural resource agencies are concerned about possible geomorphic impacts of proposed diversion projects in the Fargo-Moorhead area. Site-specific information available on sediment transport and riverine geomorphic processes is very limited and prohibits 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 2010 spring breakup event

provided a unique opportunity to sample sites during high-flow conditions when most sediment generally is transported. The USGS, in cooperation with the US Army Corps of Engineers, collected 69 suspended-sediment samples, 36 bedload samples, and 63 bed-sediment samples at 6 sites on the Red River, Sheyenne River, Maple River, and Wild Rice River in the Fargo area during the 2010 spring high-flow period from March 17 through April 7. The data will provide information to describe the distribution and transport of sediment near the Fargo-Moorhead area. The methods and results of the data collection will be compiled in a USGS Scientific Investigations Report that will be completed in December 2010.

APPENDIX A

DIRECTIVES TO THE INTERNATIONAL RED RIVER BOARD

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

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 'exceedence' is used to describe a situation where an objective is not met. A situation is classified as an exceedence 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.

Fecal Coliform	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 exceedence 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.

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					
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.

- 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
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], 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,	50 µg/l	North Dakota based on domestic consumption.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
			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	Total	Free cyanide	Total	Minnesota and North

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
	5.2 µg/l AL	5 µg/l AL	5.2 µg/l cyanide AL	5 µg/l	Dakota for protection of aquatic life.
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	Aldrin (total) Acute 3.0 µg/l Chlordane (total)	Aldicarb 0.009 mg/l Aldrin + Dieldrin	Not detectable in water**	All agencies for the protection of aquatic life, animal life domestic

B- ** Limits in fish tissue are being researched by the Task Force.
B- 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
	Benzene 6.9 µg/l Bromoform 128 µg/l 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	Acute 2.4 µg/l Chronic 0.0043 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	0.0007 mg/l Atrazine 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		consumption and human health.

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
	Toluene 253 µg/l Toxaphene 0.0013 µg/l Vinyl Chloride 0.15 µg/l Xylene(total m, p and o) 166 µg/l		0.001 µg/l 1,2-Dichloroethane 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		

Parameter	Minnesota Standards	North Dakota Standards	Manitoba Objectives	Red River Pollution Board Objectives	Origin/ Rational
			Polychlorinated biphenyls 0.014 µg/l 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.

APPENDIX C

WATER POLLUTION CONTROL CONTINGENCY

PLAN LIST OF CONTACTS

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

United States:

Minnesota Pollution Control Agency – Detroit Lakes, MN

Will Haapala
(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)

Henry Drews
(208) 755-3959 office
1-800- 422-0798 (24hr)

North Dakota Health Department – Bismark, ND

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 Water Stewardship – Winnipeg, MB

Dwight Williamson
(204) 945-7030 office
(204) 948-2357 fax
(204) 256-3706 res.
(204) 944-4888 (24hr telephone service emergency number)

Environment Canada – Regina, SK

David Donald
(306) 780-6723 office
(306) 780-5311
(306) 586-1468 res.

Girma A. Sahlu
(306) 780-6425 office
(306) 780-6810 fax
(306) 757-2892

APPENDIX D

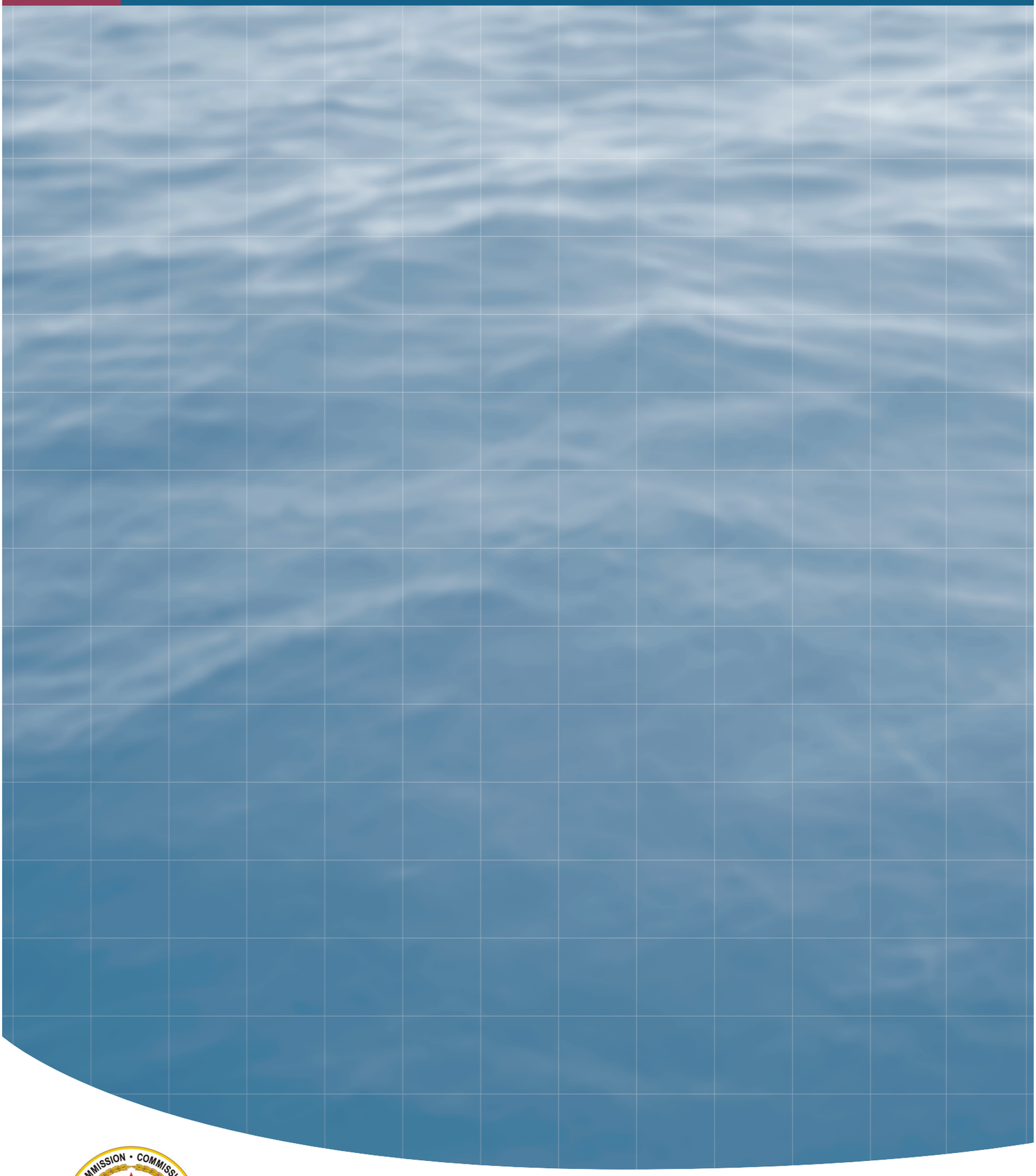
HYDROLOGY COMMITTEE & AQUATIC ECOSYSTEM COMMITTEE
MEMBERSHIP LIST

International Red River Board
Hydrology Committee
Membership:

Name	Organization	Phone	E-mail
Bob Harrison (Chair) Steve Topping (Alt.)	Manitoba Water Stewardship, Winnipeg	 (204) 945-7411 (204) 945-6398	Bob.Harrison@gov.mb.ca stopping@gov.mb.ca
Steve Robinson (Chair) Gregg Wiche (Alt.)	USGS, Bismark	(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
Chuck Fritz	International Water Institute, Fargo	(701) 231-9747	charles.fritz@ndsu.nodak.edu
Al Kean	Minnesota Board of Water and Soil Resources,	(651) 297-2907	Al.kean@bwsr.state.mn.us
Haitham Ghamry	Dept. of Fisheries & Oceans Canada	(204)	Ghamry,Haitham K: DFO XCA
Vacant	Minnesota DNR, Bemidji		
Kip Gjerde Amy Ambuehl (Alt.)	U.S. Bureau of Reclamation, Billings	(406) 247-7813 (701) 250-4242 ext. 3615	jgjerde@gp.usbr.gov aambuehl@gp.usbr.gov

lnternational Red River Board
Aquatic Ecosystem Committee
Membership:

Name	Organization	Phone	E-mail
David Rathke (Sec.)	EPA/Denver	(303) 312-6016	rathke.david@epa.gov
Mike Sauer	NDHD/Bismarck	(701) 328-5237	msauer@state.nd.us
Mike Ell	NDHD/Bismarck	(701) 328-5214	mell@state.nd.us
Rick Nelson (Chair)	USBR/Bismarck	(701) 250-4242	rnelson@gp.usbr.gov
Wayne Berkas	USGS/Bismarck	(701) 250-7429	wrberkas@usgs.gov
Molly MacGregor	MPCA/Detroit Lakes	(218) 846-0494	molly.macgregor@ pca.state.mn.us
Lance Yohe	RRBC/Moorhead	(218) 291-0422	lancer2b2@corpcomm.net
Chuck Fritz	Int'l Water Institute, Fargo	(701) 231-9747	charles.fritz@ndsu.nodak.edu
Bethany Kurz	EERC, Grand Forks	(701) 777-5050	bkurz@undeerc.org
Susan Cosens (Chair)	Fisheries and Oceans Canada	(204) 983-8838	susan.cosens@dfo-mpo.gc.ca
David Donald	Environment Canada, Regina	(306) 780-6723	david.donald@ec.gc.ca
Dwight Williamson	Manitoba Water Stewardship, Winnipeg	(204) 945-7030	dwilliamso@gov.mb.ca
Joe O'Connor	Manitoba Water Stewardship, Winnipeg	(204) 945-7814	joconnor@gov.mb.ca
Terry Shortt	DFO/Winnipeg	(204) 983-5062	shorttt@dfo-mpo.gc.ca
Pat McGarry	PFRA/Winnipeg	(204) 983-4832	mcgarryp@em.agr.ca

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