Photos Courtesy of Saskatchewan Watershed Authority

# FIFTY-FIFTH ANNUAL REPORT

## TO THE International Joint Commission

## COVERING Calendar Year 2013

## International Souris River Board

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INTERNATIONAL SOURIS
RIVER BOARD

CONSEIL INTERNATIONALE
DE LA RIVIERE SOURIS

October 2014

The International Joint Commission
Ottawa, Ontario and Washington, D.C.

Commissioners:

In accordance with the Directive of January 22, 2007 (replaces Directives of April 11, 2002 and May 31, 1959), we have enclosed the Fifty-Fifth Annual Report covering calendar year 2013.

Respectively submitted,

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For the 2013 calendar year, the natural flow of the Souris River at the Sherwood Crossing was 331 444 cubic decametres (268,702 acre-feet), or about 209 percent of the 1959-2013 long-term mean. North Dakota received 366 184 cubic decametres (296,865 acre-feet) or 110 percent of the natural flow.

Net depletions in Canada were -34 740 cubic decametres (28,164 acre-feet). Recorded runoff for the Souris River near Sherwood, North Dakota, was 363 981 cubic decametres (295,079 acre-feet), or about 55 percent of the 1931-2013 long- term mean.

The apportionment between Canada and the United States was discussed at the February 22, 2013 meeting of the International Souris River Board. The Board declared 2013 to be a 50/50 year as the forecast was for a less than 1:10 year event.

The August 31, 2013 Determination of Natural Flow showed a surplus of 189 504 cubic decametres (153,631 acre-feet). Calculations made after the end of the year indicated that Saskatchewan was in surplus to the United States by 233 604 cubic decametres (189,383 acre-feet). The natural flow at Sherwood exceeded 50 000 cubic decametres (40,535 acre-feet), resulting in a 60/40 sharing of the natural flow at the Sherwood Crossing.

The flow of the Souris River as it enters North Dakota at Sherwood was more than 0.113 cubic metres per second (4 cubic feet per second) for the entire year. Accordingly, Saskatchewan complied with the 0.113 cubic metres per second (4 cubic feet per second) provision specified in Recommendation No. 1 of the Interim Measures.

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 78 600 cubic decametres (63,721 acre-feet), or 247 percent of the long-term mean since 1959. Recommendation No. 2 of the Interim Measures was met with a net gain in the North Dakota portion of the Long Creek basin of 32 924 cubic decametres (26,692 acre-feet).

Recorded runoff leaving the United States at Westhope during the period of June 1 through October 31, 2013, was 674 229 cubic decametres (546,553 acre-feet). The flow was in compliance with the 0.566 cubic metres per second (20 cubic feet per second) minimum flow requirement as specified in Recommendation No. 3(a) of the Interim Measures for the period of June 1 through October 31, 2013.

The water quality of the Souris River in calendar year 2013 was slightly improved compared to historical data. Phosphorus levels exceeding the water quality objective continue to be a concern. This year however showed decreases in the number of exceedances in several parameters, as well as a drop in the median values of many others compared to last year. It is likely that the increased flows of 2013 (over historic) along with the flushing that occurred during the flood of 2011 are partially responsible for the improved water quality in 2013.

On May 6, 2013, the International Joint Commission appointed John-Mark Davies to the International Souris River Board.

# 1.0 INTERNATIONAL SOURIS RIVER BOARD

## 1.1 SOURIS RIVER REFERENCE (1940)

The following excerpt describes the history of the water-apportionment program that the International Souris River Board currently maintains.

In a letter on behalf of the Government of Canada dated 20 March 1959 and a letter on behalf of the Government of the United States of America dated 3 April 1959, the International Joint Commission was informed that the Interim Measures recommended in its report of 19 March 1958, in substitution for those recommended in the report dated 2 October 1940 in response to the Souris River Reference (1940), had been accepted by both Governments.

The Governments of the United States and Canada entered into an Agreement for Water Supply and Flood Control in the Souris River Basin on October 26, 1989. Pursuant to this Agreement, the Interim Measures related to the sharing of the annual flow of the Souris River from Saskatchewan into North Dakota contained in paragraph 22(1) of the Commission's 1958 Report to the Governments were modified. In light of the modifications in 1989 and pursuant to a February 28, 1992, request from the Governments of the United States and Canada, the Commission, on April 23, 1992, directed the International Souris River Board of Control to begin applying the "Interim Measures as Modified in 1992." The Governments further modified the measures in December 2000. The "Interim Measures as Modified in 2000" are shown in Appendix C of this report.

## 1.2 INTERIM MEASURES AS MODIFIED IN 2000

In December 2000, the International Joint Commission directed the Board to implement the "Interim Measures as Modified in 2000" for the 2001 calendar year and each year thereafter. The 2000 Interim Measures, shown in Appendix C, were developed to provide greater clarification of the conditions that must prevail for the determination of the share of natural flow between Saskatchewan and North Dakota at the Sherwood Crossing.

In general, the Interim Measures provide that Saskatchewan shall have the right to divert, store, and use waters that originate in the Saskatchewan portion of the Souris River basin, provided that the annual runoff of the river into North Dakota is not thereby reduced to less than half of the runoff that would have occurred in a state of nature; that North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the basin together with the waters that cross the boundary from Saskatchewan; and that Manitoba shall have the right to use the waters that originate in the Manitoba portion of the basin and, in addition, that North Dakota must provide to Manitoba, except during periods of severe drought, a regulated flow of 0.566 cubic metres per second (20 cubic feet per second) during the months of June through October.

For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall as far as practicable regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metres per second (4 cubic feet per second) when that level of flow would have occurred under the conditions of water-use development prevailing in the Saskatchewan portion of the drainage basin prior to the construction of Boundary Dam, Rafferty Dam, and Alameda Dam.

Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when those conditions occur, the minimum flow actually passed to North Dakota will be 40 percent of the natural flow at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control.

Except in flood years, flow releases to the United States should occur in the pattern that would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the International Souris River Board that the release would not be of benefit to the State at that time.

The State of North Dakota shall have the right to divert, store, and use the waters that originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing, provided that any diversion, use, or storage of Long Creek water shall not diminish the annual runoff at the Eastern Crossing of Long Creek into Saskatchewan below the annual runoff of Long Creek at the Western Crossing into North Dakota.

In periods of severe drought, when it becomes impracticable for North Dakota to deliver the regulated flow of 0.566 cubic metres per second (20 cubic feet per second), North Dakota's responsibility to Manitoba will be limited to providing such flows as the Board determines to be practicable and in accordance with the objective of making water available for human and livestock consumption as well as for household use.

## 1.3 BOARD OF CONTROL

At its meeting in May 1959, the International Joint Commission officially approved and signed a directive that created the International Souris River Board of Control. At that time, the Board was charged with the responsibility of ensuring compliance with the Interim Measures set out and of submitting to the Commission such reports as the Commission may require or as the Board at its discretion may desire to file.

## 1.4 AMALGAMATION OF THE INTERNATIONAL SOURIS-RED RIVERS ENGINEERING BOARD AND INTERNATIONAL SOURIS RIVER BOARD OF CONTROL

In 2000, the International Joint Commission directed the International Souris-Red Rivers Engineering Board to transfer its responsibilities that related to the Souris River to the International Souris River Board of Control. The Commission also changed the International Souris River Board of Control's name to the International Souris River Board.

## 1.5 AMALGAMATION OF THE INTERNATIONAL SOURIS RIVER BOARD AND SOURIS RIVER BI-LATERAL WATER QUALITY MONITORING GROUP

In 2006 the International Joint Commission changed the Board’s mandate. Because of the change in the mandate and the desire of the Commission to move to a more encompassing watershed approach, the Board was requested to develop a Directive based on existing Commission responsibilities in the Souris River basin that would move toward an enhanced mandate for the Board. By letter dated

January 22, 2007, the International Souris River Board was officially notified by the Commission that the new directive dated January 18, 2007, replaced the previous directive dated April 11, 2002. The new Directive sets out the duties of the Board as it moves toward a watershed approach in the Souris River basin and combined the duties of the International Souris River Board and Souris River Bi-Lateral Water Quality Monitoring Group. It also increased the membership of the Board to twelve members.

The Board's duties were revised to include the following:

- Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.
- Oversee the implementation of compliance with the Interim Measures as Modified for Apportionment of the Souris River as described in Appendix A of the Directive.
- Assist the Commission in the review of a Joint Water Quality Monitoring Program.
- Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.
- Report on aquatic ecosystem health issues in the watershed and regularly inform the Commission on the state and implications of aquatic ecosystem health.
- Carry out such other studies or activities as the Commission may, from time to time, request.
- Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year.
- The Board shall submit an annual report covering all of its activities at least three weeks in advance of the Commission’s fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive.
- The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year. The Board has agreed to hold the public meeting in the spring/summer and to advertise it.

In 2007 three committees were established to assist with administering the conditions of the Board’s mandate. The Natural Flow Methods Committee was renamed as the Hydrology Committee, which is charged with investigating procedures and questions on the approach and methods used to determine the natural flow of the Souris River basin. The Flow Forecasting Liaison Committee has the responsibility to ensure there is information sharing and coordination between the forecasting agencies in the basin. The Aquatic Ecosystem Health Committee has responsibility to identify water quality and aquatic health concerns in the basin and report on the adequacy of the aquatic quality monitoring programs. Membership on these committees includes all affected agencies in the basin.

## 1.6 BOARD MEMBERS

At the end of 2013, the members of the International Souris River Board were as follow:

| | |
|---|---|
| Russell Boals<br>Retired (Co-Chair)<br>Regina, Saskatchewan | Member for Canada |
| John Fahlman<br>Saskatchewan Water Security Agency<br>Moose Jaw, Saskatchewan | Member for Canada |
| Nicole Armstrong<br>Manitoba Conservation & Water Stewardship<br>Winnipeg, Manitoba | Member for Canada |
| Mark Lee<br>Manitoba Conservation and Water Stewardship<br>Winnipeg, Manitoba | Member for Canada |
| John-Mark Davies<br>Saskatchewan Water Security Agency<br>Saskatoon, Saskatchewan | Member for Canada |
| Vacant<br>Environment Canada<br>Winnipeg, Manitoba | Member for Canada |
| Todd Sando<br>North Dakota State Engineer<br>Bismarck, North Dakota | Member for the United States<br>(Co-Chair) |
| Colonel Daniel Koprowski<br>U.S. Army Corps of Engineers<br>St. Paul, Minnesota | Member for the United States |
| Gregg Wiche<br>U.S. Geological Survey<br>Bismarck, North Dakota | Member for the United States |
| Megan Estep<br>U.S. Fish and Wildlife Service<br>Denver, Colorado | Member for the United States |
| Scott Gangl<br>North Dakota Game and Fish Department<br>Bismarck, North Dakota | Member for the United States |
| Vacant<br>North Dakota Department of Health<br>Bismarck, North Dakota | Member for the United States |

## 2.0 2013 ACTIVITIES OF THE BOARD

Since the presentation of the Fifty-Fourth Annual Report to the International Joint Commission, the International Souris River Board has held two meetings and has had six teleconference calls. The discussions and decisions made are summarized in the following sections.

### 2.1 FEBRUARY 20, 2013, MEETING IN WINNIPEG, MANITOBA

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

Nicole Armstrong
Member for Canada

David Donald
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Gregg Wiche
Member for the United States

Colonel Michael Price
Member for the United States

Scott Gangl
Member for the United States

Dennis Fewless
Member for the United States

For the period ending December 31, 2012, Environment Canada reported the total diversion in the Souris River Basin was 47 692 cubic decametres (38,639 acre-feet). Recorded flow at Sherwood was 72 838 cubic decametres (59,050 acre-feet). The natural flow computed at Sherwood was 103 485 cubic decametres (83,895 acre-feet). According to these computations, the United States share at 40 percent was 41 390 cubic decametres (33,555 acre-feet). The flow received by the United States was 74 725 cubic decametres (60,580 acre-feet), which constitutes a surplus delivery of 33 335 cubic decametres (27,025 acre-feet). The annual flow requirement / apportionment at Long Creek has also been met with a surplus of 4 475 cubic decametres (3,628 acre-feet).

The Water Security Agency (formerly the Saskatchewan Watershed Authority) reported that Boundary Reservoir was at 1.1 metres (3.6 feet) below its Full Supply Level on February 1, 2013. Based on current basin conditions, it is expected that Boundary Reservoir would fill in 2013. Any excess inflow would be diverted to Rafferty Reservoir by the diversion channel. No winter release is planned at this time.

Rafferty Reservoir was at an elevation of 549.5 metres (1,802.8 feet) on February 1, 2013. Releases from Rafferty were maintained throughout the winter and the Water Security Agency plans to continue with a small release until runoff to maintain a live stream. The initial forecast called for a median volume runoff in spring 2013. Rafferty is not going to fill this year. The plan is to fill Boundary first and then divert any inflow to Rafferty.

Alameda Reservoir was at an elevation of 560.95 metres (1,840.4 feet) on February 1, 2013. Alameda will fill this year. The goal is to not fill the reservoir above the Full Service Level as there were some dam safety issues. A small release was maintained throughout the winter to achieve the February 1 target level and will be continued to maintain a live stream until spring runoff begins.

The United States Geological Survey reported that the total volume of flow past the Long Creek at Noonan gage through December 31, 2012 calendar year was 11 327 cubic decametres (9,183 acre-feet) ranking 32 in 53 years of record. The peak discharge of 12.7 cubic metres per second (450 cubic feet per second) occurred on July 4 due to a summer precipitation event.

The total volume of flow past the Souris River near Sherwood gage through December 31, 2012 calendar year was 72 838 cubic decametres (59,050 acre-feet) with a peak flow at Sherwood of 11 cubic metres per second (382 cubic feet per second) on May 20, 2012. Flows for the current year, based on the last 82 years of data, are in the normal to above average range.

Flows recorded at the Souris River near Westhope gage exceeded the long-term mean daily flow, except for February 10 to March 15, and from mid-July 2012 to the end of the year. The recorded discharge for these two periods fell below the 82-year median discharge. The peak flow at Westhope was 16 cubic metres per second (553 cubic feet per second) on April 6, 2012.

The North Dakota State Water Commission and the United States Geological Survey have a low-flow monitoring program on the Souris River main stem in the vicinity of the Eaton Irrigation Project near Towner, North Dakota. Neither of the two monitoring gages were operated in 2012 due to the higher than normal river levels.

The United States Fish and Wildlife Service reported water level conditions for Lake Darling and J. Clarke Salyer. Lake Darling was at or below normal operating range; currently at 486.47 metres (1,596.00 feet) and discharging 1.98 cubic metres per second (70 cubic feet per second). The United States Fish and Wildlife Service anticipate no changes to the operating plans in 2013. The United States Army Corps of Engineers will be doing some repair work on the outlet gates, which were not operable last year. The five pools in the J. Clarke Salyer complex are at their target levels.

Manitoba reported that overall, the Souris River Basin received below normal precipitation from May through September 2012. Most of the basin received above normal precipitation in October, however, tributaries on the west side of the river across Manitoba received below normal precipitation. The snowpack was in the normal range for water equivalent and runoff will be managed by the reservoirs upstream in North Dakota and Saskatchewan. Flow and levels at the time of freeze up were below normal along the Souris in Manitoba, however, flows at Wawanesa in January and February have increased significantly.

Environment Canada's long-term weather outlook predicts near normal temperatures and precipitation throughout the basin. The risk of significant flooding in the Manitoba portion of the basin is lower than normal, but the potential for significant spring rainstorms may result in localized flooding along the smaller tributaries with little impact on the main channel. The erratic characteristics of extreme weather events in recent years indicate that there is always a chance of severe storm events occurring, which can quickly increase the risk of significant flooding.

The International Souris River Board members, based on the information presented, decided the operation of the reservoirs this year would be a 50/50 type of operation for apportionment purposes.

Environment Canada reported that upgrades were made to the Larson and Roughbark meteorological monitoring stations used to compute reservoir evaporation. Evaporation calculations made using both pan-evaporation and an automated system will now be made using only the automated system. The Water Security Agency and United States Geological Survey mentioned there were no changes to their respective monitoring plans. Manitoba planned to add a new gage at Stony Creek, a tributary to the Souris River mainstem.

The Water Security Agency noted that there were no new applications for surface water withdrawals in Saskatchewan.

The North Dakota State Water Commission stated there were two types of appropriations in North Dakota in 2012. Permits were issued either as Conditional or Temporary. Temporary permits are usually issued for a period of up to one year, mostly for fracking oil by petroleum companies. Groundwater permits are seldom issued temporarily, in North Dakota industry is pushing hard, with government support, to avoid mining of groundwater. In the Temporary category there were three groundwater and 67 surface water permits issued. In the Conditional category there were four groundwater and one surface water permits issued.

An overview of the United States Geological Survey developed SPAtially-Referenced Regression On Watershed (SPARROW) attributes model was provided by the International Joint Commission. The model incorporates a number of input variables ranging from precipitation and temperature to nutrient loads in large watersheds to assess long-term trends in water quality. The Souris River Basin initiative now includes the Red and Assiniboine rivers, but the Lake Winnipeg Basin is proving to be difficult to model. The modeling objectives are to quantify attributes and processes of freshwater systems, to assess the state of knowledge including gaps and limitations, and to evaluate "what if" scenarios. The model input can be specified as point and non-point sources.

Phase III of the Hydrographic Data Harmonization initiative project is near completion

The Hydrology Committee identified two outstanding items that need to be completed. The Hydrology Committee will complete the Procedures Manual and the Saskatchewan Security Agency will complete the elevation/area capacity charts. The Board also welcomed Rob Kirkness as the new member and Canadian Co-Chair of the committee.

The Flow Forecasting Liaison Committee met on February 12, 2013 to approve the February 1 forecast. During runoff, conference calls will be held on a weekly basis. This year's forecast is less than 1:10 event, resulting in a 50/50 apportionment arrangement.

There was discussion about the Weather Innovations LP, a private company mainly dealing with crop damage insurance. The Weather Innovations LP has purchased what was formerly known as the Weather Farm Network and operates some 800 weather stations across Canada. Saskatchewan has an arrangement with the Weather Innovations LP for raw weather data. Appropriate agencies in the United States have a similar arrangement, though there is reluctance to sign the non-disclosure agreement due to the United States requirement for open data access. Re-broadcasting of data has been identified as an issue.

The Aquatic Ecosystem Health Committee plans to update its work plan. Heather Husband from the North Dakota Department of Health replaced Mike Sauer on the Aquatic Ecosystem Health Committee. The committee reported that Environment Canada collected eight samples at Westhope, and the United States Geological Survey collected seven samples at Sherwood. There was also one joint sampling.

- Total Phosphorus exceeded its Water Quality Objective 0.10 milligrams per liter for all samples.
- Sodium exceeded its objective of 100 milligrams per liter for five of the samples at Westhope and five samples at Sherwood.
- Sulphate exceeded its objective of 450 milligrams per liter for one of the samples at both sites (two samples out of 16 total).
- Total iron exceeded its water quality objective of 300 microgram per liter for all samples.
- The pH value objective of 8.5 units was met for all samples.
- The Dissolved Oxygen concentration was above the 5 milligrams per liter Water Quality Objective for all samples.
- The Total Dissolved Solids exceeded its Water Quality Objective of 1,000 milligrams per liter for three samples at Westhope and three samples at Sherwood.
- Chloride did not exceed the Water Quality objective of 100 milligrams per liter in any samples.
- Total Boron did not exceed its objective of 0.50 milligrams per liter in any samples.
- There was no pesticide data available for either sites in 2012.

The Board discussed what actions are needed to address the problem of repeated water quality objective exceedances. Questions were raised on whether there was a need review the current objectives, or to review the Aquatic Ecosystem Health Committee's Terms of Reference and request the Aquatic Ecosystem Health Committee to come up with recommendations. A presentation to the Board was proposed for prioritizing activities in this area. The International Joint Commission mentioned that some International Watershed Initiative funding could be available to conduct studies for determining the causes of exceedances and recommended the SPAtially-Referenced Regression On Watershed attributes model as a good starting point. The Water Security Agency proposed John Mark-Davies as a new member of the Aquatic Ecosystem Health Committee.

The Souris River Task Force reported that the Plan of Study was submitted to the International Joint Commission in December 2012, who provided comments. The International Joint Commission and legal comments were incorporated into the latest version of the Plan of Study. Funds needed to conduct the project are not available within the International Joint Commission, therefore the Plan of Study must be presented to governments who would provide funding in the form of a Reference. A separate study board to liaise with the Souris Board may be required. The timeline is dependent on the governments approving a Reference. The Board agreed to post the Plan of Study on the International Joint Commission/Souris Board Website and to host a Public Information Session in Minot, ND. There is a 30-day requirement for the public input, including the webinars.

The results of the Souris Probable Maximum Flood will be completed and posted on the Water Security Agency's website in the next couple of months. The study included summer rainfall events, which showed a significant increase in the Probable Maximum Flood. A Clean Coal Initiative is under consideration in Saskatchewan.

Several contacts were completed in 2012 for the Northwest Area Water Supply. The third round of the National Environmental Protection Act hearing is due in June/July 2013. The Environmental Impact Assessment will be ready for review in the summer of 2013. Manitoba and Missouri are currently pursuing legal action against the project.

Studies under the Souris River Flood Control Project are being conducted with local sponsors. The estimated cost for flood improvements is in the order of $800 million. BARR Engineering is doing the reconnaissance study to determine feasibility. The project needs United States Army Corps of Engineers involvement.

There are no new developments in regard to Lake Metigoshe.

## 2.2 MARCH 19, 2013, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

Nicole Armstrong
Member for Canada

Mark Lee
Member for Canada

Todd Sando
Member for the United States

Colonel Michael Price
Member for the United States

Gregg Wiche
Member for the United States

Megan Estep
Member for the United States

Dennis Fewless
Member for the United States

The purpose of the meeting was to declare Flood Operations in Spring 2013.

The Souris River Flow Forecasting Liaison Committee informed the Board that there have been changes since the March 1, 2013 forecast. The revised forecast is calling for local 30-day volume at the Sherwood Crossing in excess of 40 000 decametres (32,428 acre-feet) and approaching a greater than 1:10 year event. The conditions that would trigger flood operations under the 1989 Agreement between Canada and the United States are:

- The estimated 30-day unregulated volume at Sherwood Crossing equals or exceeds a 10 percent (10 year) event, which is equal to 216 110 decametres (175,000 acre-feet) and/or
- When the local 30-day volume at Sherwood Crossing is expected to equal or exceed 37 000 decametres (30,000 acre-feet).

Rafferty and Alameda are below their Full Supply Levels. The Water Security Agency will release 11 000 decametres (8,918 acre-feet) from Boundary Reservoir. Releases from Rafferty will increase from 7 cubic metres per second to 10 cubic metres per second (247 cubic feet per second to 353 cubic feet per second) as of March 19, 2013. Similarly, the release from Alameda will increase from 0.5 cubic metres per second to 1.5 cubic metres per second (17.7 cubic feet per second to 53 cubic feet per second).

Flood Operations for Spring 2013 was declared given one of the triggers was met.

The Board also discussed the Public Information Session regarding the Plan of Study to be held in Minot, ND on March 20,2013.

## 2.3 APRIL 9, 2013, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

David Donald
Member for Canada

Nicole Armstrong
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Scott Gangl
Member for the United States

Gregg Wiche
Member for the United States

Colonel Michael Price
Member for the United States

Dennis Fewless
Member for the United States

There was consensus that committee chairs would update their membership the list and send the list to the co-secretaries for distribution. The Water Security Agency noted that John-Mark Davies has been presented as a potential member of the International Souris River Board to the International Joint Commission to replace.

Manitoba noted that Mark Lee, who is also a candidate for International Joint Commission appointment to the Board, was appointed to the Hydrology Committee, the Flood Forecasting Liaison Committee and Souris River Task Force.

The Water Security Agency reported that Alameda is currently at 559.5 metres (1,835.6 feet) and releasing 20 cubic metres per second (706.3 cubic feet per second). The release will be reduced once the reservoir reaches 558 metres (1,830.7 feet) creating an additional 1.5 metres (4.9 feet) of storage capacity. Rafferty is at 549.3 metres (1,802.0 feet), releasing 40 cubic metres per second (1,412.6 cubic feet per second), and will be lowered to 548.3 metres (1,798.9 feet) to allow for additional storage capacity. Boundary Reservoir is at 558 metres (1,830.7 feet) and will be drawn down to 557.6 metres (1,829.4 feet). The peak flow into Boundary is expected to be around 150 cubic metres per second (5,297.3 cubic feet per second) with a diversion of 50 to 55 cubic metres per second (1,766 to 1,943 feet per second) into Rafferty Reservoir. An uncontrolled flow of 60 to 70 cubic metres per second (2,119 to 2,472 cubic feet per second) is expected at the Sherwood Crossing. Releases from the reservoirs will be halted once local runoff starts.

Lake Darling inflows were 65 to 68 cubic metres per second (2,300 to 2,400 cubic feet per second). The release from Lake Darling currently is set at 79 cubic metres per second (2,800 cubic feet per second). More precipitation is expected over the weekend.

June 1 target elevations and dam safety issues for the reservoirs were discussed as they approach their full supply levels. The Flow Forecasting Liaison Committee reported that information sharing and communication has been good between its members.

The United States Army Corps of Engineers will inform the Governor of North Dakota regarding Lake Darling flood operations. The United States Army Corps of Engineers operates Lake Darling during flood events.

The Plan of Study is to be presented to the International Joint Commission. Three presentations to stakeholders/agencies and the public on the Plan of Study were provided, which involved a webinar presentation to agencies and stakeholders on March 214, 2013; face-to-face public information session in Minot, ND, March 20, 2013; webinar presentation to the public on March 26, 2013. It was noted that the public supports the full scope study.

## 2.4 APRIL 25, 2013, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Dennis Fewless
Member for the United States

Gregg Wiche
Member for the United States

The Water Security Agency reported that April continues to be cold and the snow has disappeared in parts of the basin leading to lower flow forecasts. The drawdown targets, below the 1989 Agreement requirement to accommodate flood waters, for Alameda and Rafferty have been met and releases are minimal to maintain a live flow. The freshet is expected to start and the majority of the water is still in the upper portion of the basin according to a recent snow survey.

The new operating plan for Boundary Reservoir estimates a peak flow of 115 cubic metres per second (4,061.2 cubic feet per second) from Long Creek. A maximum of 55 cubic metres per second (1,942.3 cubic feet per second) could be diverted into Rafferty Reservoir. The remaining balance of 60 cubic metres per second (2,118.9 cubic feet per second) may be stored with a maximum spill of 30 cubic metres per second (1,059.5 cubic feet per second). Rafferty and Alameda will hold all inflows until local flow has subsided, with the aim of reaching Full Service Level by June 1.

It was noted that Boundary is not a flood storage reservoir and has very limited capacity to store flood waters, if peak flows are higher than expected downstream releases will be relatively higher. The Water Security Agency will work with the United States Army Corps of Engineers and the National Weather Service regarding releases.

Further discussion is needed on the involvement of the Flood Forecasting Liaison Committee and the Board for information sharing and public notification during flood events. The Water Security Agency in Canada and the United States Army Corps of Engineers and National Weather Service in the

United States are responsible for public notification. The National Weather Service may be reluctant to involve other entities regarding public notification as they operate on a real-time basis and the involvement of several agencies could result in delays at critical times. It was mentioned that there are guidelines in the Operating Plan designating the Water Security Agency, United States Army Corps of Engineers and the State of North Dakota. A call is to be set up to clarify the issue. It was also noted that if only the regulating agencies are involved, Manitoba would be left out.

The United States Army Corps of Engineers provided an update on Lake Darling and runoff conditions in North Dakota. Lake Darling's outflow was increased to 73.6 cubic metres per second (2,600 cubic feet per second) to lower the reservoir to 485.2 metres (1,592.0 feet), lower than the 1989 Agreement. Flows were then reduced and the gates closed on April 25, 2013. No further releases will be made until the local runoff is through the system.

The International Joint Commission confirmed that they had received the Plan of Study. The Plan of Study was also presented to the International Joint Commissioners at the Washington DC meeting on April 17, 2013. The International Souris River Board has approved the Plan of Study prior to the public consultation. There was one major change in the final Plan of Study. The International Souris River Board has moved from "medium" to "full" scope study. The International Souris River Board agreed to endorse a "full scope" Plan of Study for the Souris River. The International Joint Commissioners who attended the presentation were very receptive. Once approved by the Commissioners, the Plan of Study would go to governments for further consideration and funding.

## 2.5 JUNE 5, 2013, TELECONFERENCE CALL

Members in attendance were:

Mark Lee
Member for Canada

John Fahlman
Member for Canada

Nicole Armstrong
Member for Canada

John-Mark Davies
Member for Canada

John-Mark Davies
Member for Canada

Todd Sando
Member for the United States

Gregg Wiche
Member for the United States

Scott Gangl
Member for the United States

Megan Estep
Member for the United States

Colonel Michael Price
Member for the United States

Water Security Agency reported that Rafferty will be above Full Service Level until mid-June, releasing 20 cubic metres per second (706 cubic feet per second) and Alameda is releasing 5 cubic metres per second (177 cubic feet per second) for a total of 25 cubic metres per second (883 cubic feet per second) until mid-June. Rain events may result in increased releases.

The United States Fish and Wildlife Service reported that Lake Darling is releasing 27 cubic metres per second (950 cubic feet per second) and will increase the release when local runoff drops off. All coulees have peaked and have receded as a result of 305 millimetres (12.0 inches) in the Des Lacs basin. At this time the crest is somewhere between Foxholm and Burlington. Another 76 to 89 millimetres (3 to 3.5 inches) of rain fell saturating roads and flooding fields.

Manitoba reported that most streams were above normal flows and the Winnipeg diversion and Portage diversion are being operated.

## 2.6 JULY 19, 2013, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

Todd Sando
Member for the United States

John Fahlman
Member for Canada

Scott Gangl
Member for the United States

Saskatchewan reported that all three reservoirs (Boundary, Rafferty and Alameda) are at, or close to their Full Service Level. Currently, there is no release from Rafferty, Alameda is releasing 7 cubic metres per second (247 cubic feet per second) and is slightly above Full Service Level, Boundary reservoir is below Full Service Level. The Flood Forecasting Liaison Committee met last week and recommended that flood operations be stopped as the flow at Minot is less than 14.2 cubic metres per second (500 cubic feet per second).

North Dakota stated that the flow out of Lake Darling is currently at 3 cubic metres per second (100 cubic feet per second). The flow at Minot will be less than 14.2 cubic metres per second (500 cubic feet per second).

The Board declared that flood operations be deemed over. The United States Army Corps of Engineers will formally notify the United States Fish and Wildlife Service that flood operations are over.

The Board discussed the status of the Plan of Study, which is still with the International Joint Commission. The Board agreed to consider if some subprojects of the Plan of Study could be started without waiting for funding. The United States Department of State plans to hold a conference call with a number of federal agencies to discuss which of the three options to support. Once consensus has been reached by the agencies, the United States Department of State would meet with the Office of Canadian Affairs and make a recommendation to the International Joint Commission on the option to pursue. It was noted that the conference call should not affect the Plan of Study or the activities of the Board, who have already sent the Plan of Study with its recommendation to pursue the optimal scope, to the International Joint Commission. There will be another conference call among United States federal departments regarding this topic.

## 2.7 AUGUST 8, 2013, MEETING IN WEYBURN, SASKATCHEWAN

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

Nicole Armstrong
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Gregg Wiche
Member for the United States

Colonel Daniel Koprowski
Member for the United States

Scott Gangl
Member for the United States

Dennis Fewless
Member for the United States

The Hydrology Committee reported that they had a brief meeting on August 7, 2013 discussing the Procedures Manual and the Standard Operating Plans for Lake Darling. The Standard Operating Plans for Lake Darling were completed by the United States Army Corps of Engineers and will be provided to the Committee. Rob Kirkness is now the Canadian Co-Chair of the Hydrology Committee. Saskatchewan has updated their Probable Maximum Flood Study with inflow/outflow and area/capacity curves for Rafferty and Alameda. The United States Army Corps of Engineers will review the Probable Maximum Flood Study, which has significantly increased the estimate of the PMF.

For the period ending May 31, 2013, Environment Canada reported the total diversion in the Souris River Basin was 103 802 decametres (84,152 acre-feet). Recorded flow at Sherwood was 180 856 decametres (146,620 acre-feet). The natural flow computed at Sherwood was 230 042 decametres (186,495 acre-feet). According to these computations, the United States share at 40 percent was 92 020 decametres (74,600 acre-feet). The flow received by the United States was 182 895 decametres (148,273 acre-feet), which constitutes a surplus delivery of 90 875 decametres (73,672 acre-feet). The annual flow requirement / apportionment at Long Creek has also been met with a surplus of 18 825 decametres (15,261 acre-feet).

The Water Security Agency reported that Boundary Reservoir below is below its Full Service Level with no releases being made at this time Rafferty and Alameda Reservoirs are both slightly above Full Service Level. An ecological release of 0.5 cubic metres per second (17.7 cubic feet per second) from each reservoir will be made until the normal drawdown elevations are reached sometime in fall. There was then discussion to possibly amend the Agreement and use the March to February period instead of the calendar year for apportionment managements as this may facilitate releases during the winter to sustain a live-stream. While the desire for a live-stream is understood, it is unlikely that releases would be made once the reservoirs reached normal drawdown levels. There is no carry over credit from one year to the next for over-delivery and no other benefit to Saskatchewan to maintain the release once apportionment obligations under the agreement are met.

The United States Geological Survey reported that the total volume of flow past the Long Creek at Noonan gage through May 31, 2013 calendar year was 68 569 decametres (55,589 acre-feet). Flows in the current year are in the normal to above normal range.

The total volume of flow past the Souris River near Sherwood gage through May 31, 2013 calendar year was 180 856 decametres (146,620 acre-feet) with a peak flow for the period January 1 to May 31 of 81 cubic metres per second (2,500 cubic feet per second). Total flow for the 2013 calendar exceeds the median for the period of record by over 123 350 decametres (100,000 acre-feet). Flows for the current year, based on the last 82 years of data, are in the normal to above average range.

Flows recorded at the Souris River near Westhope gage exceeded the long-term mean for the entire period. The recorded discharge for the current year is in the normal to the much above normal range based on the 82-year median discharge. The peak flow at Westhope was 16 cubic metres per second (553 cubic feet per second) on April 6, 2012. The peak discharge for the period January 1 to May 31 was 115 cubic metres per second (4,050 cubic feet per second).

The Board discussed unregulated flows in the Souris River Basin. The Hydrology Committee is to review the issue, keeping in mind that the requirement is for a simple routing or water balance approach. It was noted that the basin is at least two years into a wet period that is expanding from eastern North Dakota to central North Dakota. There were significant rains in June particularly over the Des Lacs basin that caused significant runoff and high flows in Des Lacs.

The United States Fish and Wildlife Service reported that the total provisional inflow measured at Sherwood for the first five months of the year was 179 316 decametres (146,620 acre-feet). This was 145 percent of the historic January-May inflow, which was 101 432 decametres (82,265 acre-feet) for the period from 1938 to 2013. Total provisional outflow measured at Foxholm on the South end of the Upper Souris Refuge for the first five months was 185 111 decametres (150,070 acre-feet). This was 29 percent of the historic January to May outflow, which was 185 111 decametres (70,297 acre-feet) for the period from 1938 to 2013. Lake Darling elevation increased 0.44 metres (1.43 feet) from 468.6 metres (1,595.79 feet) on January 1 to 486.8 metres (1,597.22 feet) on May 31.

Total provisional flow measured from the Souris River to the J. Clark Salyer Refuge from January 1 to May 31 was 287 504 decametres (233,080 acre-feet). This was 218 percent of the historic January to May inflow, which was 131 994 decametres (107,008 acre-feet) for the period of 1938 to 2013. Approximately 232 119 decametres (188,179 acre-feet) was passed to Manitoba during the five-month period.

J. Clark Salyer National Wildlife Refuge entered 2013 with complete drawdowns in pools 320 and 326 and partial drawdowns in pools 332, 341 and 357 for repairs to structures and pumping stations from the 2011 flood. The 2013 management plan included raising water levels in pools 320, 326 and 332 then slowly releasing water throughout the summer to mimic a seasonal water level decline and drawing down pools 341 and 357 by June 1.

Manitoba reported that the Portage Diversion, which diverts water from the Assiniboine River to Lake Manitoba, was closed about a month ago. Spring runoff on the Manitoba tributaries began unusually late towards the end of April. Peak levels were well below earlier forecasts, as a large portion of the snow pack was lost to sublimation and infiltration. Soil moisture was normal to below normal in the fall and provided significant storage in the spring. Runoff peaks on the main stem of the Souris River

and Manitoba tributaries were very sharp due to rapid melting of the remaining snow. The peak on the main stem of the Souris River at Wawanesa was 241 metres per second (8,500 feet per second) caused by a local runoff, which is approximately a 1-in-10 year event.

Summer precipitation has been normal in the Manitoba portion of the Souris River Basin. Large events have caused above normal flow in Manitoba tributaries. Flows along the Souris River in Manitoba have been above normal and were in the range of 99 to 198 metres per second (3,500 to 7,000 feet per second) since the spring fresher in May. As of August 7, 2013, the Souris River flow at Wawanesa was 96.3 metres per second (3,400 feet per second). The water supply outlook for the remainder of 2013 for the Manitoba portion of the basin is quite good.

The Souris River Task Force reported that the International Joint Commission has submitted the Plan of Study to governments for their consideration. There are several issues outside the Board's and the International Joint Commission's mandate. The International Joint Commission has asked governments for authority through a reference to address the infrastructure upgrade concerns and funding and a response with funding, is expected by the end of summer. It was mentioned that the United States Geological Survey met with the North Dakota State Water Commission regarding a stochastic study of the Souris River Basin. The Gap Analysis identified in the 2011 Flood Plan of Study is an International Watershed Initiative project. The board will review the Plan of Study and identify activities in the Optimum Plan that it could undertake while waiting for a response from governments. Once the Plan of Study is approved, the Board will have an opportunity to input and guide the work under the Plan of Study. It was also suggested that the Board appoint a Project Leader to serve as a liaison between the International Joint Commission and the Board.

Water quantity measurements were carried out by the Water Survey of Canada and the United States Geological Survey to determine accuracy of the measurements conducted by both agencies. A comparison was made of measurements for the Long Creek near Roche Percee, Long Creek at Western Crossing, Souris River near Sherwood and Long Creek near Noonan. The differences were 8 percent, 3.7 percent, 0.4 percent and 3.6 percent respectively. Each agency did the measurements using its own equipment and crew.

A climate station replaced the pan evaporation site at Weyburn. Flood hardening work, weir repair and bank hardening is being done at the Sherwood gauge with money provided by the International Joint Commission. The United States Geological Survey hopes to complete the work in October. The Minot gauge needs similar work due to a bank collapse.

The Water Security Agency noted that there were 25 new applications for groundwater and 5 new applications for surface water in Saskatchewan.

The North Dakota State Water Commission stated there were no surface water appropriations in North Dakota in 2013. There was one application for groundwater for the City of Crosby for 247 decametres (200 acre-feet). In addition, there were 618 temporary applications for oil and gas activities. In North Dakota a temporary permit can last from one day up to one year.

The Flow Forecasting Liaison Committee has been meeting regularly via conference call to discuss flood operations. Generally the Flood Forecasting Liaison Committee functions very well with a number of lessons learned from the 2011 flood event. The current flood operations have been declared over. There was discussion about updating the membership of all committees.

The Aquatic Ecosystem Health Committee provided an updated list of members. It was noted that the committee had two conference calls and a face to face meeting. A Communications Protocol for Fish Kills has been prepared and will be presented at the next Board meeting. Current water quality objectives need to be reviewed and updated, starting with a literature review, so that they may help provide input to the Plan of Study. Water quality objectives were last reviewed six years ago. The Tri-Annual Water Quality Standards review process in North Dakota was explained, noting that there is very little change each review. It was also noted that aquatic life and human life criteria are treated separately in the review process.

The Aquatic Ecosystem Health Committee reported that in 2012 Environment Canada had collected eight samples plus a triplicate at Westhope, and there was also one joint sampling at Sherwood with the United States Geological Survey.

- Total Phosphorus exceeded its Water Quality Objective 0.10 milligrams per liter in all samples.
- Sodium exceeded its objective of 100 milligrams per liter for nine of the ten samples.
- Sulphate exceeded its objective of 450 milligrams per liter in seven of the ten samples.
- Total iron exceeded its water quality objective of 300 microgram per liter in four of the samples.
- The pH value objective of 8.5 units was exceeded in seven of the ten samples.
- The Dissolved Oxygen concentration fell below the 5 milligrams per liter Water Quality Objective in one sample.
- The Total Dissolved Solids exceeded its Water Quality Objective of 1,000 milligrams per liter in eight of the ten samples.
- Chloride did not exceed the Water Quality objective of 100 milligrams per liter in any samples.
- 2,4-D, Atrazine, Bromoxynil, Dicamba, MPCA and Picloram had positive results, but were below their respective Water Quality Objectives.

The water quality in the Souris River is influenced by flow and floods that flush the system. When comparing 2011 and 2012, the trend shows the median going up while the maximum is going down. Sodium, sulphate and iron exceedances are common during low flows. Questions were asked whether the objectives were set for drinking water, aquatic life, irrigation or livestock.

The International Souris River Board was instrumental in the Data Harmonization and the SPAtially-Referenced Regression On Watershed attributes model initiatives. There will be a two-hour discussion during the October 2013 International Joint Commission appearance in Ottawa regarding Strategic Initiatives. The International Joint Commission suggested the following five topics as possible Strategic Initiatives:

- Aspect of climate change and its impact on the responsibilities of the Boards,
- The role and needs of adaptive management,
- Water flow needs for fisheries,
- Other significant water quality challenges beyond eutrophication that are shared, or
- The need to assess international water quality objectives.

The strategic projects paper was the result of an International Joint Commissioners retreat. There will be a conference call in mid-September 2013 to discuss the Plan of Study and the International Watersheds Initiative.

The International Joint Commission suggests that the International Souris River Board needs to move from a "pilot" to "full-fledged" International Watersheds Initiative board. The International Souris River Board needs to identify public members as the governments would like to increase public involvement and active participation. First Nations participation is encouraged. The International Joint Commission also wants public participation on the boards and asked the International Souris River Board to consider nominations. The Red has one public member from each country. The International Souris River Board would be renamed the International Souris River Watershed Board. The advantage of becoming a watershed board is that the governments would consider greater funding.

The Board will discuss how public members could be identified during the September conference call.

The Water Quality Committee of the International Red River Basin made a presentation focused on nutrients and their impact on water quality across the International Red River watershed and Lake Winnipeg and specially issues pertaining to algal blooms. Algal bloom covered 10,000 square kilometers of the North Basin of Lake Winnipeg in 2005. Increases in nutrients like Nitrogen and Phosphorus contribute to excessive algal blooms. Individuals recently have started illegally dumping Copper Sulphate into the lake in an effort to control algal blooms.

The Aquatic Ecosystem Health Committee is discussing the issue in their review of the water quality objectives and will pursue the nutrient issue in the Souris River Basin in its future undertakings. The SPARROW model has undergone its final iteration. The plan is to expand the model into the Winnipeg River Basin and further east. There is also an opportunity for knowledge transfer with the University of Saskatchewan, which is currently working on the South Saskatchewan River system.

The Board discussed membership and member replacements. Canada is currently two members short and finding it challenging to replace those positions. They may have to look at other federal departments or academia for replacement members.

## 2.8 SEPTEMBER 17, 2013, TELECONFERENCE CALL

Members in attendance were:

Russell Boals
Member for Canada

John Fahlman
Member for Canada

David Donald
Member for Canada

Nicole Armstrong
Member for Canada

Mark Lee
Member for Canada

John-Mark Davies
Member for Canada

Todd Sando
Member for the United States

Megan Estep
Member for the United States

Scott Gangl
Member for the United States

Steve Robinson (for Gregg Wiche)
Member for the United States

Colonel Daniel Koprowski
Member for the United States

Dennis Fewless
Member for the United States

The International Souris River Board has been instrumental in the Canada-United States Data Harmonization Project and application of the SPARROW model in the Souris River Basin. There were challenges reconciling the "Z axis, or elevation coordinate" in the previous data harmonization work. The work will continue as an International Watersheds Initiative. The remaining time frame of the project will be identified in the Data Harmonization Task Group's work plan. The SPARROW model has made significant progress. The International Souris River Board supports continued investment in the application of the model.

The five key strategic areas identified in the International Joint Commission letter to the International Souris River Board were discussed. The International Joint Commission recommended that future International Watershed Initiative projects should include:

- Aspect of climate change and its impact on the responsibilities of the Boards,
- The role and needs of adaptive management,
- Water flow needs for fisheries,
- Other significant water quality challenges beyond eutrophication that are shared, or
- The need to assess international water quality objectives.

The Board discussed the need to review the existing water quality objectives as an International Watershed Initiative. The water quality issue has come up again and again in previous Board meetings and the objectives require review. Similar water quality issues are being discussed at the International Red River Board meetings as well, there could be some synergy in involving the International Red River Board and a possible joint project to address the water quality issues. There will be a session on Strategic Projects at the fall International Joint Commission appearance in Ottawa.

The United States State Department is talking to other federal departments about the Plan of Study, but nothing has happened other than discussions. The Plan of Study was also sent to Foreign Affairs in Canada. The International Joint Commission will have the Plan of Study on the agenda for the governments' session of the International Joint Commission Fall meeting in Ottawa. There are subprojects identified in the Plan of Study's White Paper that could be initiated by the International Souris River Board. There will be a webinar held to discuss the subprojects mentioned in the White Paper as well as to review the hydrology study conducted by the United States Army Corps of Engineers.

## 3.0 MONITORING

### 3.1 INSPECTIONS OF THE BASIN

During the year, the staff of the Water Survey Division of Environment Canada, Saskatchewan Water Security Agency, the North Dakota State Water Commission, Manitoba Water Stewardship, and the United States Geological Survey carried out frequent field inspections of the Souris River basin.

### 3.2 GAUGING STATIONS

A list of the gauging stations being operated in the Souris River basin is given in Table 1. In addition, the United States Geological Survey operated three miscellaneous stream flow-measurement sites in the vicinity of the Eaton Irrigation Project near Towner, North Dakota.

The station numbers and the locations of the hydrometric stations measuring streamflow are shown in Part I of Table 1. The gauging station numbers and the locations of the hydrometric stations located on lakes and reservoirs in the basin are shown in Part II of Table 1.

**Table 1.**
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
**Part I--Streamflow**

| Index Number | Stream | Location | State or Province | Operated By |
|---|---|---|---|---|
| 05NA003 | Long Creek[1] | at Western Crossing | Saskatchewan | Environment Canada |
| (05113360) | | | | |
| 05NA004 | Long Creek | near Maxim | Saskatchewan | Saskatchewan Watershed Authority |
| 05NA005 | Gibson Creek | near Radville | Saskatchewan | Environment Canada |
| 05NB001 | Long Creek | near Estevan | Saskatchewan | Environment Canada |
| 05NB011 | Yellowgrass Ditch | near Yellowgrass | Saskatchewan | Environment Canada |
| 05NB014 | Jewel Creek | near Goodwater | Saskatchewan | Environment Canada |
| 05NB017 | Souris River | near Halbrite | Saskatchewan | Environment Canada |
| 05NB018 | Tatagwa Lake Drain | near Weyburn | Saskatchewan | Environment Canada |
| 05NB021 | Short Creek[1] | near Roche Percee | Saskatchewan | Environment Canada |
| (05113800) | | | | |
| 05NB031 | Souris River | near Bechard[2] | Saskatchewan | Saskatchewan Watershed Authority |
| 05NB033 | Moseley Creek | near Halbrite | Saskatchewan | Environment Canada |
| 05NB034 | Roughbark Creek | near Goodwater | Saskatchewan | Environment Canada |
| 05NB035 | Cooke Creek | near Goodwater | Saskatchewan | Environment Canada |
| 05NB036 | Souris River | below Rafferty Reservoir | Saskatchewan | Environment Canada |
| 05NB038 | Boundary Reservoir Diversion Canal | near Estevan | Saskatchewan | Environment Canada |
| 05NB039 | Tributary | near Outram | Saskatchewan | Environment Canada |

| | | | | |
|---|---|---|---|---|
| 05NB040 | Souris River | near Ralph | Saskatchewan | Environment Canada |
| 05NB041 | Roughbark Creek | above Rafferty Reservoir | Saskatchewan | Environment Canada |
| 05NC001 | Moose Mountain Creek | below Moose Mountain Lake | Saskatchewan | Saskatchewan Watershed Authority |
| 05ND004 | Moose Mountain Creek | near Oxbow | Saskatchewan | Environment Canada |
| 05ND010 | Moose Mountain Creek | above Alameda Reservoir | Saskatchewan | Environment Canada |
| 05ND011 | Shepherd Creek | near Alameda | Saskatchewan | Environment Canada |
| 05NE003 | Pipestone Creek | above Moosomin Reservoir | Saskatchewan | Environment Canada |
| 05NF001 | Souris River | at Melita | Manitoba | Environment Canada |
| 05NF002 | Antler River | near Melita | Manitoba | Environment Canada |
| 05NF006 | Lightning Creek | near Carnduff | Saskatchewan | Environment Canada |
| 05NF007 | Gainsborough Creek | near Lyleton | Manitoba | Environment Canada |
| 05NF008 | Graham Creek | near Melita | Manitoba | Environment Canada |
| 05NF010 | Antler River | near Wauchope | Saskatchewan | Environment Canada |
| 05NG001 | Souris River | at Wawanesa | Manitoba | Environment Canada |
| 05NG003 | Pipestone Creek | near Pipestone | Manitoba | Environment Canada |
| 05NG007 | Plum Creek | near Souris | Manitoba | Environment Canada |
| 05NG012 | Elgin Creek | near Souris | Manitoba | Environment Canada |
| 05NG020 | Medora Creek | near Napinka | Manitoba | Environment Canada |
| 05NG021 | Souris River | at Souris | Manitoba | Environment Canada |
| 05NG024 | Pipestone Creek | near Sask. Boundary | Manitoba | Environment Canada |
| 05113520 | Long Creek Tributary | near Crosby | North Dakota | U.S. Geological Survey |
| 05113600 | Long Creek[1 3] | near Noonan | North Dakota | U.S. Geological Survey |
| (05NB027) | | | | |
| 05114000 | Souris River[1 3] | near Sherwood | North Dakota | U.S. Geological Survey |
| (05ND007) | | | | |
| 05116000 | Souris River[3] | near Foxholm | North Dakota | U.S. Geological Survey |
| 05116135 | Tasker Coulee Tributary | near Kenaston | North Dakota | U.S. Geological Survey |
| 05116500 | Des Lacs River[3] | at Foxholm | North Dakota | U.S. Geological Survey |
| 05117500 | Souris River[3] | above Minot | North Dakota | U.S. Geological Survey |
| 05119410 | Bonnes Coulee | near Velva | North Dakota | U.S. Geological Survey |
| 05120000 | Souris River[3] | near Verendrye | North Dakota | U.S. Geological Survey |
| 05120180 | Wintering River Tributary | near Kongsberg | North Dakota | U.S. Geological Survey |
| 05120500 | Wintering River[3] | near Karlsruhe | North Dakota | U.S. Geological Survey |
| 05122000 | Souris River[3] | near Bantry | North Dakota | U.S. Geological Survey |
| 05123300 | Oak Creek Tributary | near Bottineau | North Dakota | U.S. Geological Survey |
| 05123400 | Willow Creek[3] | near Willow City | North Dakota | U.S. Geological Survey |
| 05123510 | Deep River[3] | near Upham | North Dakota | U.S. Geological Survey |
| 05124000 | Souris River[1 3] | near Westhope | North Dakota | U.S. Geological Survey |
| (05NF012) | | | | |

**Table 1.**
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
**Part II--Water Level**

| Index Number | Stream | Location | State or Province | Operated By |
|---|---|---|---|---|
| 05113750 | East Branch Short Creek Reservoir | near Columbus | North Dakota | U.S. Geological Survey |
| 05115500 | Lake Darling | near Foxholm | North Dakota | U.S. Geological Survey |
| LGNN8 | Souris River | at Logan | North Dakota | U.S. Corps of Engineers |
| | | | | U.S. N. Weather Service |
| SWRN8 | Souris River | at Sawyer | North Dakota | U.S. Corps of Engineers |
| | | | | U.S. N. Weather Service |
| TOWN8 | Souris River | at Towner | North Dakota | U.S. Corps of Engineers |
| | | | | U.S. N. Weather Service |
| VLVN8 | Souris River | at Velva | North Dakota | U.S. Corps of Engineers |
| | | | | U.S. N. Weather Service |
| | Upper Souris Refuge | Dams 87 and 96 | North Dakota | U.S. Fish and Wildlife |
| | Des Lacs Refuge | Units 1 - 8 inclusive | North Dakota | U.S. Fish and Wildlife |
| | J. Clark Salyer Refuge | Dams 320, 326, 332, 341, and 357 | North Dakota | U.S. Fish and Wildlife |
| 05NA006 | Larsen Reservoir | near Radville | Saskatchewan | Environment Canada |
| 05NB012 | Boundary Reservoir | near Estevan | Saskatchewan | Saskatchewan Watershed Authority |
| 05NB016 | Roughbark Reservoir | near Weyburn | Saskatchewan | Environment Canada |
| 05NB020 | Nickle Lake | near Weyburn | Saskatchewan | Environment Canada |
| 05NB032 | Rafferty Reservoir | near Estevan | Saskatchewan | Environment Canada |
| 05NC002 | Moose Mountain Lake | near Corning | Saskatchewan | Environment Canada |
| 05ND008 | White Bear (Carlyle) Lake | near Carlyle | Saskatchewan | Saskatchewan Watershed Authority |
| 05ND009 | Kenosee Lake | near Carlyle | Saskatchewan | Saskatchewan Watershed Authority |
| 05ND012 | Alameda Reservoir | near Alameda | Saskatchewan | Environment Canada |
| 05NE002 | Moosomin Lake | near Moosomin | Saskatchewan | Environment Canada |
| 05NF804 | Metigoshe Lake | near Metigoshe | Manitoba | Manitoba Water Stewardship |
| 05NF805 | Sharpe Lake | near Deloraine | Manitoba | Manitoba Water Stewardship |
| 05NG023 | Whitewater Lake | near Boissevain | Manitoba | Environment Canada |
| 05NG801 | Plum Lake | above Deleau Dam | Manitoba | Manitoba Water Stewardship |
| 05NG803 | Elgin Reservoir | near Elgin | Manitoba | Manitoba Water Stewardship |
| 05NG806 | Souris River | above Hartney Dam | Manitoba | Manitoba Water Stewardship |

| | | | | |
|---|---|---|---|---|
| 05NG807 | Souris River | above Napinka Dam | Manitoba | Manitoba Water Stewardship |
| 05NG809 | Plum Lake | near Findlay | Manitoba | Manitoba Water Stewardship |
| 05NG813 | Oak Lake | at Oak Lake Resort | Manitoba | Manitoba Water Stewardship |
| 05NG814 | Deloraine Reservoir | near Deloraine | Manitoba | Manitoba Water Stewardship |

**Table 1.**
STREAMFLOW, WATER-LEVEL, AND WATER QUALITY STATIONS
IN THE SOURIS RIVER BASIN
**Part III--Water Quality**

| Index Number | Stream | Location | State or Province | Operated By |
|---|---|---|---|---|
| 05114000 | Souris River[1 3] | near Sherwood | North Dakota | U.S. Geological Survey |
| (05ND007) | | | | |
| 05115500 | Lake Darling | near Foxholm | North Dakota | U.S. Geological Survey |
| 05116000 | Souris River[3] | near Foxholm | North Dakota | U.S. Geological Survey |
| 05116500 | Des Lacs River[3] | at Foxholm | North Dakota | U.S. Geological Survey/ |
| (380021) | | | | N.D. Dept. of Health |
| 05117500 | Souris River[3] | above Minot | North Dakota | U.S. Geological Survey/ |
| (380161) | | | | N.D. Dept. of Health |
| 05120000 | Souris River[3] | near Verendrye | North Dakota | U.S. Geological Survey/ |
| (380095) | | | | N.D. Dept. of Health |
| 05122000 | Souris River[3] | near Bantry | North Dakota | U.S. Geological Survey |
| 05123400 | Willow Creek[3] | near Willow City | North Dakota | U.S. Geological Survey |
| 05123510 | Deep River[3] | near Upham | North Dakota | U.S. Geological Survey |
| | J. Clark Salyer Refuge | Pool 357 | North Dakota | U.S. Fish and Wildlife |
| 05124000 | Souris River[1 3] | near Westhope (QA) | North Dakota | U.S. Geological Survey |
| (05NF012) | | | | |

[1] International gauging station

[2] Formerly published as Souris River below Lewvan

[3] Operated jointly for hydrometric and water-quality monitoring

# 4.0 TRANSBOUNDARY WATER QUALITY OBJECTIVES AND MONITORING

## 4.1 OVERVIEW OF WATER QUALITY

The water quality of the Souris River at the International Boundary has been monitored by the International Souris River Board (formally the Souris River Bilateral Water Quality Monitoring Group) since 1990. The water quality sampling sites are located at the Saskatchewan/North Dakota border near Sherwood, ND (Sherwood station), and at the North Dakota/Manitoba border near Westhope, ND (Westhope station).

Water quality objectives are established for the two border crossings. When water quality objectives are not achieved, such conditions are referred to as "exceedances." A summary of water quality exceedances for 2013 along with historical data is reported in Appendix E.

Historically, the principal concerns regarding water quality in the Souris River basin are related to high total dissolved solids (TDS), depleted dissolved oxygen, and high levels of nutrients, especially phosphorus. High TDS increases the hardness of water and can cause scale build up in pipes and filters. It is also detrimental to aquatic life, especially spawning fish and juveniles as it reduces water clarity. Low dissolved oxygen levels, or hypoxia, can suffocate fish and other aquatic life and cause fish kills as well as mobilize trace metals. High nutrient levels like phosphorus can cause algae blooms, which lead to reductions in dissolved oxygen. It can also aid in the formation of blue-green algae that can produce toxins that are harmful to humans and animals.

In 2013 all of the constituents showed improvement. TDS was less than the water quality objective in fifty percent of the samples at the Sherwood station and in seventy-five percent at the Westhope station. Dissolved oxygen concentrations were well above the objective at both sites throughout the sampling year, and for the first time since 1999, the Westhope station had a phosphorus value that did not exceed the water quality objective. The Aquatic Ecosystem Health Committee believes that the higher flows of 2013 along with the flushing of the flood of 2011 have contributed to this improvement.

At the Sherwood station, the United States Geological Survey (USGS) conducted sampling eight times in 2013. At the Westhope station, the USGS conducted one sample in 2013 simultaneously with Environment Canada to compare sampling methods. Environment Canada conducted eight samples at the Sherwood station border crossing.

At the Sherwood station exceedances of specific water quality objectives included total phosphorus, sodium, and total iron. While the phosphorus results had 100 percent exceedance of the water quality objective, the median and maximum values were down from 2012. Sodium exceeded the water quality objective for fifty percent of the samples, which is down from eighty percent in 2012. The total iron numbers were up however, with one hundred percent exceedance of the 300 micrograms per liter objective, with only one sample measuring below 1,000 micrograms per liter. The maximum value was 3,010 micrograms per liter.

While dissolved oxygen has historically been a constituent of concern, this year it was above the water quality objective for all samples, ranging from 7.3 milligrams per liter to 12.4 milligrams per liter. A concentration of less than 5.0 milligrams per liter is considered an exceedance. The Aquatic Ecosystem Health Committee believes that the continual flow through the winter was partially responsible for the higher dissolved oxygen levels and lack of winter fish kills. As well, pH met the water quality objective for all samples in 2013.

At the Sherwood station, pesticide samples were also collected as a part of an intensive statewide study conducted by the North Dakota Department of Agriculture. Each sample was tested for ninety-eight pesticides and none were above the water quality objectives. Six pesticides (2,4-D, Atrazine, Bromoxynil, Dicamba, MPCA and Picloram) had positive, though very low results.

At the Westhope station, exceedances of specific water quality objectives included total phosphorus, sodium, sulphate, total dissolved solids, total iron, pH, and fecal coliform bacteria. Total phosphorus met water quality objectives in one of eight samples. This was the first time a sample was below the water quality objective since 1999. Sodium exceeded the water quality objective in 50 percent of the samples and total dissolved solids exceeded the water quality objective in 25 percent of the samples. Sulphate values have not been steady in the past few years. In 2013, sulphate exceeded the water quality objective in 12.5 percent of the samples, but in 2012 it exceeded in 70 percent of the samples. No exceedances were observed in 2011, but sulphate had a 12.5 percent exceedance level in 2010. The total iron objective was exceeded once and the pH objective was exceeded once in 2013. Fecal coliform exceeded the 200 colonies per 100 milliliters objective once with a value of 300 colonies per 100 milliliters. This was the first exceedance since 2010.

Pesticide samples were collected four times in 2013 and similar to 2012. Six pesticides (Atrazine, Bromoxynil, Dicamba, MCPA, Picloram, and 2,4-D) had positive results but were well below their respective water quality objectives.

## 4.2 CHANGES TO POLLUTION SOURCES IN 2013

Development in the Saskatchewan/North Dakota region of the basin in connection with the oil exploration in the Bakken Formation has the potential to increase water quality concerns in the basin. As in previous years, 2013 saw the continuing growth of the oil and gas industry in this area. Though most of the activity has occurred outside of the basin, more wells, well pads, and holding areas are being constructed within the basin each year. This has the potential to cause a variety of water quality impairments. However, the most prevalent source of pollution is still nonpoint source pollution from agriculture.

The Souris River basin typically experiences short duration but intense precipitation during the spring and early summer months. These storms can cause overland flooding and rising river levels. Cropping practices that don’t use soil and water conservation methods and livestock grazing near and watering in the river are the likely sources of excessive nutrient, sediment, and E. coli bacteria concentrations, along with laying the groundwork for dissolved oxygen depletion. However, this has been lessened in recent years by the installation of animal waste systems and Best Management Practices on agricultural land through a variety of watershed improvement projects throughout the basin on both sides of the border.

Dams frequently alter downstream nutrient concentrations. Studies from various locations have found increased downstream phosphorus loads as a result of hypolimnetic releases in deep reservoirs; however, studies on the prairies have also shown substantial nutrient sequestration and transformation of nutrient forms in reservoirs. Reservoirs can also alter the timing of downstream loads, especially during high flow events or when bottom waters become anoxic, which can result in the release of phosphorus from sediments. The continual release of water throughout the year from the large upstream reservoirs appears to have decreased concentrations of total phosphorus at the border.

Point source pollution from the cities of Estevan and Minot has been reduced by advanced wastewater treatment. Smaller cities continue to discharge effluent intermittently. All wastewater treatment lagoons in North Dakota are required in their permit to meet the State's water quality standards at the point of discharge. These standards are protective of the objectives set up by the International Souris River Board.

Future impacts to water quality and aquatic ecosystem health included changing agriculture and landscape, urban development, energy development, water appropriations that reduce flows and reservoir operations.

## 4.3 CHANGES TO MONITORING

The only change to monitoring for 2014 is that E. coli data will now be collected at the Sherwood site (Saskatchewan/North Dakota border). The 2014 monitoring plan can be found in Appendix F

## 4.4 CHANGES TO THE PHOSPHORUS OBJECTIVE

The Aquatic Ecosystem Committee is looking into submitting a proposal for assistance in determining data trends and appropriate comparative nutrient values that may be applicable to the Souris River basin. Determining the correct water quality objective for phosphorus has been an item of concern for the ISRB for some time. It is hoped that by creating a project to look for appropriate values, along with the information gained from North Dakota's development of nutrient water quality standards which is under way, and with the information in Manitoba's nutrient management plan for the Red River, the ISRB will be better able to determine the best nutrient target for the Souris River.

## 4.5 WINTER ANOXIA

Winter anoxia and fish kills are the result of very low dissolved oxygen concentrations that have been documented in the Souris River basin on many occasions in previous years. Factors contributing to low dissolved oxygen concentrations have not been definitively determined, but are thought to be increased sediment oxygen demand (as determined in North Dakota's 2010 Total Maximum Daily Load report on the reach of the Souris River from Sherwood to Lake Darling), macrophyte decomposition, organic enrichment, photosynthesis suppression, low flow, scouring of low head dams during high flow events, and low level draw downs from reservoirs.

Dissolved oxygen concentrations at the Sherwood and Westhope stations met the water quality objective of 5.0 milligrams per liter for all samples collected 2013. This was the second consecutive year of meeting the objective. To better determine the minimum flow needed to protect these levels, the Board agrees to keep a watch on dissolved oxygen conditions and the USGS and Environment Canada will attempt to collect dissolved oxygen and ammonia samples if low flow conditions prevail during future winters.

## 5.0 WATER-DEVELOPMENT ACTIVITIES IN 2013

### 5.1 NORTHWEST AREA WATER SUPPLY PROJECT

The Garrison Diversion Municipal, Rural, and Industrial (MRI) water-supply program, passed by the United States Congress on May 12, 1986, as part of the Garrison Diversion Reformation Act of 1986, authorized the appropriation of federal funds for the planning and construction of water-supply facilities throughout North Dakota. An agreement between the North Dakota State Water Commission and the Garrison Conservancy District in 1986 provided a method through which the agencies can request funding for MRI water-system projects from the Secretary of the Interior. On the basis of this agreement, the Northwest Area Water Supply (NAWS) study was initiated in November 1987. The NAWS project has been designed to supply a reliable source of treated water to cities, communities, and rural water systems in 10 counties in northwestern North Dakota. The project has an estimated cost of $217 million.

The water supply for the project is Lake Sakakawea, located in the Missouri River system. The annual use authorized under the State of North Dakota water permit is 18 502 dam3 (15,000 acre-feet). Canada is concerned that the NAWS project could permit the interbasin transfer of non-native biota. NAWS would be the first project to divert water across the continental divide to the Hudson Bay drainage basin.

The Province of Manitoba filed suit in U.S. District Court. The court required the project undergo further NEPA review, and placed an injunction on the project.

On April 15, 2005, the Court modified the injunction to allow the construction on the pipeline between Lake Sakakawea and Minot to continue.

On March 24, 2006, the Court modified the injunction to allow additional construction of the Minot High Service Pump Station, the pipeline from the High Service Pump Station to the northern part of the City of Minot, and the pipeline to Berthold to proceed. It was determined that this construction would not affect treatment decisions. Design work on these projects was completed in 2006 and contract awards were made in 2007 and 2008. All 45 miles of this pipeline were completed by the summer of 2008. Berthold started receiving water in August 2008. The High Service Pump Station started operating in December 2009.

On March 18, 2008, the Court again modified the injunction to allow additional design and construction activities for the entire Northern Tier for features not affecting treatment decisions. The Kenmare-Upper Souris project started serving water in December 2009. The NAWS-All Seasons-Upham pipeline started serving water in September 2009. The Mohall-Sherwood-All Seasons pipeline has planned completion in Spring 2012. The Minot Air Force Base pipeline and the Upper Souris-Glenburn segment north of the Air Force Base have planned completion in 2012. Berthold, the Kenmare-Upper Souris project, and the NAWS-All Seasons-Upham pipeline are currently receiving limited water supply from the Minot and Sundre aquifers.

The construction activity in 2012 revolved around three contracts that were delayed by the flooding in 2011. Two are pipeline contracts connecting Minot's North Hill, the Minot Air Force Base, Glenburn, Upper Souris Water Users System II water treatment facility three miles north of Glenburn, and two connections for the North Prairie Rural Water System to the NAWS project. These projects were completed.

The other contract was for the rehabilitation of the filter bays and associated piping at the Minot Water Treatment Plant Filtration Upgrades as well as the control instrumentation and SCADA (telemetry) for the entire North Tier project works which were operational by the end of 2012 with substantial completion shortly thereafter.

In 2012, 475 million gallons of potable water were distributed to customers through the NAWS project.

Work continued on the Supplemental Environmental Impact Statement with the Bureau of Reclamation and their consultant, CardnoENTRIX. A status update was provided to the Federal Court in October, 2012.

All construction activity on NAWS in 2013 entailed completion and closeout of the contracts that got underway in 2011 and 2012. New construction was prevented by a March 1, 2013 Court order. In 2013 742 million gallons of potable water were distributed to customers through NAWS project works.

## 5.2 WATER APPROPRIATIONS

### 5.2.1 Background

In 1995, the International Souris River Board adopted a new method for reporting minor project diversions for the purpose of determining apportionment. The new method uses a common set of criteria and ensures that the same criteria will be used in both Saskatchewan and North Dakota. It also involves taking the project lists generated by the Natural Flow Methods Committee and adding newly constructed projects or subtracting cancelled projects each year. The projects that met the criteria in 1993 are the benchmark for all future reporting.

### 5.2.2 Saskatchewan

In 1993 there were 137 minor projects in the Saskatchewan portion of the Souris River basin that met the new criteria. These projects had an annual diversion of 5 099 cubic decametres (4,134 acre-feet). On December 31, 2008, there were 139 minor projects in the Saskatchewan portion of the basin with an annual diversion of 4 824 cubic decametres (3,912 acre-feet). In 2013 there were no new projects.

### 5.2.3 North Dakota

In 1993 there were 12 minor projects in the North Dakota portion of the Souris River basin upstream of Sherwood that met the new criteria. The projects had an annual diversion of 1 257 cubic decametres (1,019 acre-feet). On December 31, 2012, there were 12 minor projects in the North Dakota portion of the Long and Short Creek basins. The annual diversions totaled 1 423 cubic decametres (1,154 acre-feet).

The diversion from East Branch Short Creek near Columbus, North Dakota, was estimated by correcting for precipitation, evaporation and seepage, and the storage change. The diversion in 2013 was 780 cubic decametres (632 acre-feet). The diversion from the reservoir was added to the minor project diversions for the Long and Short Creek basins to obtain the total diversion of 2 203 cubic decametres (1,786 acre-feet) by the United States.

## 6.0 HYDROLOGIC CONDITIONS IN 2013

Fall precipitation in the Souris River Basin in 2012 was generally below normal up to January. However, significant precipitation did occur in November. The Saskatchewan Water Security Agency reported that as of January 1 the snow water equivalent in the Saskatchewan portion of the Souris River basin generally ranged from 100 percent to 130 percent of normal. Satellite estimates of snow water equivalent were above normal based on snow water equivalent maps from Environment Canada. Ground surveys and gamma surveys indicated more median snowpack conditions. The February 1 data indicated no significant additional snowfall. Temperatures were above normal over most of Saskatchewan in January and February, but not enough to significantly diminish the snowpack that was present.

All Canadian reservoirs were at or below their February 1 target elevations. Rafferty was not expected to fill.

Precipitation in the summer of 2013 was near normal across the entire province. The Water Security Agency (WSA) relied on rainfall to fill the reservoirs. The fall precipitation in the 30-days freeze-up was generally below normal except in central Saskatchewan which was above normal. Topsoil conditions were characterized as being generally adequate. The long range precipitation forecasts from Environment Canada for southern and central Saskatchewan indicate near normal precipitation for the winter of 2013/2014.

On December 31, 2013, Rafferty Reservoir was at an elevation of 549.676 metres (1803.38 feet), or 0.010 metres (0.34 feet) higher than at the beginning of the year. Total inflow to Rafferty Reservoir in 2013 was 176 448 cubic decametres (143,046 acre-feet), and the calculated diversion for 2013 was 1 418 cubic decametres (1,150 acre-feet). No water was transferred from Rafferty Reservoir to Boundary Reservoir via the pipeline in 2013.

The mainstem inflow to Alameda Reservoir (Moose Mountain Creek above Alameda Reservoir) was 66 984 cubic decametres (54,304 acre-feet), and the calculated diversion for 2012 was 3 703 cubic decametres (3,002 acre-feet). Alameda Reservoir was at an elevation of 561.157 metres (1,841.04 feet) on December 31, 2013, or 0.043 metres (0.14 feet) less than at the beginning of the year.

Boundary Reservoir received an inflow of 111 524 cubic decametres (90,413 acre-feet) from Long Creek. The calculated diversion for 2013 was 8 051 cubic decametres (6,527 acre-feet). On December 31, 2013, Boundary Reservoir was at an elevation of 560.396 metres (1,838.55 feet), or 0.629 metres (2.06 acre-feet) higher than at the beginning of the year.

On December 31, 2013, the estimated storage in the five major reservoirs in Saskatchewan (Boundary, Rafferty, Alameda, Nickle Lake, and Moose Mountain Lake) was 572 677cubic decametres (464,269 acre-feet) as compared to storage of 562 323 cubic decametres (455,875 acre-feet) on December 31, 2012. Figure 1 shows the storage contents of several reservoirs in the Canadian portion of the Souris River basin for 2012 and 2013.

Recorded runoff for the year for the Souris River near Sherwood was 363 982 cubic decametres (295,080 acre-feet), or about 270 percent of the 1931-2013 long-term mean. The artificially drained areas of Yellow Grass Ditch and Tatagwa Lake contributed 62 677 cubic decametres (50,812 acre-feet) during 2013. Figure 2 provides a schematic representation of recorded runoff above Sherwood, North Dakota.

On December 31, 2013, the level of Lake Darling was 486.49 metres (1,596.09 feet). The 2013 year-end storage in Lake Darling was 123 566 cubic decametres (100,175 acre-feet), or approximately 3 509 cubic decametres (2,845 acre-feet) more than on December 31, 2012. The 2013 year-end storage in the J. Clark Salyer Refuge pools was 42 364 cubic decametres (34,345 acre-feet) or 14 283 cubic decametres (11,579 acre-feet) more than on December 31, 2012. The combined year-end storage in Lake Darling and the J. Clark Salyer Refuge pools was 165 930 cubic decametres (134,520 acre-feet), well above the 66 600 cubic decametres (54,000 acre-feet) "severe drought" criterion. Figure 3 shows the storage contents of the mainstem reservoirs in the United States.

Recorded runoff for the year for the Souris River at Westhope was 1 047 329 cubic decametres (849,070 acre-feet) or some 683 348 cubic decametres (553,990 acre-feet) more than entered North Dakota at the Sherwood Crossing. The annual runoff for the Souris River near Westhope was 356 percent of the 1929-2013 long-term mean.

Figure 4 shows the monthly releases from Boundary, Rafferty, Alameda, and Lake Darling Reservoirs.

Manitoba reported precipitation in 2013 was above normal in Manitoba. Soil moisture analysis shows southern and western regions of Manitoba had above normal conditions at the time of freeze-up in 2013. Parts of the Souris River Basin are showing similar antecedent moisture and soil moisture conditions similar to fall 2010. The 2013 peak flow of the Souris River at Wawanesa occurred during the ice breakup period. The estimated peak was 240.7 cubic metres per second (8,500 cubic feet per second). Well above normal flow conditions continued throughout the summer. A peak flow of approximately 192.6 cubic metres per second (6,800 cubic feet per second) occurred in early July. In comparison, the normal flow for this time of year is a few hundred cubic feet per second. Flows and levels at the time of freeze up were well above normal along the Souris River in Manitoba. Current flows within the Souris are also above normal conditions.

## 7.0 SUMMARY OF FLOWS AND DIVERSIONS

### 7.1 SOURIS RIVER NEAR SHERWOOD

The natural runoff near Sherwood for 2013 was 331 444 cubic decametres (268,702 acre-feet). Depletions in Canada totaled 0 cubic decametres (0 acre-feet). The additional water received from the Yellow Grass Ditch and Tatagwa Lake Drain basins was 34 740 cubic decametres more than the total depletions in Canada. The total volume of water released from Boundary, Rafferty, and Alameda Reservoirs in Canada in 2013 was 304 245 cubic decametres (246,651 acre-feet), representing 83.6 percent of the recorded flow at Sherwood, or 91.8 percent of the computed natural runoff at Sherwood. A schematic representation of the 2013 flow volumes in the Souris River basin above Sherwood is shown in Figure 2 and the summary of the natural flow computations is provided in Appendix A. It should be noted that Saskatchewan was in surplus on December 31, 2013 by 233 604 cubic decametres (189,383 acre-feet).

The flow of the Souris River at Sherwood was more than 0.113 cubic metres per second (4 cubic feet per second) for calendar year 2013. Accordingly, Saskatchewan complied with the 0.113 cubic metres per second (4 cubic feet per second) provision specified in Recommendation No. 1 of the Interim Measures.

### 7.2 LONG CREEK AND SHORT CREEK

Recorded runoff for Long Creek at the Western Crossing as it enters North Dakota was 78 600 cubic decametres (63,721 acre-feet), or 247 percent of the long-term mean since 1959. Recommendation No. 2 of the Interim Measures was met with the increase of runoff on Long Creek between the Western and Eastern Crossings of 32 924 cubic decametres (26,692 acre-feet).

Short Creek, which rises in North Dakota, contributed 31 859 cubic decametres (25,828 acre-feet) of runoff in the Souris River above Sherwood.

### 7.3 SOURIS RIVER NEAR WESTHOPE

Recorded flow near Westhope during the period of June 1 through October 31, 2013, was 674 229 cubic decametres (546,553 acre-feet). Figure 5 illustrates the recorded flows at Westhope and at Wawanesa near the mouth of the Souris River in Manitoba.

Due to ice conditions the flows in the Souris River near Westhope were estimated for the periods January 1 to May 1 and November 10 to December 31. The peak daily discharge of 15.7 cubic metres per second (553 cubic feet per second) occurred on June 26, and ranked 30 in 81 years of discharge record.

The flow at Westhope was in compliance with the 0.566 cubic metres per second (20 cubic feet per second) minimum flow requirement as specified in Recommendation No. 3(a) of the Interim Measures.

## 8.0 WORKPLAN SUMMARY FOR 2013

The International Souris River Board was created by the International Joint Commission in April 2000 when it combined responsibilities for the Souris River previously assigned in two separate References. The two were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948).

On June 9, 2005, the Board's mandate was changed further through an exchange of diplomatic notes, assigning water quality functions and the oversight for flood forecasting and operations to the Board. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations is a step in the evolution of the Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

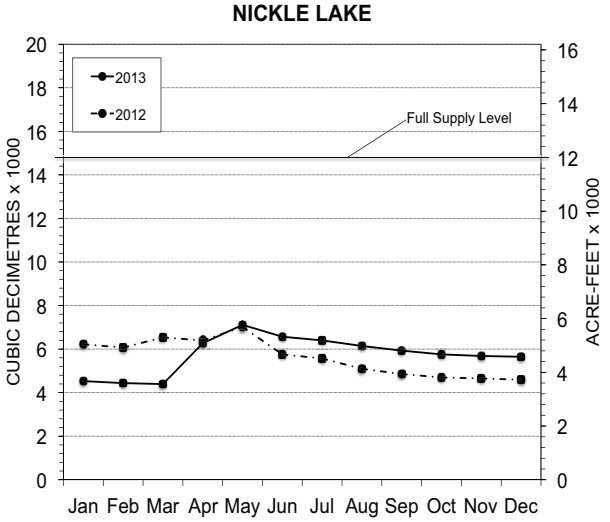
The Board determined that a workplan would be beneficial in helping the Board identify and deliver on results.

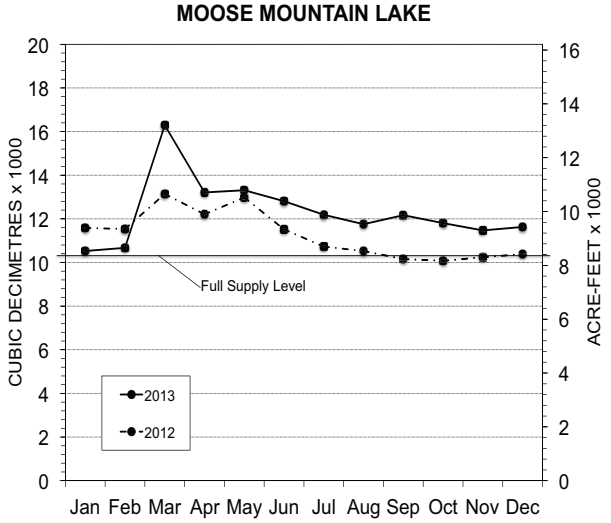
A multi-year workplan was updated for 2013 with the Plan of Study for the 2011 Flood the major focus. The workplan follows the four strategic initiatives of the International Watershed Initiative.

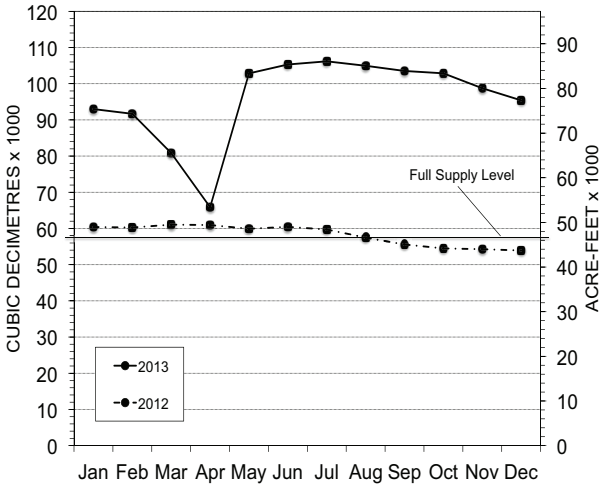
- Build shared understanding of the watershed and related transboundary issues.
- Communicate watershed issues at the local, regional and national levels to increase awareness, highlight potential issues, and identify opportunities for cooperation and resolution.
- Contribute to the resolution of watershed issues.
- Administer the existing orders and references.

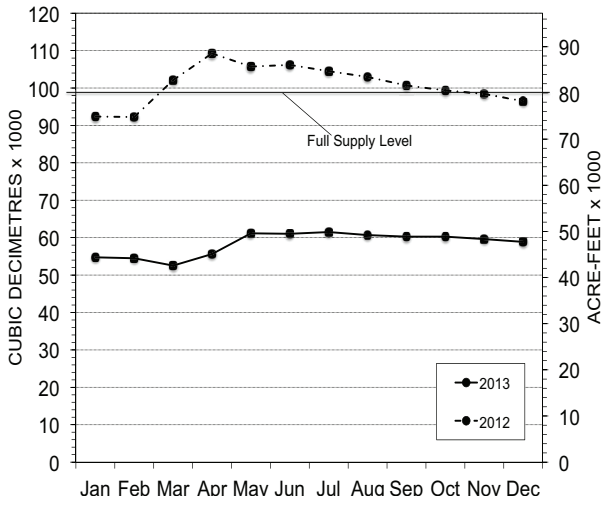
Figure 1

# MONTH END CONTENTS OF RESERVOIRS IN CANADA FOR THE YEARS 2012 AND 2013



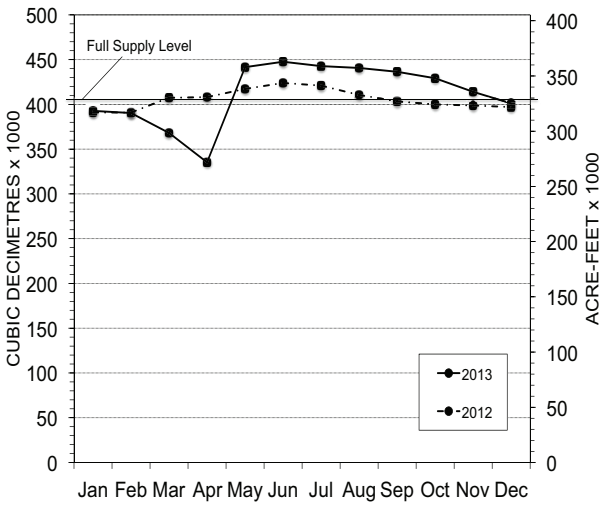



Figure 2

## SCHEMATIC REPRESENTATION OF 2011 FLOWS IN THE SOURIS RIVER BASIN ABOVE SHERWOOD, NORTH DAKOTA, U.S.A.

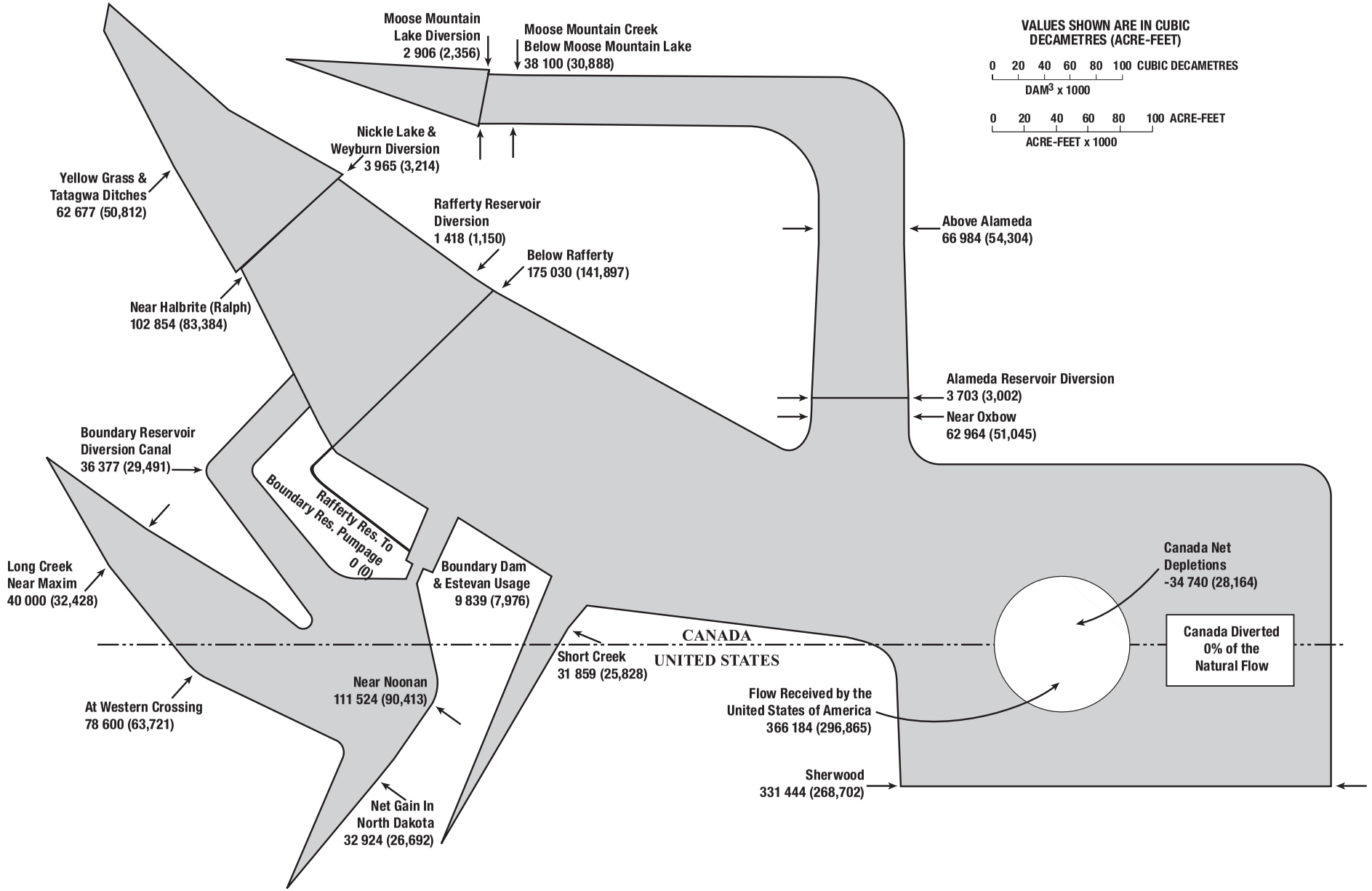
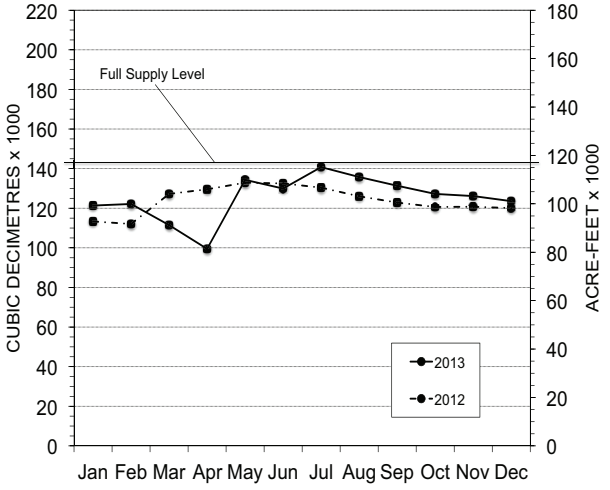


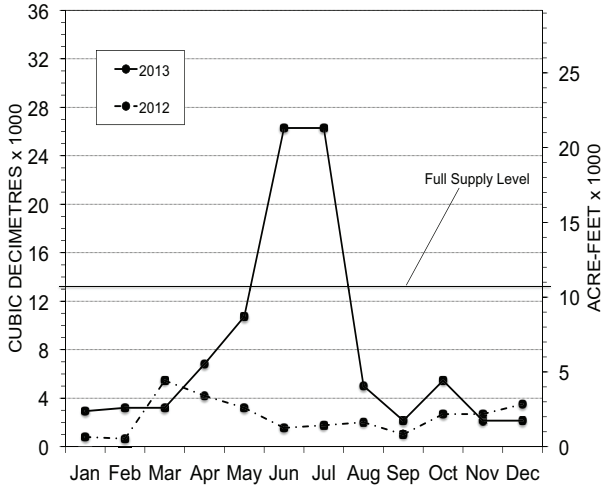
Figure 3

# MONTH END CONTENTS OF RESERVOIRS IN USA FOR THE YEARS 2011 AND 2012

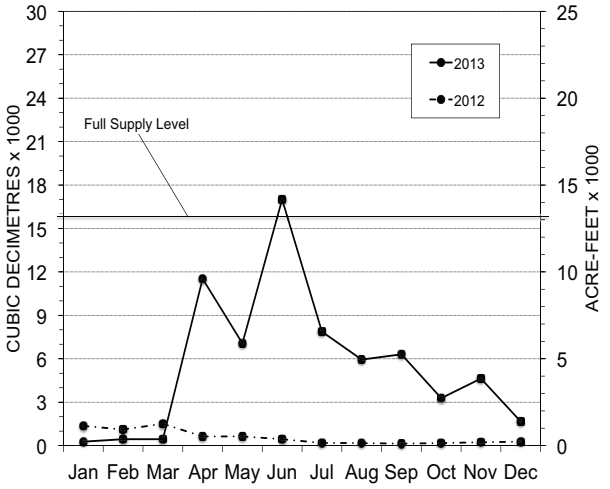
## LAKE DARLING



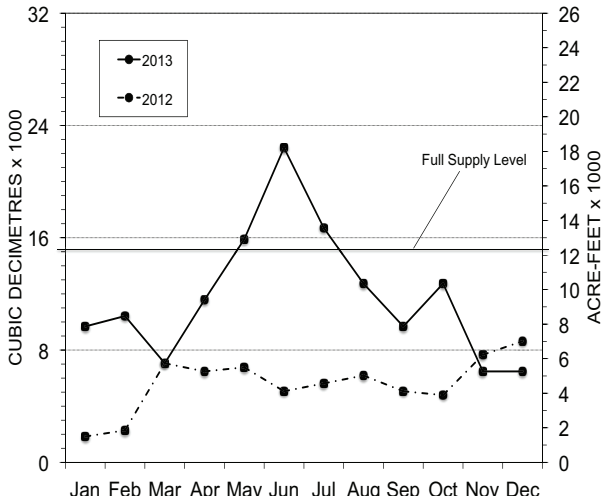

## J. CLARK SALYER REFUGE POOL 332




## J. CLARK SALYER REFUGE POOL 320




## J. CLARK SALYER REFUGE POOL 341

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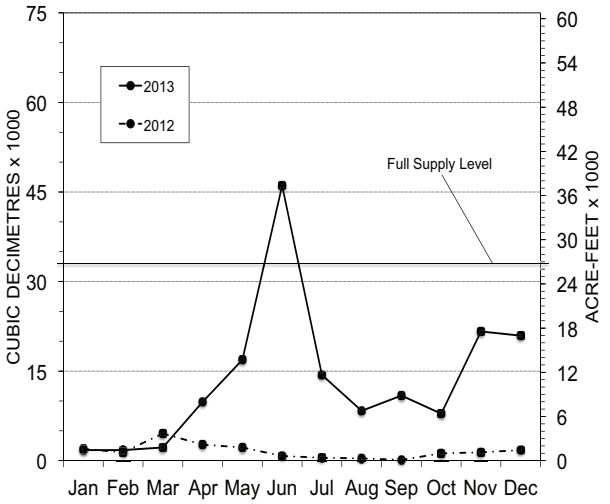



## J. CLARK SALYER REFUGE POOL 357

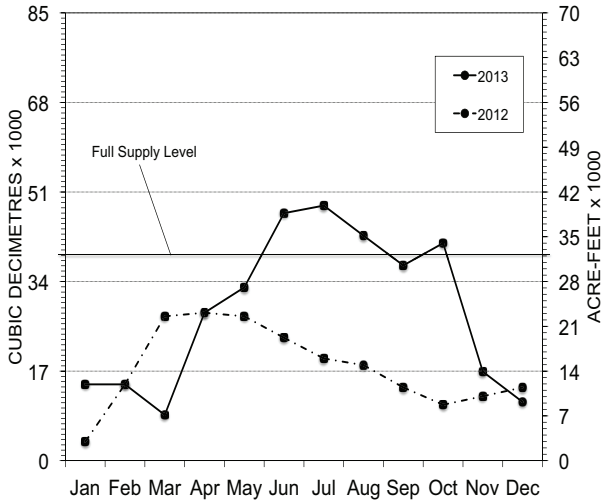
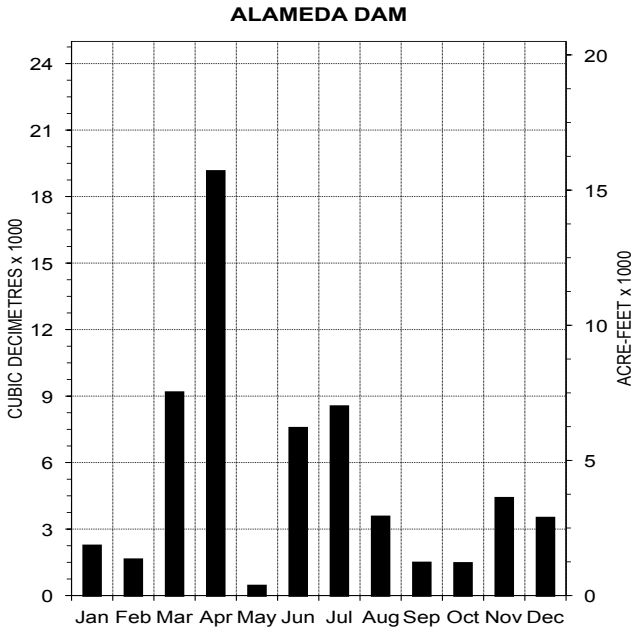
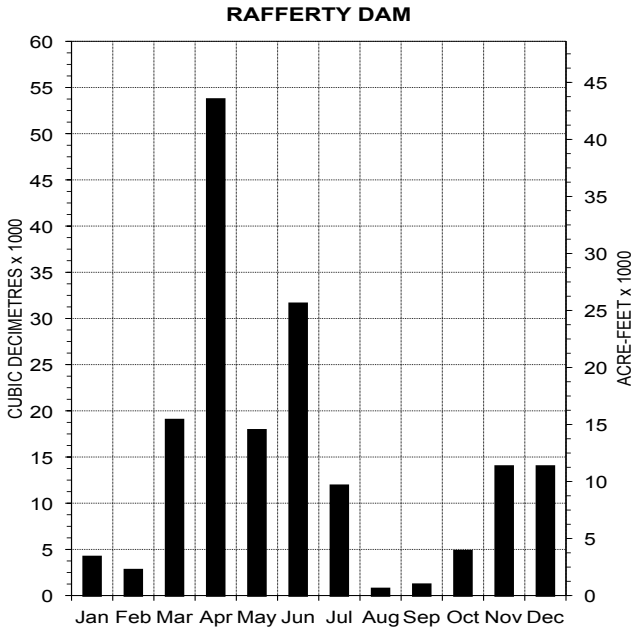
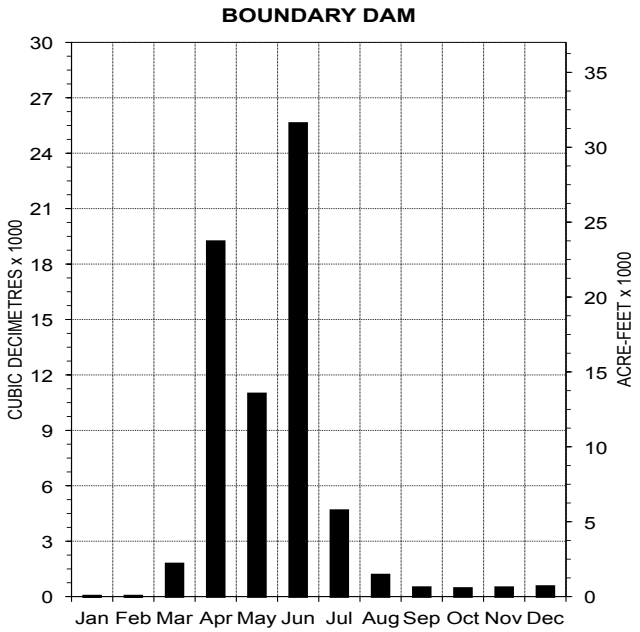


Figure 4

# MONTHLY RESERVOIR RELEASES FOR THE YEAR 2012



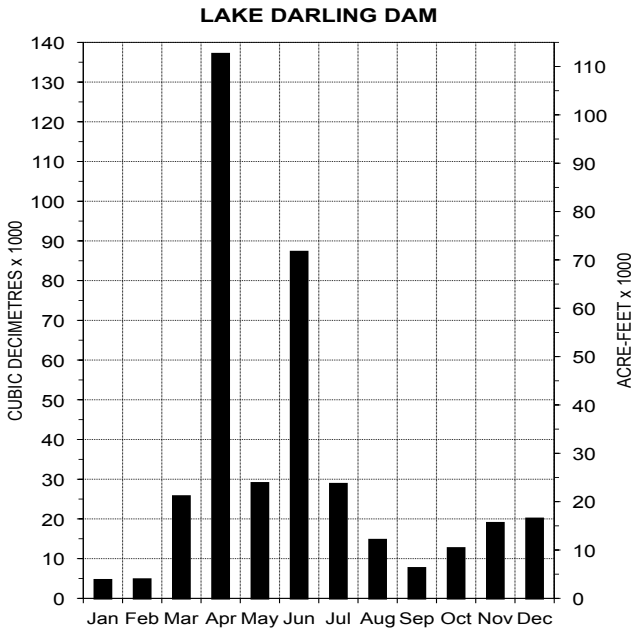
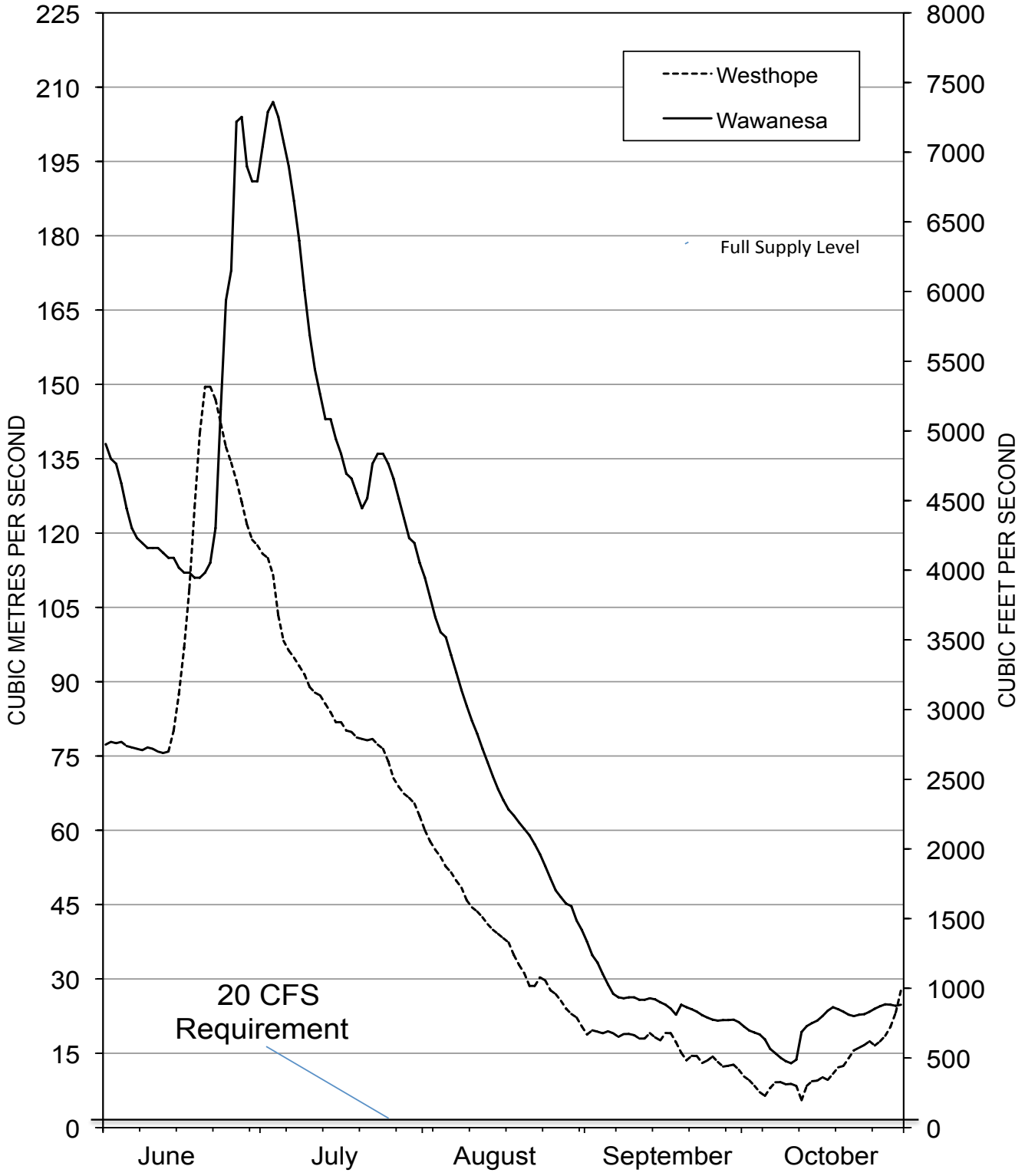



Figure 5

**SOURIS RIVER NEAR WESTHOPE**
**AND**
**SOURIS RIVER NEAR WAWANESA**

**June 1, 2012 to October 31, 2012**



# Map of the Souris River Drainage Basin

INTERNATIONAL JOINT COMMISSION • COMMISSION MIXTE INTERNATIONALE 1909

0 5 10 15 20
Miles
0 10 20 30 40
Kilometres
North

## Legend

- Souris River Basin
- Indian / Native Reserve
- Provincial Park
- US Fish and Wildlife
- Gauging Stations
- City
- Town, Village
- Highway
- River
- Lake or Reservoir

Datum: NAD 1983
Projection: Lambert Conformal Conic
Latitude of Origin: 49'
Central Meridian: -104'
Standard Parallel 1: 49'
Standard Parallel 2: 77'

Date: October 2007

Contact: M.R. Gilchrist, 306-780-6411
Environment Canada

# APPENDIX A

## Determination of Natural Flow of Souris River at International Boundary (Sherwood)

# DETERMINATION OF NATURAL FLOW OF SOURIS RIVER AT INTERNATIONAL BOUNDARY (SHERWOOD)

**All Quantities Reported In Cubic Decametres**

**FOR THE PERIOD: JANUARY 1 TO DECEMBER 31, 2013**

## LONG CREEK BASIN

| LARSEN RESERVOIR | | | | BOUNDARY RESERVOIR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | INFLOW | OUTFLOW | | | | | | | |
| 1 | 2 | 3 | 4 | 5 * | 6 | 7 | 8 | 9 | 10 | 11 | 12 * | 13 |
| STORAGE CHANGE | EVAPORATION | DIVERSION | TOWN OF RADVILLE PUMPAGE | LONG CREEK AT EASTERN CROSSING | LONG CREEK NEAR ESTEVAN | ESTEVAN PIPELINE | DIVERSION CANAL | TOTAL (OUTFLOW) | DIVERSION | MINOR PROJECT DIVERSION | U.S.A. DIVERSION BETWEEN WESTERN & EASTERN CROSSING | **TOTAL DIVERSION LONG CREEK** |
| 106 | 124 | 230 (1+2) | 30 | 111524<br>0<br>PIPELINE | 65014 | 2082 | 36377 | 103473 (6+7+8) | 8051 (5-9) | 840 | 403 | 9554 **(3+4+10+11+12)** |

## UPPER SOURIS RIVER BASIN - ABOVE ESTEVAN

| NICKLE LAKE RESERVOIR | | | | | ROUGHBARK RESERVOIR | | | RAFFERTY RESERVOIR | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| STORAGE CHANGE | EVAPORATION | CITY OF WEYBURN PUMPAGE | DIVERSION | CITY OF WEYBURN RETURN FLOW | STORAGE CHANGE | EVAPORATION | DIVERSION | INFLOW | OUTFLOW | DIVERSION | MINOR PROJECT DIVERSION | **TOTAL DIVERSION UPPER SOURIS RIVER** |
| 2200 | 1567 | 1934 | 5701 (14+15+16) | 1736 | 229 | 180 | 409 (19+20) | 176448 | 175030<br>0<br>PIPELINE | 1418 (22-23) | 1542 | 7334 **(17-18+21+24+25)** |

## LOWER SOURIS RIVER--ESTEVAN TO SHERWOOD

| 27 | 28 * | 29 | 30 |
|---|---|---|---|
| CITY OF ESTEVAN NET PUMPAGE | SHORT CREEK DIVERSIONS IN U.S.A. | MINOR PROJECT DIVERSION | **TOTAL DIVERSION LOWER SOURIS RIVER** |
| 1788 | 1800 | 1603 | 5191 **(27+28+29)** |

## MOOSE MOUNTAIN CREEK BASIN

| MOOSE MOUNTAIN LAKE | | | ALAMEDA RESERVOIR | | | | |
|---|---|---|---|---|---|---|---|
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 |
| STORAGE CHANGE | EVAPORATION | DIVERSION | STORAGE CHANGE | EVAPORATION | DIVERSION | MINOR PROJECT DIVERSIONS | **TOTAL DIVERSIONS MOOSE MOUNTAIN CREEK BASIN** |
| 1400 | 1506 | 2906 (31+32) | -400 | 4103 | 3703 (34+35) | 1452 | 8061 **(33+36+37)** |

## NON-CONTRIBUTORY BASINS

| 39 | 40 | 41 |
|---|---|---|
| YELLOW GRASS DITCH | TATAGWA LAKE DRAIN | **TOTAL ADDITIONS** |
| 51275 | 11402 | 62677 (39+40) |

## SUMMARY OF NATURAL FLOW

| 42 | 43 * | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|
| TOTAL DIVERSION SOURIS RIVER BASIN | RECORDED FLOW AT SHERWOOD | NATURAL FLOW AT SHERWOOD | U..S.A. SHARE | FLOW RECEIVED BY U.S.A. | SURPLUS (+) OR DEFICIT (-) TO U.S.A. |
| | | | 40% OF 44<br>132580 | | (46-45) 40% SHARE<br>**233604** |
| 30140 (13+26+30+38) | 363981 | 331444 (42+43-41) | 50% OF 44 | 366184 (12+28+43) | (46-45) 50% SHARE |

## RECOMMENDATION - SECTION 2
## ANNUAL FLOW OF LONG CREEK

| 48 | 49 * | 50 |
|---|---|---|
| RECORDED FLOW AT WESTERN CROSSING | RECORDED FLOW AT EASTERN CROSSING | SURPLUS (+) OR DEFICIT (-) FROM U.S.A. |
| 78600 | 111524 | **32924** (49-48) |

*** DATA CONTRIBUTED BY U.S.G.S.**

# APPENDIX B

## Equivalents of Measurements

## EQUIVALENTS OF MEASUREMENTS

The following is a list of equivalents of measurement that have been agreed to for use in reports of the International Souris River Board.

1 centimetre equals 0.39370 inch
1 metre equals 3.2808 feet
1 kilometre equals 0.62137 mile

1 hectare equals 10 000 square metres
1 hectare equals 2.4710 acres
1 square kilometre equals 0.38610 square mile

1 cubic metre per second equals 35.315 cubic feet per second

The metric (SI) unit that replaces the British acre-foot unit is the cubic decametre ($dam^3$), which is the volume contained in a cube 10 m x 10 m x 10 m or 1 000 cubic metres.

1 cubic decametre equals 0.81070 acre-feet
1 cubic metre per second flowing for 1 day equals 86.4 cubic decametres
1 cubic foot per second flowing for 1 day equals 1.9835 acre-feet

# APPENDIX C

# Interim Measures as Modified in 2000

## INTERIM MEASURES AS MODIFIED IN 2000

## APPENDIX A TO THE DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

1. The Province of Saskatchewan shall have the right to divert, store, and use waters which originate in the Saskatchewan portion of the Souris River basin, provided that such diversion, storage, and use shall not diminish the annual flow of the river at the Sherwood Crossing more than 50 percent of that which would have occurred in a state of nature, as calculated by the International Souris River Board. For the purpose of these calculations, any reference to "annual" and "year" is intended to mean the period January 1 through December 31.

   For the benefit of riparian users of water between the Sherwood Crossing and the upstream end of Lake Darling, the Province of Saskatchewan shall, so far as is practicable, regulate its diversions, storage, and uses in such a manner that the flow in the Souris River channel at the Sherwood Crossing shall not be less than 0.113 cubic metre per second (4 cubic feet per second) when that much flow would have occurred under the conditions of water use development prevailing in the Saskatchewan portion of the Souris River basin prior to construction of the Boundary Dam, Rafferty Dam, and Alameda Dam.

   Under certain conditions, a portion of the North Dakota share will be in the form of evaporation from Rafferty and Alameda Reservoirs. During years when these conditions occur, the minimum amount of flow actually passed to North Dakota will be 40 percent of the annual natural flow volume at the Sherwood Crossing. This lesser amount is in recognition of Saskatchewan's operation of Rafferty Dam and Alameda Dam for flood control in North Dakota and of evaporation as a result of the project.

   a. Saskatchewan will deliver a minimum of 50 percent of the annual natural flow volume at the Sherwood Crossing in every year except in those years when the conditions given in (i) or (ii) below apply. In those years, Saskatchewan will deliver a minimum of 40 percent of the annual natural flow volume at the Sherwood Crossing.

      i. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 486.095 metres (1594.8 feet); or

      ii. The annual natural flow volume at Sherwood Crossing is greater than 50 000 cubic decametres (40,500 acre-feet) and the current year June 1 elevation of Lake Darling is greater than 485.79 metres (1593.8 feet), and since the last occurrence of a Lake Darling June 1 elevation of greater than 486.095 metres (1594.8 feet) the elevation of Lake Darling has not been less than 485.79 metres (1593.8 feet) on June 1.

   b. Notwithstanding the annual division of flows that is described in (a), in each year Saskatchewan will, so far as is practicable as determined by the Board, deliver to North Dakota prior to June 1, 50 percent of the first 50 000 cubic decametres (40,500 acre-feet) of natural flow which occurs during the period January 1 to May 31. The intent of this division of flow is to ensure that North Dakota receives 50 percent of the rate and volume of flow that would have occurred in a state of

nature to try to meet existing senior water rights.

c. Lake Darling Reservoir and the Canadian reservoirs will be operated (insofar as is compatible with the Projects' purposes and consistent with past practices) to ensure that the pool elevations, which determine conditions for sharing evaporation losses, are not artificially altered. The triggering elevation of 485.79 metres (1593.8 feet) for Lake Darling Reservoir is based on existing water uses in North Dakota, including refuges operated by the U.S. Fish and Wildlife Service. Each year, operating plans for the refuges on the Souris River will be presented to the Board. Barring unforeseen circumstances, operations will follow said plans during each given year. Lake Darling Reservoir will not be drawn down for the sole purpose of reaching the elevation of 485.79 metres (1593.8 feet) on June 1.

   Releases will not be made by Saskatchewan Watershed Authority from the Canadian reservoirs for the sole purpose of raising the elevation of Lake Darling Reservoir above 486.095 metres (1594.8 feet) on June 1.

d. Flow releases to the United States should occur (except in flood years) in the pattern which would have occurred in a state of nature. To the extent possible and in consideration of potential channel losses and operating efficiencies, releases from the Canadian dams will be scheduled to coincide with periods of beneficial use in North Dakota. Normally, the period of beneficial use in North Dakota coincides with the timing of the natural hydrograph, and that timing should be a guide to releases of the United States portion of the natural flow.

e. A determination of the annual apportionment balance shall be made by the Board on or about October 1 of each year. Any shortfall that exists as of that date shall be delivered by Saskatchewan prior to December 31.

f. The flow release to the United States may be delayed when the State of North Dakota determines and notifies Saskatchewan through the Board that the release would not be of benefit to the State at that time. The delayed release may be retained for use in Saskatchewan, notwithstanding the 0.113 cubic metre per second (4 cubic feet per second) minimum flow limit, unless it is called for by the State of North Dakota through the Board before October 1 of each year. The delayed release shall be measured at the point of release and the delivery at Sherwood Crossing shall not be less than the delayed release minus the conveyance losses that would have occurred under natural conditions between the point of release and the Sherwood Crossing. Prior to these releases being made, consultations shall occur between the Saskatchewan Watershed Authority, the U.S. Fish and Wildlife Service, and the State of North Dakota. All releases will be within the specified target flows at the control points.

2. Except as otherwise provided herein with respect to delivery of water to the Province of Manitoba, the State of North Dakota shall have the right to divert, store, and use the waters which originate in the North Dakota portion of the Souris River basin together with the waters delivered to the State of North Dakota at the Sherwood Crossing under Recommendation (1) above; provided, that any diversion, use, or storage of Long Creek water shall not diminish the annual flow at the eastern crossing of Long Creek into Saskatchewan below the annual flow of said Creek at the western crossing into North Dakota.

3. (a) In addition to the waters of the Souris River basin which originate in the Province of Manitoba, that Province shall have the right, except during periods of severe drought, to receive for its own use and the State of North Dakota shall deliver from any available source during the months of June, July, August, September, and October of each year, six thousand and sixty-nine (6,069) acre-feet of water at the Westhope Crossing regulated so far as practicable at the rate of twenty (20) cubic feet per second except as set forth hereinafter: provided, that in delivering such water to Manitoba no account shall be taken of water crossing the boundary at a rate in excess of the said 20 cubic feet per second.

   (b) In periods of severe drought when it becomes impracticable for the State of North Dakota to provide the foregoing regulated flows, the responsibility of the State of North Dakota in this connection shall be limited to the provision of such flows as may be practicable, in the opinion of the said Board of Control, in accordance with the objective of making water available for human and livestock consumption and for household use. It is understood that in the circumstances contemplated in this paragraph the State of North Dakota will give the earliest possible advice to the International Souris River Board of Control with respect to the onset of severe drought conditions.

4. In event of disagreement between the two sections of the International Souris River Board of Control, the matters in controversy shall be referred to the Commission for decision.

5. The interim measures for which provision is herein made shall remain in effect until the adoption of permanent measures in accordance with the requirements of questions (1) and (2) of the Reference of January 15, 1940, unless before that time these interim measures are qualified or modified by the Commission.

# APPENDIX D

# Board Directive from January 18, 2007

## DIRECTIVE TO THE INTERNATIONAL SOURIS RIVER BOARD

The International Souris River Board was created by the International Joint Commission in April 2000 when it amalgamated the Souris River basin responsibilities previously assigned to the Commission in two separate references by the governments of Canada and the United States. The two references were the International Souris River Board of Control Reference (1959) and the Souris-Red Rivers Engineering Board Reference (1948). The International Souris River Board's mandate changed further through an exchange of diplomatic notes on June 9, 2005 assigning water quality functions and the oversight for flood forecasting and operations as described in Section 4 below. The consolidation of water quantity, water quality, and the oversight for flood forecasting and operations is a step in the evolution of the International Souris River Board as it moves towards an integrated approach to transboundary water issues in the Souris River basin.

This directive replaces the April 11, 2002 Directive to the International Souris River Board and sets out the mandate under which the Board will operate.

1. Pursuant to the Boundary Waters Treaty of 1909 and related agreements, responsibilities have been conferred on the Commission to ensure compliance with apportionment measures for the waters of the Souris River, to investigate and report on water requirements and uses as they impact the transboundary waters of the Souris River basin, and to assist in the implementation and review of the Joint Water Quality Monitoring Program pursuant to the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin.

2. The apportionment measures derive from the approvals given by the governments of Canada and the United States, by letters of March 20, 1959 and April 3, 1959 respectively, to the recommendations made by the Commission in paragraph 22 of its report to the governments of March 19, 1958. Subsequently, with the signing of the Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin on October 26, 1989 (hereafter referred to as the 1989 Agreement), the Interim Measures for apportionment of the Souris River at the Saskatchewan-North Dakota boundary were revised as described in Annex B of the 1989 Agreement. By letters of February 28, 1992, the Commission was requested to monitor compliance with the measures as modified in the 1989 Agreement. By letters of December 20 and 22, 2000, the governments amended Annex B of the 1989 Agreement. The attached Appendix A is a consolidation of the apportionment measures against which the Commission is to monitor compliance.

3. By letters of January 12, 1948, the governments requested the Commission to undertake investigations of water requirements and uses arising out of existing dams and other works or projects in the mid-continent portion of the Canada-United States boundary, including the Souris River basin, and to make advisory recommendations.

4. By exchange of diplomatic notes between the governments of Canada and the United States dated January 14 and June 9, 2005, the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin was formally revised to include a reference pursuant to Article IX of the Boundary Waters Treaty which assigned water quality responsibilities contained in the 1989 Agreement to the Commission. The Commission was requested to assist with the implementation and review of the Joint Water Quality Monitoring Program. On October 21, 2005 at the October 2005 Commission's meeting with governments, the U.S. State Department read a statement into the Commission's formal record that the U.S. State Department is of the opinion the Commission has the authority and has obtained the notification it needs from the U.S. State Department to proceed with carrying out the flood related responsibilities for the Souris River. On April 6, 2006 at the April 2006 Commission's meeting with governments, the Department of Foreign Affairs and International Trade indicated that the Board should be assigned these responsibilities. It is recognized that Article X of the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River basin designates the entities responsible for operation and maintenance of the improvements mentioned in the 1989 Agreement and that the operations will be in accordance with the Operating Plan shown in Annex A of the 1989 Agreement. The Department of Army is the entity designated responsible for flood operations within the United States. The Government of Saskatchewan is the Canadian entity designated responsible for flood operations within the Canadian Province of Saskatchewan.

5. The Board's mandate is to support the Commission's initiative to explore and encourage the development of local and regional capacity with the objective of preventing and resolving transboundary disputes regarding the waters and aquatic ecosystem of the Souris River and its tributaries and aquifers. This would 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 Souris River basin. The Board's mandate will be accomplished by performing the tasks identified in Clause 6 below.

6. The Board's duties shall be to:

   (i) Maintain an awareness of existing and proposed developments, activities, conditions, and issues in the Souris River basin that may have an impact on transboundary water levels, flows, water quality, and aquatic ecosystem health and inform the Commission about existing or potential transboundary issues.

   (ii) Oversee the implementation of compliance with the Interim Measures As Modified For Apportionment of the Souris River as described in Appendix A of this document by:
   - identifying an adequate hydro-climatic monitoring network to support the determination of natural flow and apportionment balance,
   - encouraging the appropriate authorities to establish and maintain hydro-climatic monitoring and information collection networks and reporting

systems to ensure suitable information is available as required for the determination of natural flow and apportionment balance,

- informing the Commission, in a timely manner, of critical water supply or flow conditions in the basin,
- encouraging appropriate authorities to take steps to ensure that apportionment measures are met, and
- preparing an annual report and submitting it to the Commission.

(iii) Assist the Commission in the review of a Joint Water Quality Monitoring Program (referred to hereafter as "the Program") by:

- developing recommendations on the Program and the setting of water quality objectives,
- exchanging data provided by the Program on a regular basis,
- collating, interpreting, and analyzing the data provided by the Program,
- reviewing the Program and the water quality objectives at least every five years and developing recommendations, as appropriate, to the Commission to improve the Program and the objectives, and
- preparing an annual report containing:
  - a summary of the principal activities of the Board during the year with respect to the Program,
  - a summary of the principal activities affecting water quality in the Souris River Basin during the year,
  - a summary of the collated, interpreted, and analyzed data provided by the Program,
  - a summary of the water quality of the Souris River at the two locations at which it crosses the International Boundary,
  - a section summarizing any definitive changes in the monitored parameters and the possible causes of such changes,
  - a section discussing the water quality objectives for the Souris River at the Saskatchewan/North Dakota boundary and at the North Dakota/Manitoba boundary as established and revised pursuant to the 1989 Agreement,
  - a section summarizing other significant water quality changes and the possible causes of such changes, and
  - recommendations on new water quality objectives or on how existing water quality objectives can be met, including suggestions on water quality as it relates to water quantity during periods of low flow, in the event that the annual report indicates that the water quality objectives have not been attained as a result of activities pursued under the 1989 Agreement.

(iv) Perform an oversight function for flood operations in cooperation with the designated entities identified in the 1989 Canada-United States Agreement for Water Supply and Flood Control in the Souris River Basin by:

- ensuring mechanisms are in place for coordination of data exchange, flood forecasts and communications related to flood conditions and operations;
- determining whether the operations under the 1989 Agreement should proceed based on the Flood Operation or Non-Flood Operation of the Operating Plan, which is Annex A to the 1989 Agreement, using its criteria and informing designated agencies of this determination;
- reporting to the Commission on any issues related to flood operations and management; and
- providing the Commission and the designated entities under the 1989 Agreement recommendations on how flood operations and coordination activities could be improved.

(v) Report on aquatic ecosystem health issues in the watershed, regularly informing the Commission on the state and implications of aquatic ecosystem health, and encourage the appropriative authorities to establish and maintain water quality and other monitoring and information collection networks and reporting systems to ensure suitable information is available as required for the determination of the health of the aquatic ecosystem.

(vi) Carry out such other studies or activities as the Commission may, from time to time, request.

(vii) Prepare an annual work plan including both routine board activities and new initiatives planned to be conducted in the subsequent year. The work plan shall be submitted annually to IJC for review.

7. The Board shall provide opportunities for the public to be involved in its work, including at least one public meeting in the basin each year.

8. The Board shall coordinate and collaborate with other agencies and institutions both within and outside the Souris River basin as may be needed or desirable, and facilitate the timely dissemination of pertinent information within the basin. The Board shall keep the Commission informed of these activities.

9. The Board shall have an equal number of members from each country. The Commission shall normally appoint each member for a three-year term. Appointments may be renewed for additional terms. Members shall act in their personal and professional capacity, and not as representatives of their countries, agencies or institutions. The Commission shall appoint Canadian and United States co-chairs of the Board and will strive to appoint chairs with complementary expertise that encompasses a broad spectrum of basin issues.

10. The co-chairs of the Board shall be responsible for maintaining proper liaison between the Board and the Commission, and among the Board members.

11. The co-chairs shall ensure that members of the Board are informed of all instructions, inquiries, and authorizations received from the Commission and also of activities undertaken by or on behalf of the Board, progress made, and any developments affecting such progress.

12. The co-chairs may appoint secretaries of the Board who, under the general supervision of the co-chairs, shall carry out such duties as are assigned by the co-chairs or the Board as a whole.

13. The Board may establish such committees and working groups as may be required to fulfill its responsibilities in a knowledgeable and effective manner. The Commission shall be kept informed of the duties and composition of any committee or working group.

14. Unless other arrangements are made with the Commission, members of the Board, committees, or working groups shall make their own arrangements for reimbursement of necessary expenditures for travel or other related expenses.

15. The Board shall inform the Commission in advance of plans for any meetings, or other means of involving the public in Board deliberations, and shall report to the Commission, in a timely manner, on these and any other presentations or representations made to the Board.

16. The Board shall conduct its public outreach activities in accordance with the Commission's public information policies and shall maintain files in accordance with the Commission policy on segregation of documents.

17. Prior to their release, 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.

18. The Board shall submit an annual report covering all of its activities, including the annual report regarding the Program and the work plan, as described in Section 6 above, to the Commission, at least three weeks in advance of the Commission's fall semi-annual meeting, and the Board shall submit other reports as the Commission may request or the Board may feel appropriate in keeping with this Directive. Reports shall be submitted in a format suitable for public release and electronic copies shall be provided to each of the Commission's section offices.

19. Reports, including annual reports, minutes 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. The Board shall provide minutes of Board meetings to the Commission within 45 days of the close of the meeting in keeping with the Commission's April 2002 Policy Concerning Public Access to Minutes of Meetings. The minutes will subsequently be put on the Commission's web site.

20. 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.

21. The Board shall operate by consensus. In the event of any disagreement among the members of the Board which they are unable to resolve, the Board shall refer the matter forthwith to the Commission for decision.

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

Signed this 18th day of January, 2007

Elizabeth Bourget
Secretary
United States Section

Murray Clamen
Secretary
Canadian Section

# APPENDIX E

## Water Quality Data for Sherwood and Westhope

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2013
STATION 05114000 SHERWOOD USGS

| WATER QUALITY PARAMETERS | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA* Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTION |
|---|---|---|---|---|---|---|---|
| **Biological Parameters** | | | | | | | |
| Fecal Coliform | 200/100 ml | #/100 ml | 30 (8,300-<1) 196 | NDA | 0 | | |
| | | | | | | | |
| **Inorganic Parameters** | | | | | | | |
| Ammonia (un-ionized as N) | **** | mg/L | 0.001 (0.025-<0.001) 214 | NDA | 0 | | |
| Chloride | 100 | mg/L | 44 (220-4) 339 | 19.0 (33.1-12.7)8 | 0 | | |
| Fluoride | 1.5 | mg/L | 0.2 (1.8-<0.1) 337 | 0.17 (0.25-0.16)6 | 0 | | |
| $NO_2$ + $NO_3$(as N) dissolved | 1.0 | mg/L | 0.05 (1.4-<0.01) 301 | 0.16 (0.41-<0.04) 8 | 0 | | |
| Phosphorus(total P) | 0.10 | mg/L | 0.19(1.9-0.02)378 | 0.26 (0.33-0.15) 8 | 100 | | |
| Sodium | 100 | mg/L | 120 (532-14) 337 | 103.95 (154-69.5)8 | 50 | | |
| Sulfate | 450 | mg/L | 232 (1,000-45) 339 | 346 (381-192)8 | 0 | | |
| | | | | | | | |
| Arsenic (total) | 50 | µg/L | <5.0 (28.3-<0.1) 174 | 5.4 (6.5-3.2)8 | 0 | | |
| Barium(total) | 1,000 | µg/L | 58.9 (300-14.7)173 | 97.65 (111-81.6) 8 | 0 | | |
| Boron(total) | 500 | µg/L | 200 (3,500-40) 171 | 151 (320-100) 8 | 0 | | |
| Beryllium(total) | 100 | µg/L | <10 (43.5-<0.02) 173 | 0.085 (0.11-<0.02) 8 | 0 | | |
| Cadmium(total) | ***27 | µg/L | <1 (<2-<0.014) 172 | 0.0695 (0.109-0.021) 8 | 0 | | |
| Chromium(total) | 50 | µg/L | <1(30-<0.3) 172 | 1.4 (2.4-0.61) 8 | 0 | | |
| Cobalt(total) | 50 | µg/L | 0.876 (2-0.25) 172 | 1.3 (1.6-0.35) 8 | 0 | | |
| Copper(total) | ***30 | µg/L | 2.35 (20-<1) 166 | 3.4 (4.8-1.58 | 0 | | |
| Iron(total) | 300 | µg/L | 583 (10,000-<16) 181 | 1,860 (3,010-535)8 | 100 | | |

***based on hardness of 300 mg/L
****unionized ammonia is calculated using temperature and pH
NDA: No Data Available
NC: Not Calculated

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2013
05114000 SHERWOOD USGS

| WATER QUALITY PARAMETER | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTIONS |
|---|---|---|---|---|---|---|---|
| Lead(total) | ***13 | µg/L | <1 (4.54-0.1) 167 | 1.235 (2.0-0.31) 8 | 0 | | |
| Mercury | 0.5 ug/g in fish flesh | µg/g | NDA | NDA | NDA | | |
| Molybdenum(total) | 10 | µg/L | 2.76 (45-0.48) 173 | 5.08 (15.4 -3.2) 8 | 12.5 | | |
| Nickel(total) | ***220 | µg/L | 4 (17-<1) 187 | 5.4 (7.2-3.4) 8 | 0 | | |
| Selenium(total) | 5 | µg/L | <1(7 -<0.4) 175 | 0.796 (2.36-0.383) 8 | 0 | | |
| Zinc(total) | 30 | µg/L | 8.8 (620-<2) 221 | 7.85 (10.3-<3) 8 | 0 | | |
| | | | | | | | |
| **Miscellaneous** | | | | | | | |
| | | | | | | | |
| Total Dissolved Solids | 1,000 | mg/L | 727 (2,310-159) 235 | 784 (927-503) 8 | 50 | | |
| Total Suspended Solids | the lesser of 10 mg/L or 10% over ambient | mg/L | 15(132-<1) 215 | 73 (132-<15) 8 | 100 | | |
| pH (range) | 8.5-6.5 | standard units | 8.1 (9.2-6.9) 456 | 8.1 (8.3-7.1) 8 | 0 | | |
| Dissolved Oxygen (conc.) | >5.0 | mg/L | 8.0 (19.4-0.0) 444 | 8.5 (12.4-7.3) 9 | 0 | | |
| Aesthetics | | visual | NDA | NDA | NDA | | |
| Oil and Grease | | visual | NDA | NDA | NDA | | |
| | | | | | | | |

*** based on a hardness of 300 mg/L
NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER NORTH DAKOTA/SASKATCHEWAN BOUNDARY 2013
STATION 05114000 SHERWOOD USGS

| WATER QUALITY PARAMETER | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Organic Parameters** | | | | | | | |
| Atrazine | 2 | µg/L | <0.05(0.03-<0.001)19 | 0.00325(0.0060-<0.0022)7 | 0 | | |
| Bromoxynil | 5 | µg/L | NDA | Below Detection Limit | 0 | | |
| Carbaryl | 90 | µg/L | <0.003(<0.003)17 | Below Detection Limit | 0 | | |
| Chlordane | 0.0043 | µg/L | <0.10(0.10-<0.10)40 | NDA | 0 | | |
| DDT | 0.001 | µg/L | <0.01(0.02-<0.01)40 | NDA | 0 | | |
| Dieldrin | 0.0019 | µg/L | <0.01(0.03-<0.01)40 | NDA | 0 | | |
| Dicamba | IN DEVELOPMENT | µg/L | <0.01(<0.01)10 | Below Detection Limit | 0 | | |
| Diclofop-methyl | IN DEVELOPMENT | µg/L | NDA | NDA | 0 | | |
| Heptachlor | 0.0038 | µg/L | <0.01(0.15-<0.01)40 | NDA | 0 | | |
| MCPA | 0.20 | µg/L | 0.0031(0.0063-<0.0023)7 | 0.0031(0.0063-<0.0023)7 | 0 | | |
| Parathion | 0.04 | µg/L | <0.01(<0.01)47 | Below Detection Limit | 0 | | |
| Picloram | 0.05 | µg/L | <0.01(<0.01)10 | Below Detection Limit | 0 | | |
| Phenols(total) | 1.0 | µg/L | <17(26-<17)217[a] | <7(26-<7)8[b] | NC | | |
| Polychlorinated biphenyl (total) | 0.001 | µg/L | <0.1(0.3-<0.1)39 | NDA | 0 | | |
| Triallate | 0.57 | µg/L | <0.001(0.035-<0.001)17 | Below Detection Limit | 0 | | |
| Trifluralin | 0.10 | µg/L | <0.002(0.084-<0.002)17 | NDA | 0 | | |
| 2,4-D | 4.0 | µg/L | 0.02(0.24-0.0045)33 | 0.0082(0.0099-0.0045)7 | 0 | | |
| | | | | | | | |

NDA: No Data Available
NC: Not calculated
< symbol represents samples where parameter was below the reporting limit.
[a] Due to the difficulty involved in phenol analysis, the historic data was resensored to the highest detection limit that occurred during the period of record (<17). During this time detection limits have varied between <1 and <17. Values recorded above the method detection limit specific to each sample range from 1 to 26 during the period of record.
[b] Annual phenol data was also resensored to the highest detection limit that occurred during 2013 (<7).

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY 2013
00US05NF0001 WESTHOPE

| WATER QUALITY PARAMETERS | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA* Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTION |
|---|---|---|---|---|---|---|---|
| **Biological Parameters** | | | | | | | |
| Fecal Coliform | 200/100 ml | #/100 ml | <10 (2,300-<2) 436 | <2 (300-<2) 7 | 12.5 | | |
| | | | | | | | |
| **Inorganic Parameters** | | | | | | | |
| Ammonia (un-ionized as N) | **** | mg/L | 0.004 (0.433-0) 209 | 0.0035 (0.021-0.002) 7 | 0 | | |
| Chloride | 100 | mg/L | 289 (297-1.2) 573 | 21.25 (83.8-13) 8 | 0 | | |
| Fluoride | 1.5 | mg/L | 0.2 (0.98-<0.01) 620 | 0.155 (0.23-0.08)8 | 0 | | |
| $NO_2$ + $NO_3$(as N) dissolved | 1.0 | mg/L | <0.01 (1.11-<0.01) 207 | 0.032 (0.183-0.01) 8 | 0 | | |
| Phosphorus(total P) | 0.10 | mg/L | 0.31(4.52-0.09) 204 | 0.3415 (0.498-0.091) 8 | 87.5 | | |
| Sodium | 100 | mg/L | 115 (1040-6.4) 818 | 110.55 (319-58.3) 8 | 50 | | |
| Sulfate | 450 | mg/L | 190 (3490-4.8) 819 | 287.5 (694-189) 8 | 12.5 | | |
| | | | | | | | |
| Arsenic (total) | 50 | µg/L | 4.2 (33.4-0.5) 384 | 5.18 (5.93-3.26) 8 | 0 | | |
| Barium(total) | 1,000 | µg/L | 97 (631-32.3) 290 | 82.55 (165-64.4) 8 | 0 | | |
| Boron(total) | 500 | µg/L | 223 (2080-<2) 385 | 177.5 (286-119) 8 | 0 | | |
| Beryllium(total) | 100 | µg/L | 0.05 (<0.5-0.004) 174 | 0.017 (0.027-0.004) 8 | 0 | | |
| Cadmium(total) | ***27 | µg/L | 0.1 (1-0.006) 325 | 0.014 (0.036-0.008) 8 | 0 | | |
| Chromium(total) | 50 | µg/L | <0.734(2.36-0.01) 172 | 0.15 (0.42-0.08) 8 | 0 | | |
| Cobalt(total) | 50 | µg/L | <1 (9-0.172) 293 | 0.2855 (0.597-0.217) 8 | 0 | | |
| Copper(total) | ***30 | µg/L | 2 (38-0.41) 324 | 1.27 (1.99-0.64) 8 | 0 | | |
| Iron(total) | 300 | µg/L | 132 (14,500-<7) 352 | 138 (682-45.7) 8 | 12.5 | | |

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY 2013
00US05NF0001 WESTHOPE

| WATER QUALITY PARAMETER | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTIONS |
|---|---|---|---|---|---|---|---|
| Lead(total) | ***13 | µg/L | 1.1 (6.7-0.065) 322 | 0.1425 (0.454-0.058) 8 | 0 | | |
| Mercury | 0.5 ug/g in fish flesh | µg/g | (35.2 max) | NDA | NDA | | |
| Molybdenum(total) | 10 | µg/L | 2.7 (24.7-0.591) 171 | 2.865 (5.32 -1.64) 8 | 0 | | |
| Nickel(total) | ***220 | µg/L | 3.19 (2-1.6) 326 | 2.775 (5.15-2.49) 8 | 0 | | |
| Selenium(total) | 5 | µg/L | 0.39(32 -<0.05) 383 | 0.725 (1.55-0.33) 8 | 0 | | |
| Zinc(total) | 30 | µg/L | 2.28 (32-0.3) 319 | 0.75 (2.7-0.3) 8 | 0 | | |
| | | | | | | | |
| **Miscellaneous** | | | | | | | |
| | | | | | | | |
| Total Dissolved Solids | 1,000 | mg/L | 754 (3821-129) 291 | 732.383 (1634.131-500.385) 8 | 25 | | |
| Total Suspended Solids | the lesser of 10 mg/L or 10% over ambient | mg/L | 15(300-<1) 603 | 3.6 (23.2-1) 8 | 12.5 | | |
| pH (range) | 8.5-6.5 | standard units | 8.3 (9.85-6.8) 488 | 8.17 (8.56-7.62) 8 | 12.5 | | |
| Dissolved Oxygen (conc.) | >5.0 | mg/L | 8.4 (21.6-0.05) 484 | 9.02 (18.8-7.49) 7 | 0 | | |
| Aesthetics | | visual | NDA | NDA | NDA | | |
| Oil and Grease | | visual | NDA | NDA | NDA | | |
| | | | | | | | |

NDA: No Data Available

ANNUAL WATER QUALITY OBJECTIVES SUMMARY
SOURIS RIVER - MANITOBA/NORTH DAKOTA BOUNDARY 2013
00US05NF0001 WESTHOPE

| WATER QUALITY PARAMETER | WATER QUALITY OBJECTIVE | UNITS | HISTORIC DATA Median(max-min)#samples | ANNUAL DATA Median(max-min)#samples | %EXCEEDANCE | TRENDS | POTENTIAL ACTION |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Organic Parameters** | | | | | | | |
| Atrazine | 2 | µg/L | <0.05(2.4-<0.00186) 145 | 0.02735 (0.0464-0.00702) 4 | 0 | | |
| Bromoxynil | 5 | µg/L | <0.0213 (0.202-0.00099) 118 | 0.001335 (0.00557-<0.00133) 4 | 0 | | |
| Carbaryl | 90 | µg/L | NDA | NDA | 0 | | |
| a-Chlordane | 0.0043 | µg/L | <0.003(0.003-<0.00014) 235 | Below Detection Limit | 0 | | |
| g-Chlordane | 0.0043 | µg/L | <0.002(<0.002-<0.00004) 235 | Below Detection Limit | 0 | | |
| DDT | 0.001 | µg/L | <1(<4-<0.00004) 237 | Below Detection Limit | 0 | | |
| Dieldrin | 0.0019 | µg/L | <0.002(<0.002-<0.00018) 273 | Below Detection Limit | 0 | | |
| Dicamba | IN DEVELOPMENT | µg/L | <0.03(0.04551-<0.00073) 155 | 0.005535 (0.011-<0.0089) 4 | 0 | | |
| Diclofop-methyl | IN DEVELOPMENT | µg/L | <0.0452(<0.05-<0.0034) 130 | Below Detection Limit | 0 | | |
| Heptachlor | 0.0038 | µg/L | <0.001(0.004-<0.00014)271 | Below Detection Limit | 0 | | |
| MCPA | 0.20 | µg/L | 0.0575 (0.7-<0.00058) 280 | 0.006555(0.0122-<0.00132)4 | 0 | | |
| Parathion | 0.04 | µg/L | <0.0155(<0.088-<0.0155)25 | NDA | 0 | | |
| Picloram | 0.05 | µg/L | <0.05(<0.2-<0.00033) 219 | 0.0239(0.0462-0.00668) 4 | 0 | | |
| Phenols(total) | 1.0 | µg/L | NDA | NDA | | | |
| Polychlorinated biphenyl (total) | 0.001 | µg/L | <0.00034 (<0.0102-<0.00021) 45 | Below Detection Limit | 0 | | |
| Triallate | 0.57 | µg/L | <0.00864(0.072-0.0013)137 | Below Detection Limit | 0 | | |
| Trifluralin | 0.10 | µg/L | <0.005(0.01-<0.00266)141 | Below Detection Limit | 0 | | |
| 2,4-D | 4.0 | µg/L | <0.03(0.587-<0.00047) 284 | 0.02415(0.0611-0.00275)4 | 0 | | |
| | | | | | | | |

NDA: No Data Available

# APPENDIX F

# Water Quality Monitoring Plan for Sherwood and Westhope

1. Sherwood Monitoring Plan

| Season | No. of Site Visits | No. of Samples Per Year | | | |
|---|---|---|---|---|---|
| | | Dissolved Oxygen | Major Ions | Nutrients | Trace Elements |
| 1 (Mar-Jun) | 2 | 2 | 2 | 2 | 2 |
| 2 (Jul-Oct) | 4 | 4 | 4 | 4 | 4 |
| 3 (Nov-Feb) | 1 | 1 | 1 | 1 | 1 |
| TOTAL | 7 | 7 | 7 | 7 | 7 |

2. Westhope Monitoring Plan

| Season | No. of Site Visits | No. of Samples Per Year | | | | |
|---|---|---|---|---|---|---|
| | | Dissolved Oxygen | Major Ions | Nutrients | Trace Elements | Pesticides |
| 1 (Mar-Jun) | 3 | 3 | 3 | 2 | 3 | 3 |
| 2 (Jul-Oct) | 3 | 3 | 2 | 3 | 2 | 1 |
| 3 (Nov-Feb) | 2 | 2 | 2 | 2 | 2 | |
| TOTAL | 8 | 8 | 7 | 7 | 7 | 4 |