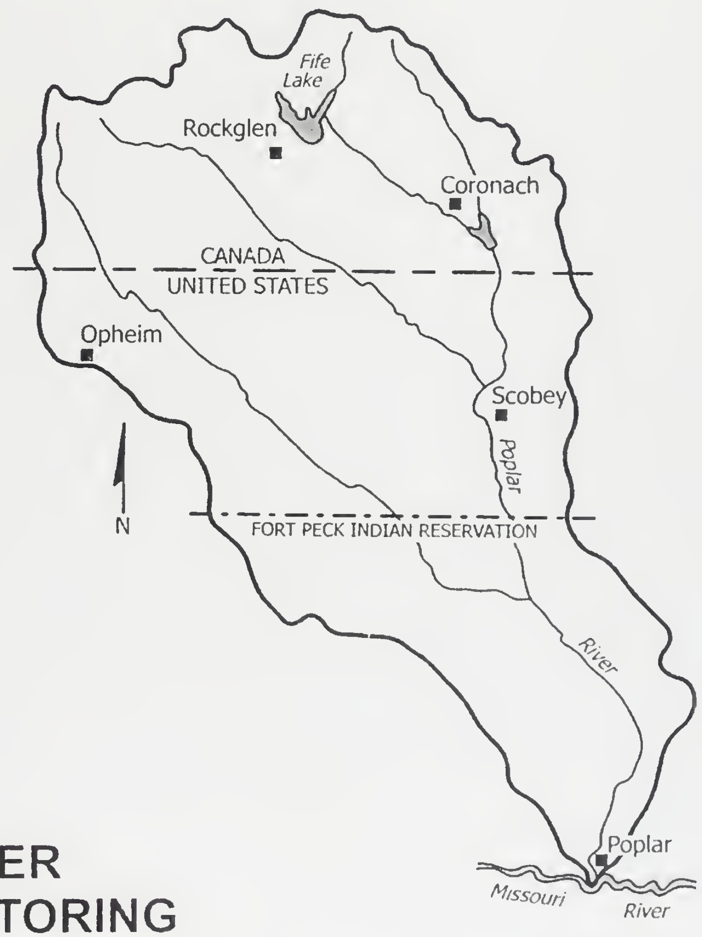
2009 ANNUAL REPORT

to the

GOVERNMENTS OF CANADA, UNITED STATES, SASKATCHEWAN AND MONTANA



by the

POPLAR RIVER BILATERAL MONITORING COMMITTEE

COVERING CALENDAR YEAR 2009

June 2010

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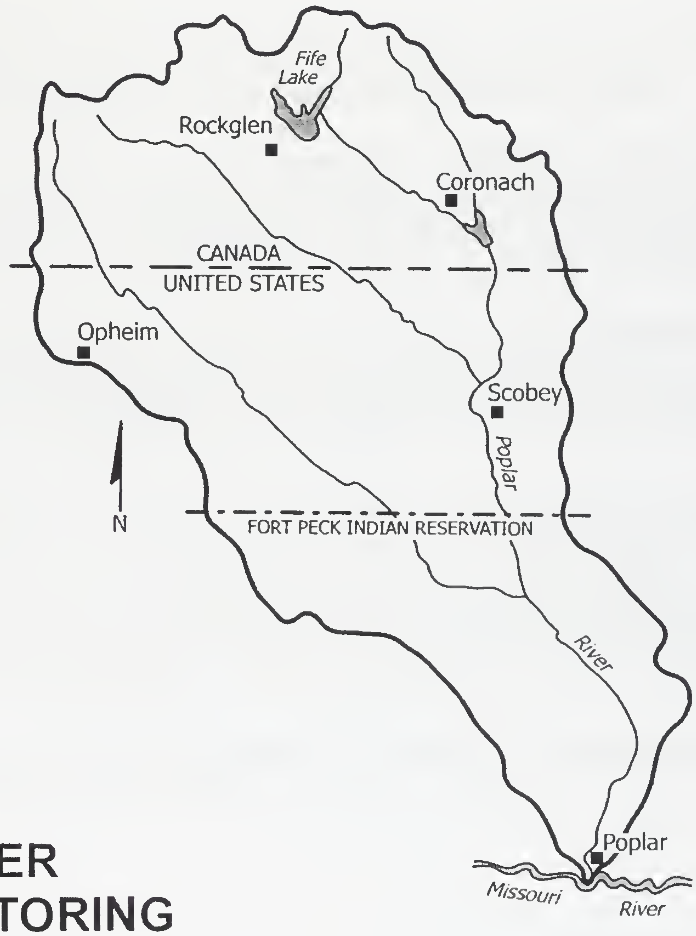

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POPLAR RIVER BILATERAL MONITORING COMMITTEE

COVERING CALENDAR YEAR 2009

June 2010

Poplar River Bilateral Monitoring Committee

Department of State
Washington, D.C., United States

Governor's Office
State of Montana
Helena, Montana, United States

Department of Foreign Affairs
and International Trade Canada
Ottawa, Ontario, Canada

Saskatchewan Environment
Regina, Saskatchewan, Canada

Ladies and Gentlemen:

Herein is the 29th Annual Report of the Poplar River Bilateral Monitoring Committee. This report discusses the Committee activities of 2009 and presents the Technical Monitoring Schedules for the year 2010.

During 2009, the Poplar River Bilateral Monitoring Committee continued to fulfill the responsibilities assigned by the governments under the Poplar River Cooperative Monitoring Agreement dated September 23, 1980. Through exchange of Diplomatic Notes, the Arrangement was extended in March 1987, July 1992, July 1997, March 2002, and April 2007. The Monitoring Committee is currently extended to March 2012.

The enclosed report summarizes current water-quality conditions and compares them to guidelines for specific parameter values that were developed by the International Joint Commission (IJC) under the 1977 Reference from Canada and the United States. After evaluation of the monitoring information for 2009, the Committee finds that the measured conditions meet the recommended objectives.

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

During 2009, monitoring continued in accordance with Technical Monitoring Schedules outlined in the 2008 Annual Report of the Poplar River Bilateral Monitoring Committee.

Yours sincerely,

John M. Kilpatrick
Chairman, United States Section

Thomas Schultz
Member, United States Section

Mike Renouf
Chairman, Canadian Section

Greg Adilman
Member, Canadian Section

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The Poplar River Power Station completed its twenty-sixth full year of operation in 2009. The two 300-megawatt coal-fired units generated 4,503,657 gross megawatts (MW) of electricity. The average capacity factors for Units No. 1 and 2 were 79.5 percent and 83.3 percent, respectively. The capacity factors are based on the maximum generating rating of 315 MW/hour for both Unit No. 1 and Unit No. 2. The scheduled maintenance outage for Unit 1 and 2 were completed in the spring and fall of 2009 so as not to coincide with system peak demand periods that occur over the summer and winter periods.

Monitoring information collected in both Canada and the United States during 2009 was exchanged in the spring of 2010.

The recorded volume of the Poplar River at International Boundary from March 1 to May 31, 2009 was 13,560 dam^3 (11,000 acre-feet). Based on IJC recommendations and the assumption that the recorded flow is the natural flow, the United States was entitled to a minimum discharge on the East Poplar River of 0.085 cubic metres per second (m^3/s) (3.0 cubic feet per second (ft^3/s)) for the period June 1, 2009 to August 31, 2009, and 0.057 m^3/s (2.0 ft^3/s) for the period September 1, 2009 to May 31, 2010. The minimum entitled flow for the period January 1 to May 31, 2009 was 0.028 m^3/s (1.0 ft^3/s), determined on the basis of the Poplar River flow volume for March 1 to May 31, 2008.

Daily flows during 2009 met or exceeded the minimum flow recommended by the IJC for most of the year except for June 12 to July 16 and several periods during January and December when daily flows were below the recommended minimum due to ice conditions in the channel.

In addition to the minimum flow, the IJC apportionment recommendation entitles Montana to an on-demand release to be delivered in the East Poplar River during the twelve-month period commencing June 1. Based on the March 1 to May 31, 2008 runoff volume of 1,400 dam^3 (1,130 acre-feet) recorded at the Poplar River at International Boundary gauging station, Montana was entitled to an additional release of 370 dam^3 (300 acre-feet) from Cookson Reservoir during the succeeding twelve-month period commencing June 1, 2008. Montana requested this release to be made between May 1 and May 31, 2009. A volume of 442 dam^3 (358 acre-feet), in addition to the minimum flow, was delivered during this period.

The 2009 five-year TDS flow-weighted concentrations were below the long-term objective of 1,000 milligrams per litre (mg/L). The maximum monthly five-year flow-weighted concentration value calculated in 2009 was about 987 mg/L, relative to the 2008 level of 992 mg/L. Spring runoff in the Poplar River basin was above normal in 2009 and helped to reduce the TDS concentration to some extent. Boron concentrations for 2009, though based upon a limited number of water-quality samples as is TDS, continued to remain well below the long-term objective of 2.5 mg/L. In 2009, the maximum monthly five-year flow-weighted concentration of Boron was 1.92 mg/L.

1.0 INTRODUCTION

The Poplar River Bilateral Monitoring Committee was authorized for an initial period of five years by the Governments of Canada and the United States under the Poplar River Cooperative Monitoring Arrangement dated September 23, 1980. A copy of the Arrangement is attached to this report as Annex 1. Through exchange of Diplomatic Notes, the Arrangement was extended in March 1987, July 1992, July 1997, March 2002, and April 2007. The Monitoring Committee is currently extended to March 2012. A more detailed account of the historical background of the Monitoring Arrangement is contained in the 1990 Annual Report of the Poplar River Bilateral Monitoring Committee.

The Committee oversees monitoring programs designed to evaluate the potential for transboundary impacts from SaskPower's (formerly Saskatchewan Power Corporation) coal-fired thermal generating station and ancillary operations near Coronach, Saskatchewan. Monitoring is conducted in Canada and the United States at or near the International Boundary for quantity and quality of surface and ground water and for air quality. Participants from both countries, including Federal, State and Provincial agencies, are involved in monitoring.

The Committee submits an annual report to Governments which summarizes the monitoring results, evaluates apparent trends, and compares the data to objectives or standards recommended by the International Joint Commission (IJC) to Governments, or relevant State, Provincial, or Federal standards. The Committee reports to Governments on a calendar year basis. The Committee is also responsible for drawing to the attention of Governments definitive changes in monitored parameters which may require immediate attention.

A responsibility of the Committee is to review the adequacy of the monitoring programs in both countries and make recommendations to Governments on the Technical Monitoring Schedules. The Schedules are updated annually for new and discontinued programs and for modifications in sampling frequencies, parameter lists, and analytical techniques of ongoing programs. The Technical Monitoring Schedules listed in the annual report (Annex 2) are given for the year 2008. The Committee will continue to review and propose changes to the Technical Monitoring Schedules as information requirements change.

2.0 COMMITTEE ACTIVITIES

2.1 Membership

The Committee is composed of representatives of the Governments of the United States of America and Canada, the State Government of Montana, and the Provincial Government of Saskatchewan. In addition to the representatives of Governments, two ex-officio members serve as local representatives for the State of Montana and Province of Saskatchewan.

During 2009, the members of the Committee included: Mr. J. Kilpatrick, U.S. Geological Survey, United States representative and Co-chair; Mr. M. Renouf, Environment Canada, Canadian representative and Co-chair; Mr. T. Schultz, Montana Department of Natural Resources and Conservation, Montana representative; Mr. G. Adilman, Saskatchewan Ministry of Environment, Saskatchewan representative; Mr. C. W. Tande, Daniels County Commissioner, Montana local ex-officio representative; and Mr. D. Kirby, Reeve, R.M. of Hart Butte, Saskatchewan local ex-officio representative.

2.2 Meetings

The Committee met via a conference call on June 26, 2009. Delegated representatives of Governments, with the exception of the ex-officio members from Montana and Saskatchewan, participated in the conference call. In addition to Committee members, other technical advisors representing Federal, State, and Provincial agencies participated in the conference call, as well. Committee members reviewed the operational status of the Poplar River Power Station and associated coal-mining activities; examined data collected in 2008 including surface-water quality and quantity, ground-water quality and quantity, and air quality; discussed proposed changes in the water-quality sampling program; and established the Technical Monitoring Schedules for the year 2010.

2.3 Review of Water-Quality Objectives

The International Joint Commission in its Report to Governments, titled "Water Quality in the Poplar River Basin," recommended that the Committee periodically review the water-quality objectives within the overall Basin context and recommend new and revised objectives as appropriate. In 1991, an action item from the annual Committee meeting set in motion the review and revision of the water-quality objectives.

In 1993, the Committee approved changes in water-quality objectives recommended by the subcommittee that was formed in 1992 to review the objectives. The Committee also discussed the water-quality objectives for 5-year and 3-month flow-weighted concentrations for total dissolved solids and boron. Although the Committee agreed that calculation procedures to determine flow-weighted concentrations are time consuming and probably scientifically questionable, no consensus was reached on alternative objectives or procedures.

In 1997, the Committee agreed to suspend the monitoring and reporting of several parameters. The parameters affected were: dissolved aluminum, un-ionized ammonia, total chromium, dissolved copper, mercury in fish tissues, fecal coliform, and total coliform. The Committee also agreed to other minor revisions for clarification purposes. For example, changing the designation for pH from "natural" to "ambient".

In 1999, the Committee replaced the term "discontinued" with "suspended" in Table 2.1.

In 2001, the Committee suspended the monitoring of dissolved mercury and total copper. This decision to suspend monitoring for these parameters was based on data indicating concentrations or levels well below or within the objectives. Current objectives approved by the Committee are listed in Table 2.1.

The Committee also agreed to periodically review all parameters for which monitoring has been suspended.

Another responsibility of the Committee has included an ongoing exchange of data acquired through the monitoring programs. Exchanged data and reports are available for public viewing at the agencies of the participating governments or from Committee members.

2.4 Data Exchange

The Committee is responsible for assuring exchange of data between governments. The exchange of monitoring information was initiated in the first quarter of 1981 and was an expansion of the informal quarterly exchange program initiated between the United States and Canada in 1976. Until 1991, data were exchanged on a quarterly basis. At the request of the Committee, the United States and Canada agreed to replace the quarterly exchange of data with an annual exchange effective at the beginning of the 1992 calendar year. Henceforth, data will be exchanged once each year as soon after the end of the calendar year as possible. However, unusual conditions or anomalous data will be reported and exchanged whenever warranted. No unusual conditions occurred during 2009 which warranted special reporting.

2.5 Water-Quality Monitoring Responsibilities

Environment Canada has agreed to take responsibility of repairing the continuous water-quality monitor installed at the East Poplar station at the International Boundary. The continuous water-quality monitor records daily specific conductance values which are used in the computation of TDS and boron values to monitor water quality in the East Poplar River. In the absence of regular monthly grab water-quality samples, the Committee has agreed to utilize the data collected by the continuous water-quality monitor for its surface-water-quality monitoring program.

The USGS, in cooperation with the Fort Peck Tribes, collects water-quality samples four times per year to supplement the daily specific conductance data collected by the continuous water-quality monitor.

Funding from the Fort Peck Tribes has been discontinued in 2010 putting the grab sample collection effort by the USGS at jeopardy. The Committee will discuss the issue at its face-to-face meeting on June 22, 2010 in Coronach, Saskatchewan.

Table 2.1 Water-Quality Objectives

Parameter	Original Objective	Recommendation	Current Objective
Boron, total	3.5/2.5[1]	Continue as is	3.5/2.5[1]
TDS	1,500/1,000[1]	Continue as is	1,500/1,000[1]
Aluminum, dissolved	0.1	Suspended*	---
Ammonia, un-ionized	0.02	Suspended*	---
Cadmium, total	0.0012	Continue as is	0.0012
Chromium, total	0.05	Suspended*	---
Copper, dissolved	0.005	Suspended*	---
Copper, total	1	Suspended*	---
Fluoride, dissolved	1.5	Continue as is	1.5
Lead, total	0.03	Continue as is	0.03
Mercury, dissolved	0.0002	Suspended*	---
Mercury, fish (mg/kg)	0.5	Suspended*	---
Nitrate	10	Continue as is	10
Oxygen, dissolved	4.0/5.0[2]	Objective applies only during open water	4.0/5.0[2]
SAR (units)	10	Continue as is	10
Sulfate, dissolved	800	Continue as is	800
Zinc, total	0.03	Continue as is	0.03
Water temperature (C)	30.0[3]	Continue as is	30.0[3]
pH (units)	6.5[4]	Continue as is	6.5[4]
Coliform (no./100 mL)			
Fecal	2,000	Suspended*	---
Total	20,000	Suspended*	---

Units in mg/L except as noted.

1. Five-year average of flow-weighted concentrations (March to October) should be <2.5 boron, <1,000 TDS. Three-month average of flow-weighted concentration should be <3.5 boron and <1,500 TDS.
2. 5.0 (minimum April 10 to May 15), 4.0 (minimum remainder of year - Fish Spawning).
3. Natural temperature (April 10 to May 15), <30 degree Celsius (remainder of year)
4. Less than 0.5 pH units above ambient, minimum pH=6.5.

*Suspended after review of historic data found sample concentrations consistently below the objective. The Committee will periodically review status of suspended objectives.

3.0 WATER AND AIR: MONITORING AND INTERPRETATIONS

3.1 Poplar River Power Station Operation

Saskatchewan Power Corporation operates the Poplar River Power Station near the town on Coronach, Saskatchewan. The Poplar River Power Station is comprised of two lignite-burning power generating units designated Unit No. 1 and Unit No. 2. Unit No. 1 is rated as a 315 MW/hour generating unit and Unit No. 2 is rated as a 315 MW/hour generating unit. Both units share a common 122 meter stack.

In 2009 both units were operated as base load units supplying the maximum production except when system constraint and outages dictated otherwise. The scheduled maintenance outages for Unit No. 1 and Unit No. 2 were completed in the spring and fall of 2009 so as not to coincide with system peak demand periods that occur over the summer and winter periods.

Between January 1 and December 31, Poplar River Power Station generated 4,503,657 MW hours. During this time approximately 3,455,271 tonnes of coal and 3,535 m^3 of fuel oil were consumed. The average capacity factors for Unit No. 1 and Unit No. 2 were 79.5% and 83.3% respectively.

3.2 Surface Water

3.2.1 Streamflow

Streamflow in the Poplar River basin was above normal in 2009. The March to October recorded flow of the Poplar River at International Boundary, an indicator of natural flow in the basin, was 16,420 cubic decametres (dam^3) (13,310 acre-feet), which was 165 percent of the 1931-2008 median seasonal flow of 9,930 dam^3 (8,050 acre-feet). A comparison of 2009 monthly mean discharge with the 1931-2008 median monthly mean discharge is shown in Figure 3.1.

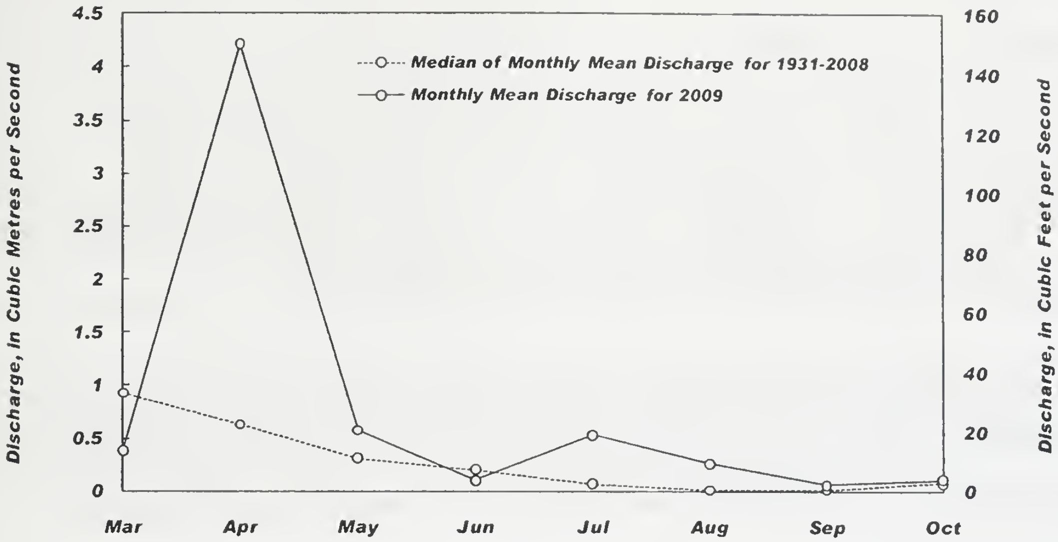


Figure 3.1 Monthly Mean Discharge during 2009 as Compared with the Median Monthly Mean Discharge from 1931-2008 for the Poplar River at International Boundary.

The 2009 recorded flow volume of the East Poplar River at International Boundary was 2,450 dam^3 (1,990 acre-feet). This volume is 91 percent of the median annual flow of 2,680 dam^3 (2,170 acre-feet) for 1976-2008 (since the completion of Morrison Dam).

3.2.2 Apportionment

In 1976 the International Souris-Red Rivers Engineering Board, through its Poplar River Task Force, completed an investigation and made a recommendation to the Governments of Canada and the United States regarding the apportionment of waters of the Poplar River basin. Although the recommendations have not been officially adopted, the Province of Saskatchewan has adhered to the apportionment recommendations. Annex 3 contains the apportionment recommendation.

3.2.3 Minimum Flows

The recorded volume of the Poplar River at International Boundary from March 1 to May 31, 2009 was 13,560 dam^3 (11,000 acre-feet). Based on IJC recommendations and the assumption that the recorded flow is the natural flow, the United States was entitled to a minimum discharge on the East Poplar River of 0.085 cubic metres per second (m^3/s) (3.0 cubic feet per second (ft^3/s)) for the period June 1, 2009 to August 31, 2009, and 0.057 m^3/s (2.0 ft^3/s) for the period September 1, 2009 to May 31, 2010. The minimum entitled flow for the period January 1 to May 31, 2009 was 0.028 m^3/s (1.0 ft^3/s), determined on the basis of the Poplar River flow volume for March 1 to May 31, 2008. A hydrograph for the East Poplar River at International Boundary and the minimum flow as recommended by the IJC are shown in Figure 3.2.

Daily flows during 2009 met or exceeded the minimum flow recommended by the IJC for most of the year except for June 12 to July 16 and several periods during January and December when daily flows were below the recommended minimum due to ice conditions in the channel.

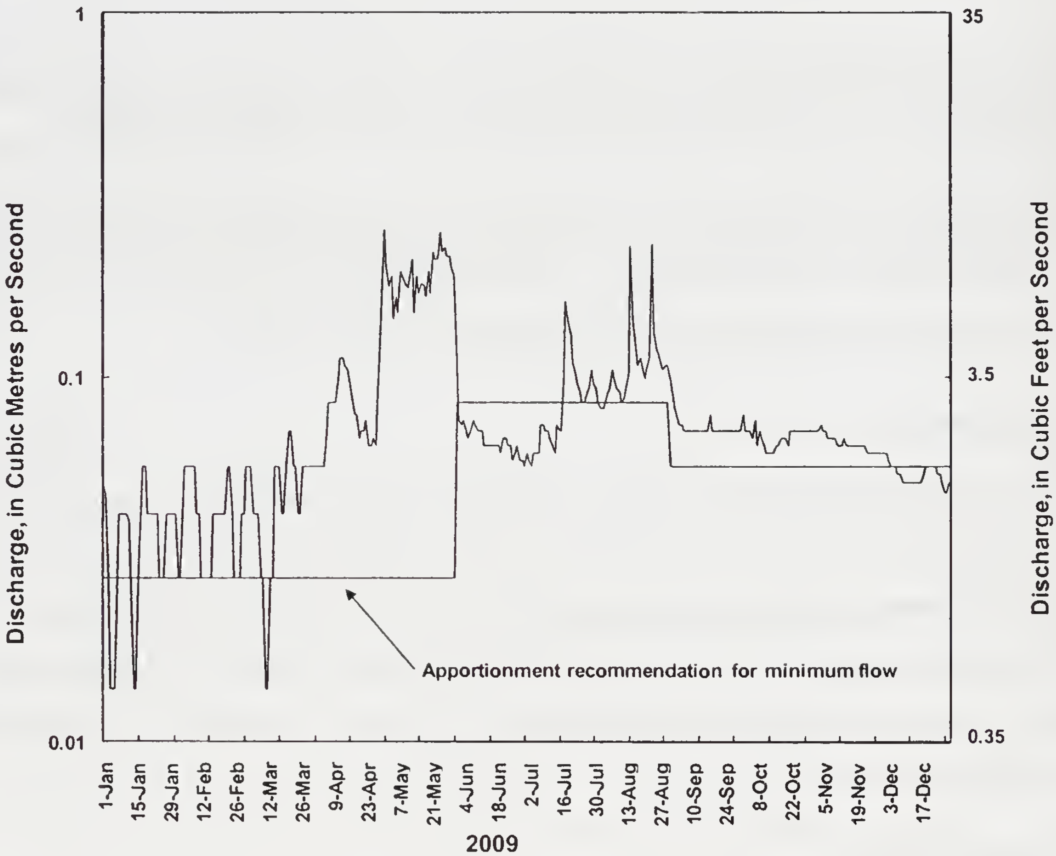


Figure 3.2 Flow Hydrograph of the East Poplar River at International Boundary.

3.2.4 On-Demand Release

In addition to the minimum flow, the IJC apportionment recommendation entitles Montana to an on-demand release to be delivered in the East Poplar River during the twelve-month period commencing June 1. Based on the March 1 to May 31, 2008 runoff volume of 1,400 dam^3 (1,130 acre-feet) recorded at the Poplar River at International Boundary gauging station, Montana was entitled to an additional release of 370 dam^3 (300 acre-feet) from Cookson Reservoir during the succeeding twelve-month period commencing June 1, 2008. Montana requested this release to be made between May 1 and May 31, 2009. A volume of 442 dam^3 (358 acre-feet), in addition to the minimum flow, was delivered during this period. A hydrograph showing cumulative volume of the on-demand release request and on-demand release delivery made at the East Poplar River at International Boundary is shown in Figure 3.3.

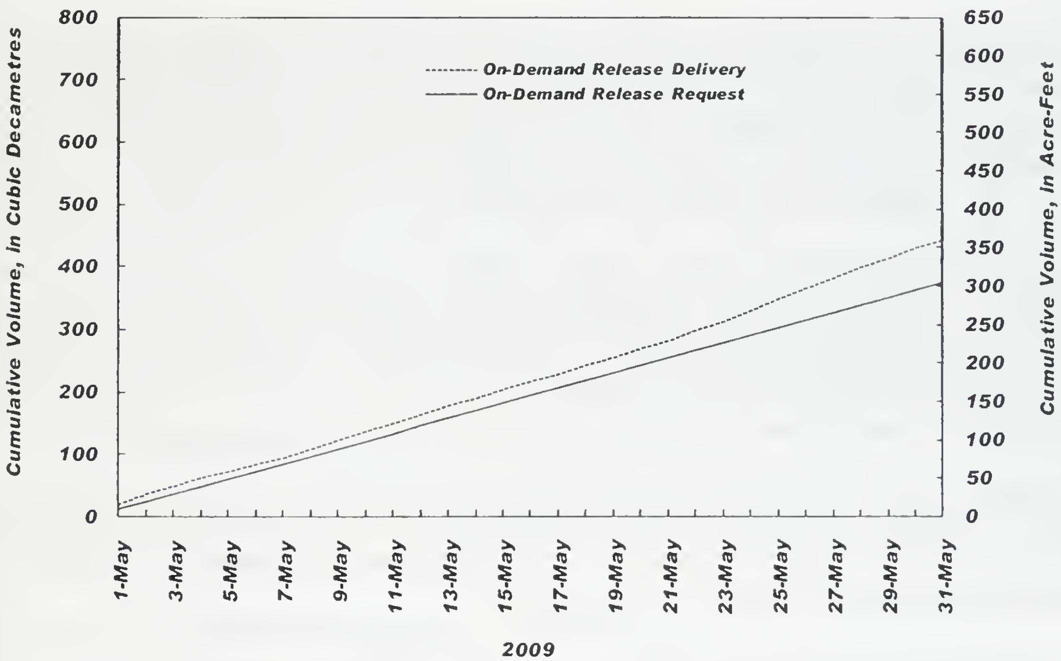


Figure 3.3 Cumulative Volume Hydrograph of On-Demand Release.

3.2.5 Surface-Water Quality

The 1981 report by the IJC to Governments recommended:

For the March to October period, the maximum flow-weighted concentrations should not exceed 3.5 milligrams per litre (mg/L) for boron and 1,500 mg/L for TDS for any three consecutive months in the East Poplar River at the International Boundary. For the March to October period, the long-term average of flow-weighted concentrations should be 2.5 mg/L or less for boron, and 1,000 mg/L or less for TDS in the East Poplar River at the International Boundary.

For the period prior to 1982, the three-month moving flow-weighted concentration (FWC) for boron and total dissolved solids (TDS) was calculated solely from monthly water-quality monitoring results. Since the beginning of 1982, the USGS has monitored specific conductance daily in the East Poplar River at the International Boundary, making it possible to estimate boron and TDS concentrations using a linear regression relationship with specific conductance.

In 2003, the Poplar River Bilateral Monitoring Committee decided to suspend much of the water-quality sampling program until it is warranted again. All surface-water-quality sample collection by Environment Canada has been suspended at the East Poplar River boundary station. The number of samples collected was also reduced. At present, four surface water quality samples are collected and analysed by the USGS per year at the East Poplar River at the International Boundary. The Committee has agreed to use the continuous data collected by the specific-conductance monitor as a surrogate for the monthly water-quality sampling program, except for the four water-quality samples collected for TDS and boron by the USGS in 2009. Hence, the three-month FWC for TDS and boron in 2009 were calculated using the two established equations (shown later in text) and the continuous specific-conductance data collected at the East Poplar River at the International Boundary.

The Bilateral Monitoring Committee adopted the approach that, for the purpose of comparison with the proposed IJC long-term objectives, the boron and TDS data are best plotted as a five-year moving FWC which is advanced one month at a time.

Prior to 1988, long-term averages were calculated for a five-year period in which 2.5 years preceded and 2.5 years followed each plotted point. Beginning in 1988, the FWC was calculated from the 5-year period preceding each plotted point. For example, the FWC for December 2009 is calculated from data generated over the period December 2003 to December 2009. The calculations are based on the results of samples collected throughout the year, and are not restricted to only those collected during the months bracketing the period of irrigation (March to October) each year.

3.2.5.1 Total Dissolved Solids

TDS is inversely related to streamflow at the East Poplar River at the International Boundary station. During periods of high runoff such as spring freshet, TDS decreases as the proportion of streamflow derived from ground water decreases. Conversely, during times of low streamflow (late summer, winter) the contribution of ground water to streamflow is proportionally greater. Because the ground water entering the river has a higher ionic strength than the surface water, the TDS of the stream increases markedly during low-flow conditions.

Measured and estimated TDS concentrations for 2009 for East Poplar River at the International Boundary are shown in Figure 3.4. The TDS concentrations in 2009 ranged from an 866 mg/L on October 15 to 1,122 mg/L on December 15. The three-month moving FWC for TDS for the period of 1990-2009 is presented in Figure 3.5. The short-term TDS objective has not been exceeded during the period of record.

The five-year moving estimated FWC for TDS (Figure 3.6) did not exceed the long-term objective of 1,000 mg/L in 2009. The maximum monthly five-year estimated FWC in 2009 was about 987 mg/L, relative to the 2008 maximum monthly value of 992 mg/L. Dissolved solids concentrations in 2009 were similar to those recorded in 2008. In general, low spring runoff and higher contribution from ground water have kept the TDS level close to the long-term objective of 1,000 mg/L.

The daily TDS values, as estimated by linear regression from the daily specific-conductance readings, for the period January 1990 through December 2009 are shown in Figure 3.7. The figure shows an abrupt drop in estimated TDS corresponding to the snowmelt runoff occurring during the spring of each year.

The relationship between TDS and specific conductance based upon data collected from 1974 to 2003 is as follows:

$$TDS = (0.624613813 \times \text{specific conductance}) + 35.1841527$$
$$(R^2 = 0.84, n = 617)$$

Note: The above equation was used to estimate TDS concentrations for the E. Poplar River at the International Boundary for 2009. These estimates are used in the current annual water-quality report.

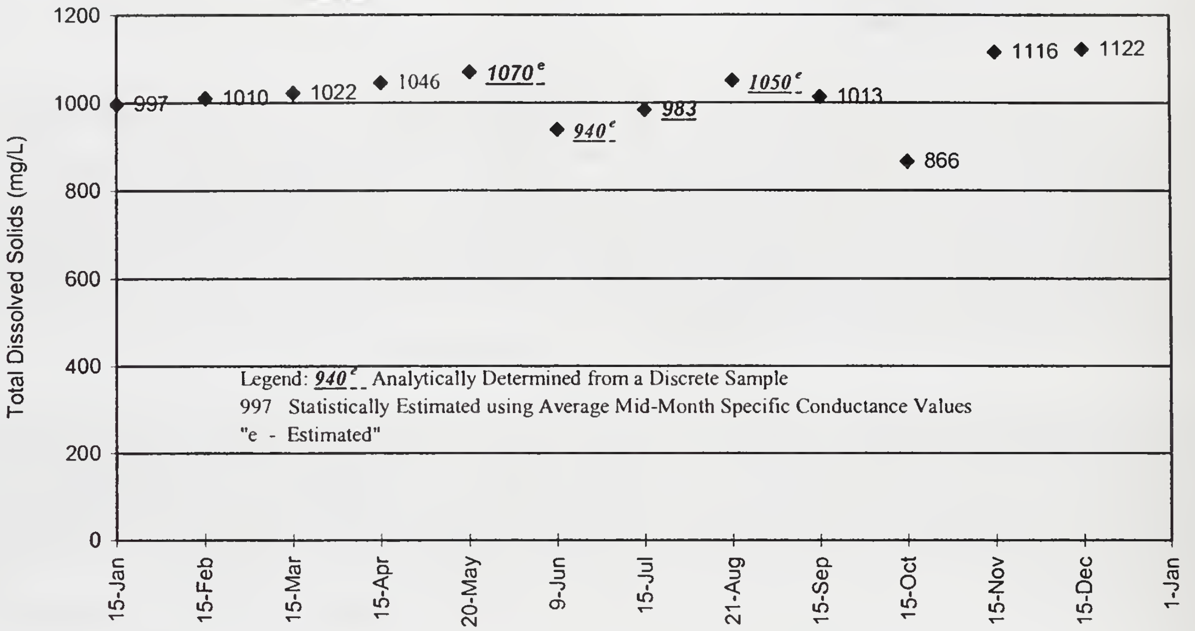


Figure 3.4: Measured and Estimated TDS Concentration for East Poplar River at the International Boundary

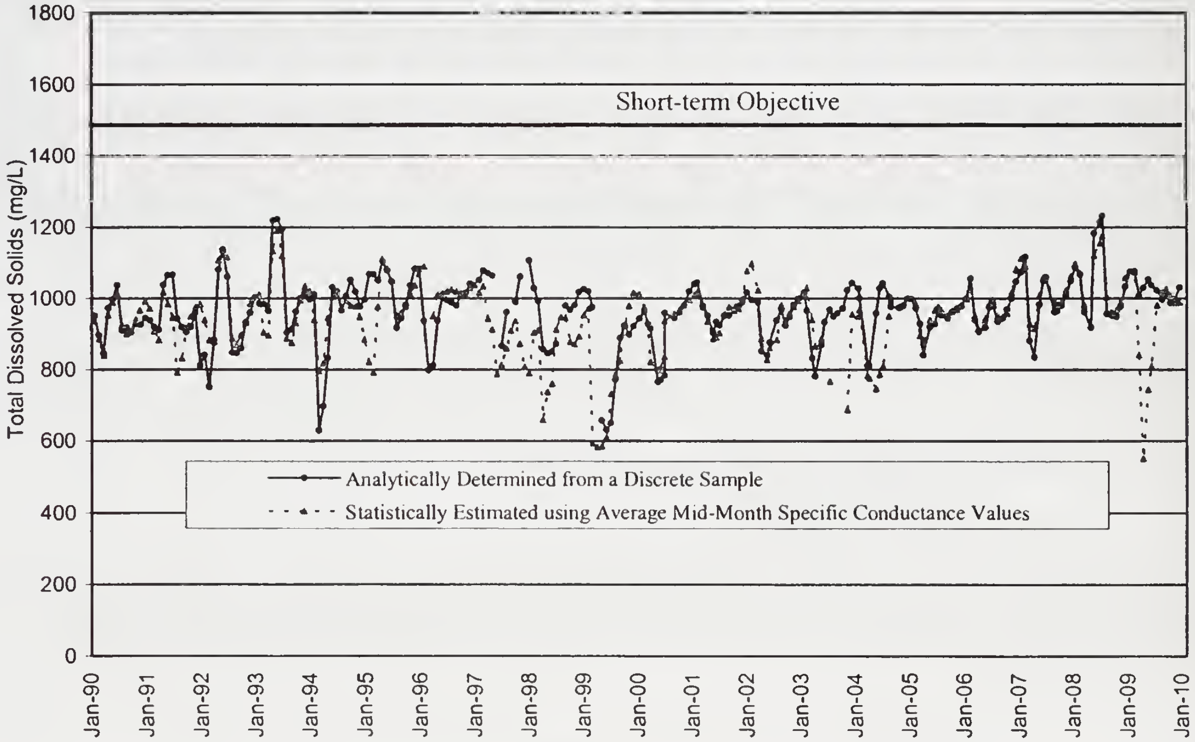


Figure 3.5: Three-Month Moving Flow-Weighted Average Estimated TDS Concentration for East Poplar River at the International Boundary

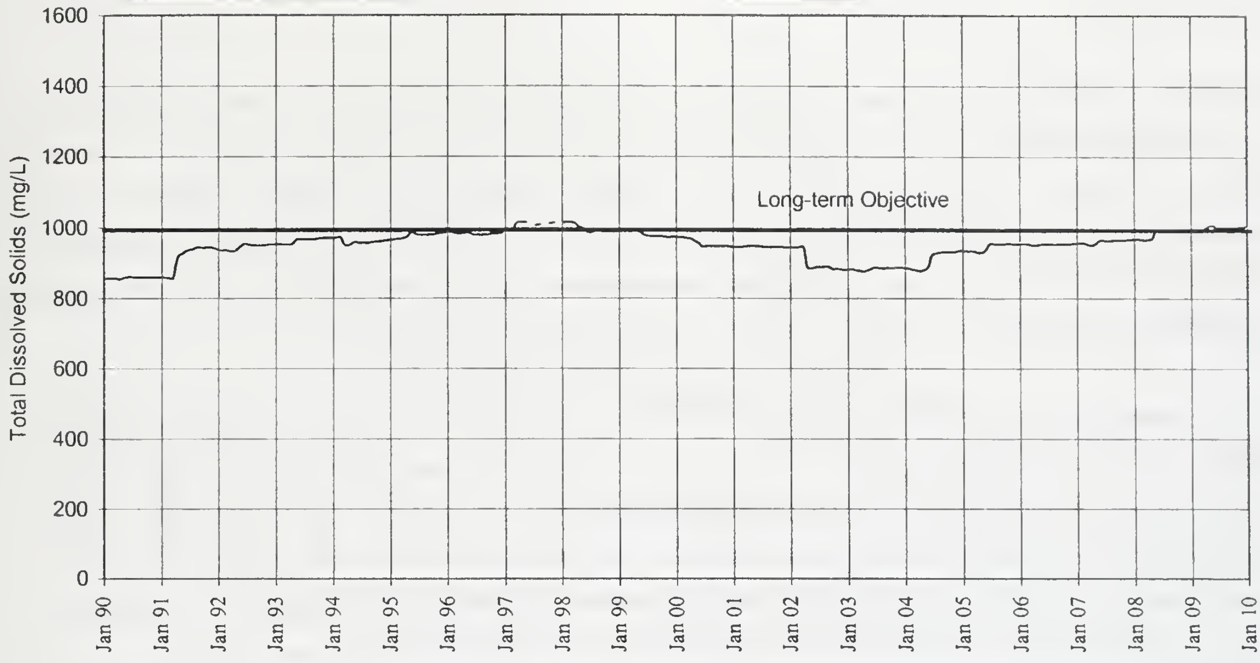


Figure 3.6: Five-Year Moving Flow-Weighted Average Estimated TDS Concentration for East Poplar River at the International Boundary

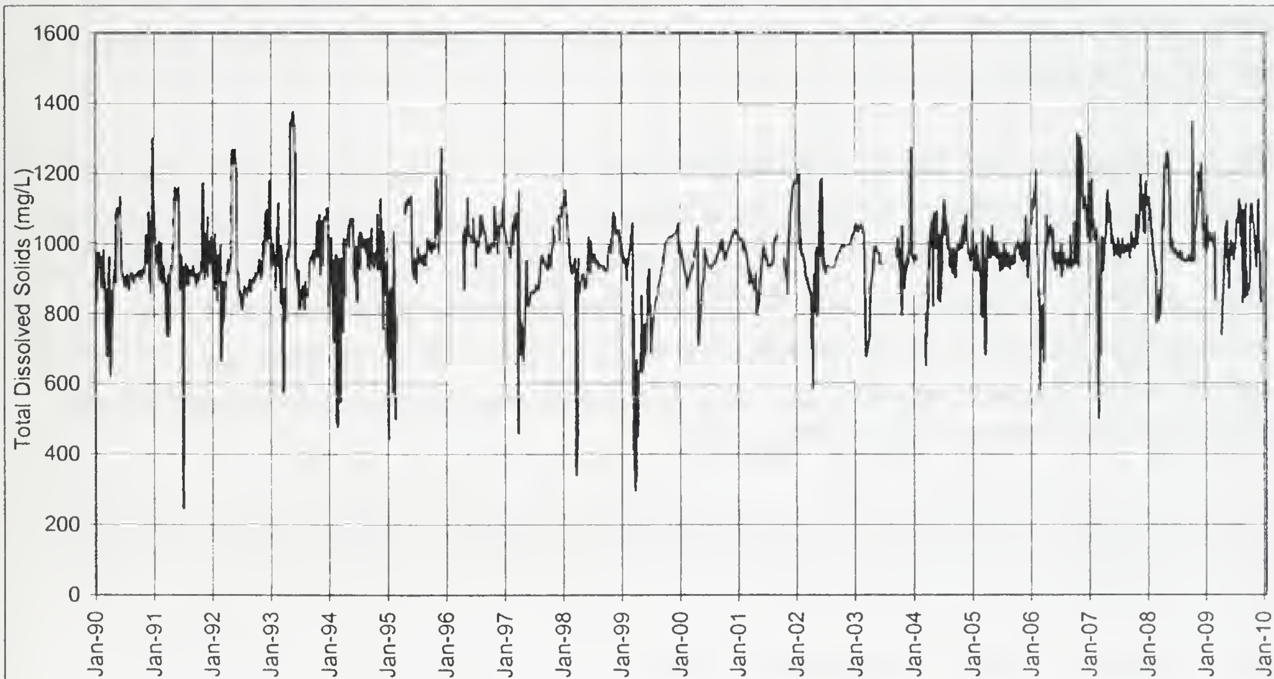


Figure 3.7: Estimated Daily TDS Concentration, 1990 to 2009 East Poplar River at the International Boundary (Statistically Estimated)

3.2.5.2 Boron

Similar to TDS, four water-quality samples were collected by the USGS for boron in 2009. Other boron concentrations presented below were estimated using the boron equation that was developed from water-quality samples collected from 1974-2003 and the daily specific conductance data collected by the specific-conductance monitor. Figure 3.8 shows that during 2009, measured and estimated monthly-mean dissolved boron concentrations in the East Poplar at the International Boundary varied from 1.67 mg/L on October 15 to 2.20 mg/L on December 15.

The 3-month flow-weighted concentration (FWC) for boron for the period of record is shown in Figure 3.9. The short-term objective of 3.5 mg/L has not been exceeded over the period 1975 to 2009. It can be seen that the concentrations measured in water-quality samples and those estimated using regression equations describing a statistical relation between boron concentration and specific conductance are similar, with the highs and lows in some degree of correspondence. This suggests that using regression equations to estimate boron and TDS concentrations based on specific conductance measurements, is in general terms, a valid procedure despite problems which arise from attempting to generate representative concentration and flow data for an entire month, based on a limited number of samples.

The 5-year moving FWC for boron displayed in Figure 3.10 remained well below the long-term objective of 2.5 mg/L.

Boron concentrations are not as well-correlated with specific conductance as TDS. Boron is a relatively minor ion, and does not in itself contribute to a large degree to the total load of dissolved constituents in the water. Accordingly, it appears likely that the standard deviation of dissolved boron (relative to the long-term mean boron concentration) may be greater than that of the major cations (sodium, potassium, and magnesium) and anions (sulphate, bicarbonate, and chloride) around their respective long-term mean concentrations. Daily boron concentrations for the period December 1990 to December 2009 are shown in Figure 3.11.

The relationship between boron and specific conductance applied to data collected from 1974 to 2003 is as follows:

Boron = (0.00129 x specific conductance) - 0.04709 **(R^2 = 0.57, n = 617)**

Note: The above equation was used to estimate boron concentrations for the E. Poplar River at the International Boundary for 2009. These estimates are used in the current annual water-quality report.

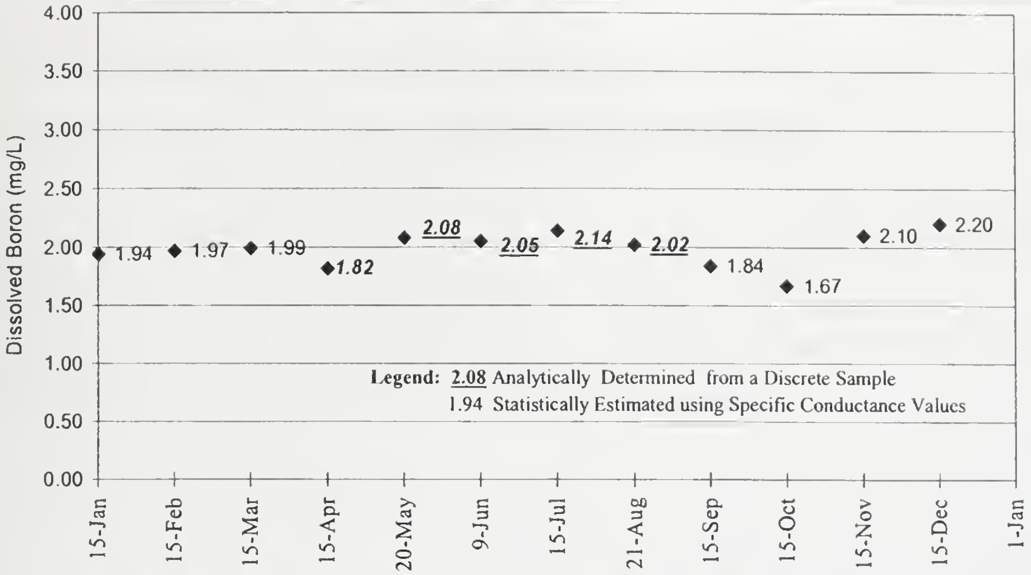


Figure 3.8: Measured and Estimated Boron Concentration for 2009
for East Poplar River at the International Boundary

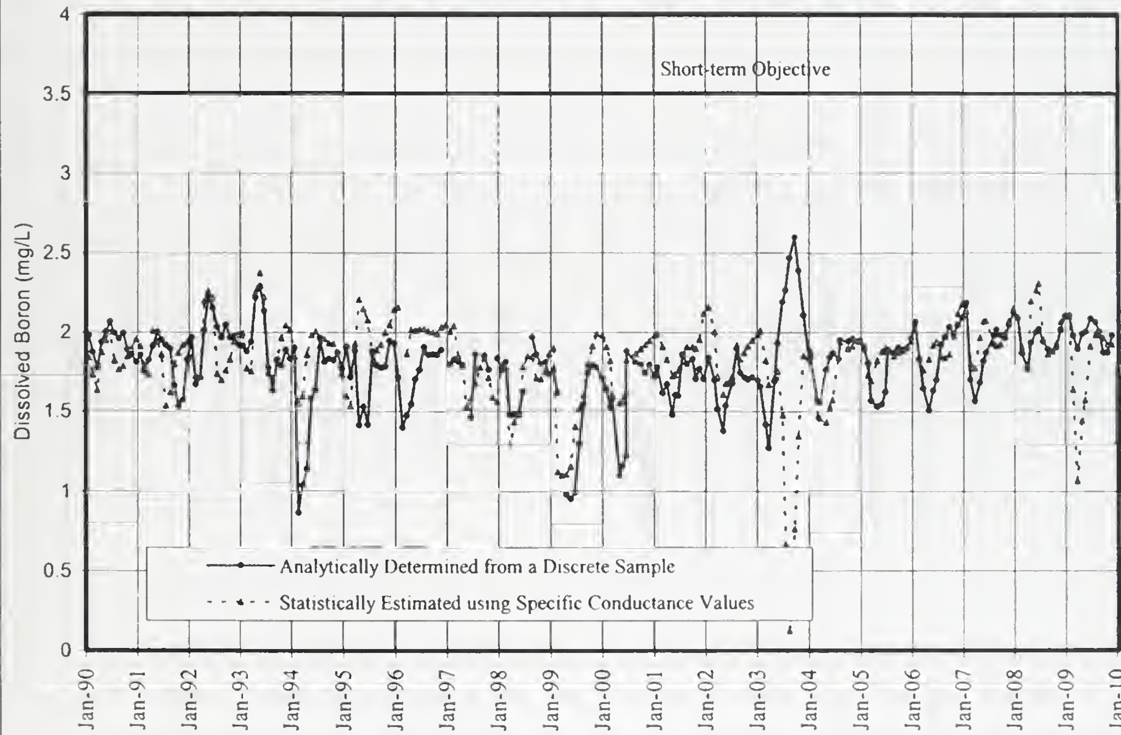


Figure 3.9: Three-Month Moving Flow-Weighted Average Estimated Boron
Concentration for East Poplar River at the International Boundary

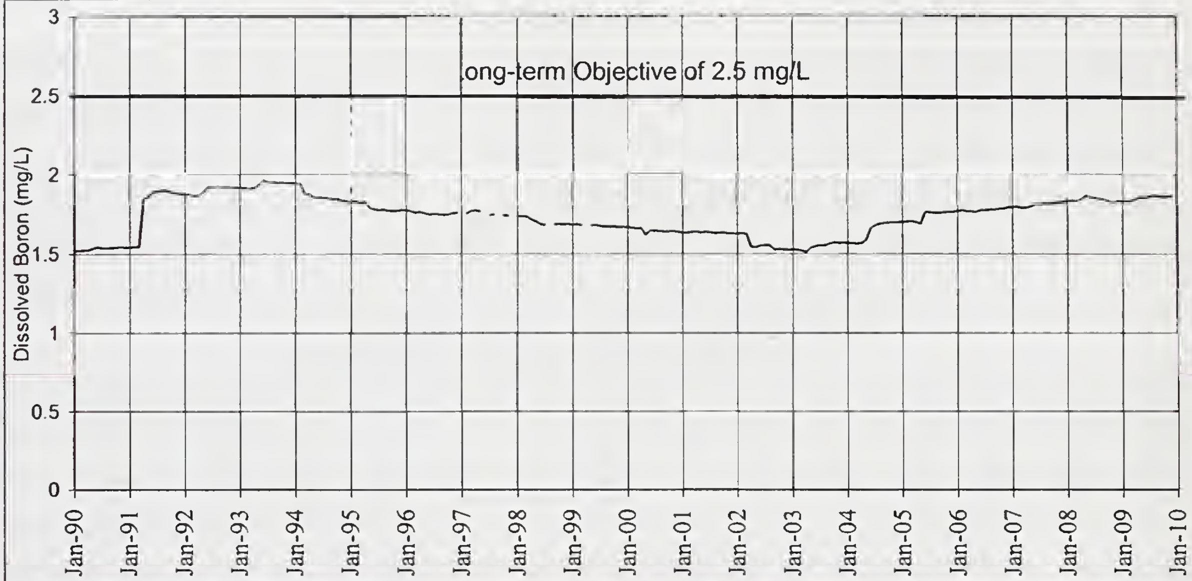


Figure 3.10: Five-Year Moving Flow-Weighted Average Estimated Boron Concentration for East Poplar River at the International Boundary (Statistically Estimated)

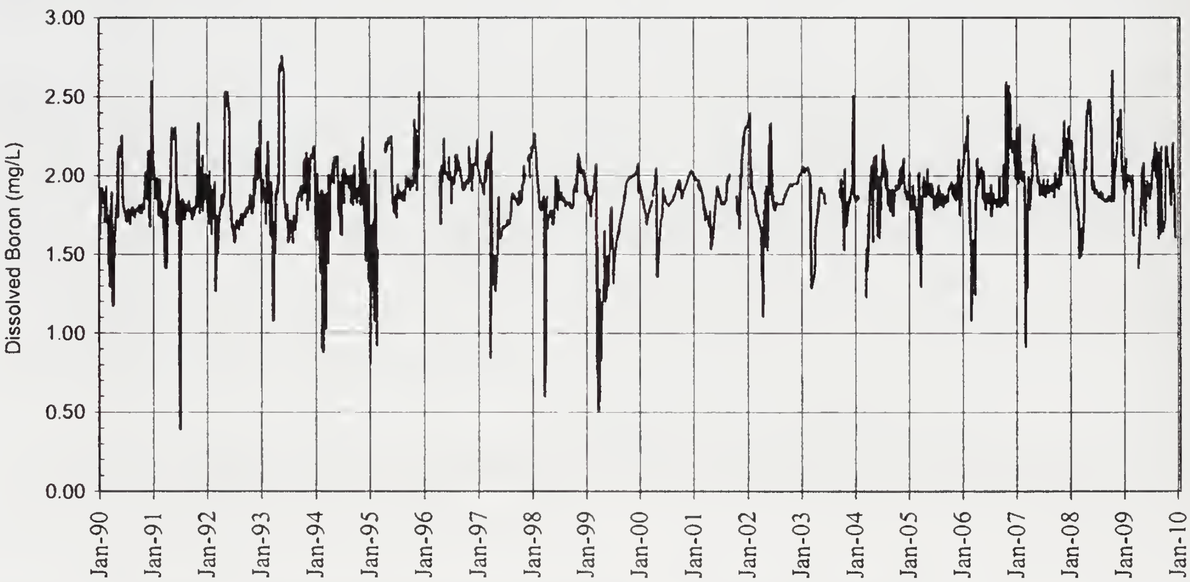


Figure 3.11: Estimated Daily Boron Concentration, 1990 to 2009 for East Poplar River at the International Boundary (Statistically Estimated)

3.2.5.3 Other Water-Quality Objectives

Table 3.1 contains the multipurpose water-quality objectives for the East Poplar River at International Boundary, recommended by the International Poplar River Water Quality Board to the IJC. The table shows the number of samples collected for each parameter and the number of times over the course of the year that the objectives were exceeded. In the table, multiple replicate samples collected during the annual quality control exercise are treated as a single sample, but where an objective was exceeded in a replicate sample, this is charged against the single sample noted. As the table shows, all parameters were within the appropriate objectives.

Table 3.1 Recommended Water-Quality Objectives and Excursions, 2009 Sampling Program, East Poplar River at International Boundary (units in mg/L, except as otherwise noted)

Parameter	Objective	No. of Samples		Excursions
		USA	Canada	
Objectives recommended by IJC to Governments				
Boron, dissolved	3.5/2.5 (1)	4	0	0
Total Dissolved Solids	1,500/1,000 (1)	4	0	0
Objectives recommended by Poplar River Bilateral Monitoring Committee to Governments				
Cadmium, total	0.0012	4	0	0
Fluoride, dissolved	1.5	4	0	0
Lead, total	0.03	4	0	0
Nitrate	10.0	4	0	0
Oxygen, dissolved	4.0/5.0 (2)	4	0	0
Sodium adsorption ratio	10.0	4	0	0
Sulphate, dissolved	800.0	4	0	0
Zinc, total	0.03	4	0	0
Water temperature (Celsius)	30.0 (3)	4	0	0
pH (pH units)	6.5 (4)	4	0	0

(1) Three-month average of flow-weighted concentrations should be <3.5 mg/L boron and <1,500 mg/L TDS. Five-year average of flow-weighted concentrations (March to October) should be <2.5 mg/L boron and <1,000 mg/L TDS.

(2) 5.0 (minimum April 10 to May 15), 4.0 (minimum, remainder of the year).

(3) Natural temperature (April 10 to May 15), <30 degrees Celsius (remainder of the year).

(4) Less than 0.5 pH units above natural, minimum pH = 6.5.

Note: No excursions were noted in 2009.

3.3 Ground Water

3.3.1 Operations – Saskatchewan

SaskPower's supplementary supply continued to operate during 2009 with 3,297 cubic decameters (dam^3) of ground water being produced. This is down slightly from the 4,046 dam^3 pumped in 2008. Production from 1991 to 2009 has averaged 4,736 dam^3 per year. Prior to 1991, the well network was part of a dewatering network for coal mining operations, which resulted in the high production levels experienced in the early to mid 1980's. With the drought of the late 1980's and early 1990's it was evident that there was a continued need for ground water to supplement water levels in Cookson Reservoir. Consequently the wells were taken over by SaskPower for use as a supplementary supply.

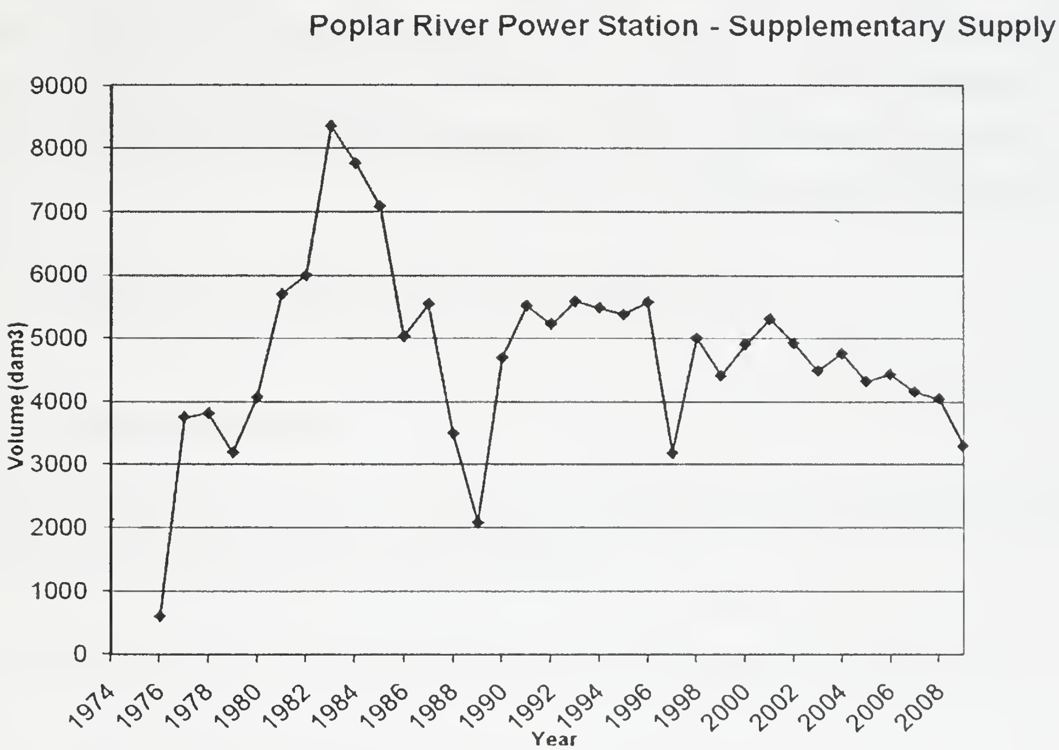


Figure 3.12 Annual Pumpage by the Poplar River Power Station's Supplementary Water Supply

SaskPower has an approval for the supplementary supply project to produce an annual volume of 5,500 dam^3/year. The supplementary supply well network currently consists of 21 wells with a total of 10 discharge points. No wells were added or deleted from the well field during the year.

In addition to the supplementary supply, SaskPower also operates the Soil Salinity Project south of Morrison Dam. The project was initiated in 1989 to alleviate soil salinity which had developed below the dam. The Soil Salinity project consists of a network of production wells discharging into the cooling water canal, which in turn discharges directly to Cookson Reservoir. Ongoing operational difficulties with the production wells resulted in a continued decline in the annual volume pumped from a high of 1,100 dam^3 in 1994 to a low point of 426 dam^3 in 2003. A well rehabilitation program resulted in some recovery in production rates with production of 812 dam^3 in 2006. Production dropped again to 426 dam^3 in 2009. The majority of water (382 dam^3) came from wells PW87104 and PW87105 on the east side of the river 103 dam^3 from PW90109 on the west side. The total water produced from the Soil Salinity Project in 2009 was 527 dam^3.

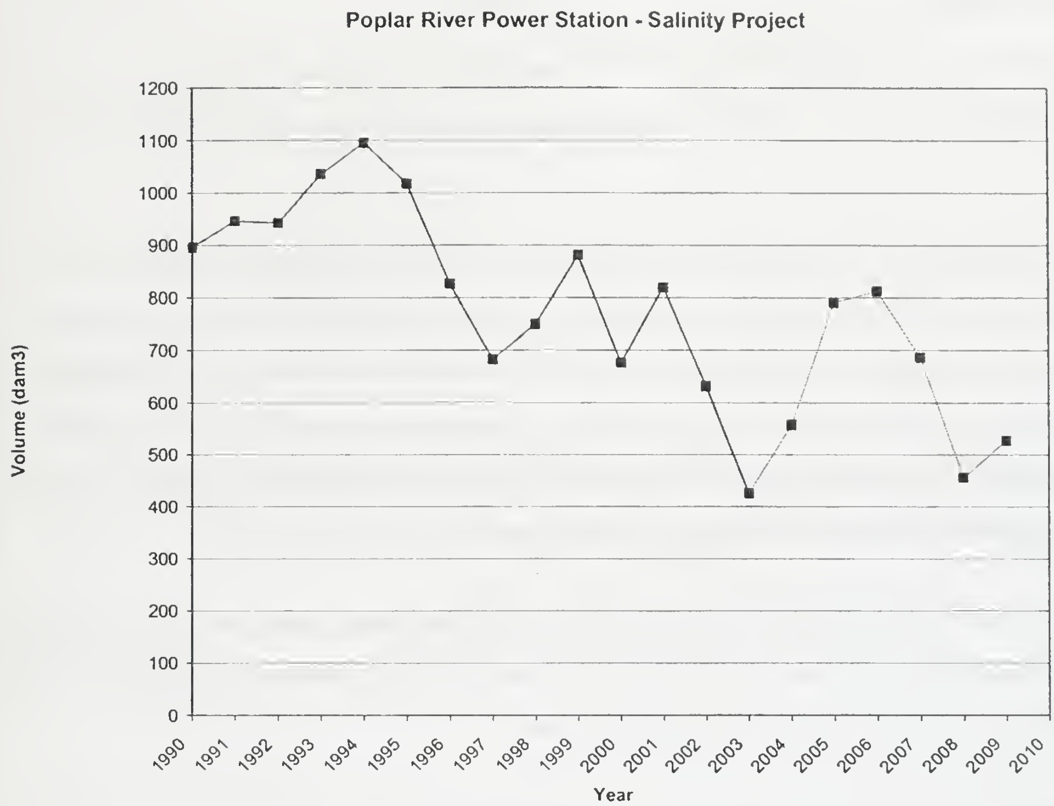


Figure 3.13 Annual Pumpage from Soil Salinity Project

3.3.2 Ground-Water Monitoring

Equivalent geologic formations present in Saskatchewan and Montana have different names. A list of the corresponding formation names is provided in Table 3.2.

Table 3.2 Geologic Formation Name Equivalence between Saskatchewan and Montana

Formation Location	Geologic Formation Name			
Saskatchewan	Eastend to Whitemud	Frenchman	Ravenscrag	Alluvium
Montana	Fox Hills	Hell Creek	Fort Union	Alluvium

3.3.2.1 Saskatchewan

In 2003, SaskPower reduced its monitoring network from 180 to about 85 piezometers. Saskatchewan Environment approved this reduction based on modelling studies undertaken by SaskPower.

The goal of the Soil Salinity Project is to lower groundwater levels in the Empress Sands below Morrison Dam two to three metres, which is roughly equivalent to pre-reservoir levels. Groundwater pumpage from 1990 to 1995 ranged between 900 and 1,100 dam^3/year and consequently the drawdown objectives were achieved in 1995 and 1996. Declining pumpage from 1995 until 2004 resulted in negligible drawdown by 2003. Drawdown remains marginal and is limited in extent and magnitude being two meters or less in piezometers adjacent to the production wells.

Figures 3.14 and 3.15 show hydrographs for Hart Coal Seam monitoring wells near the International Boundary. These hydrographs illustrate that there have been no significant changes in water levels in the Hart Coal Seam near the boundary in the past 20 years.

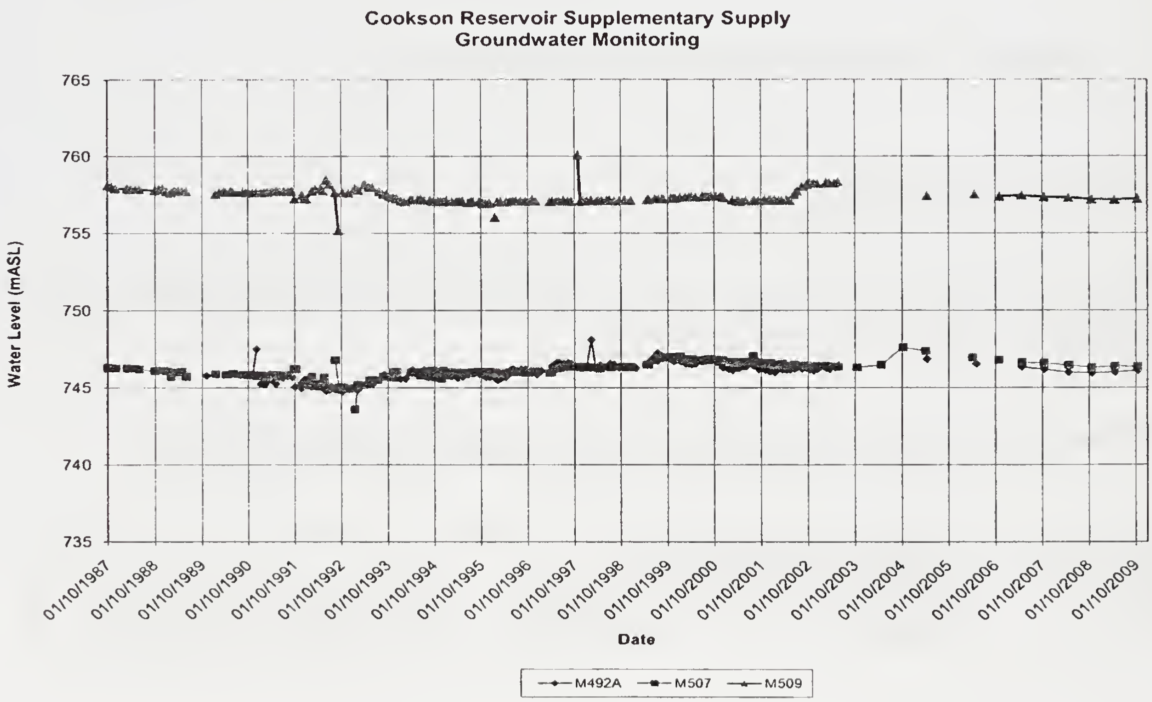


Figure 3.14 Hydrograph of Selected Wells Completed in the Hart Coal Seam

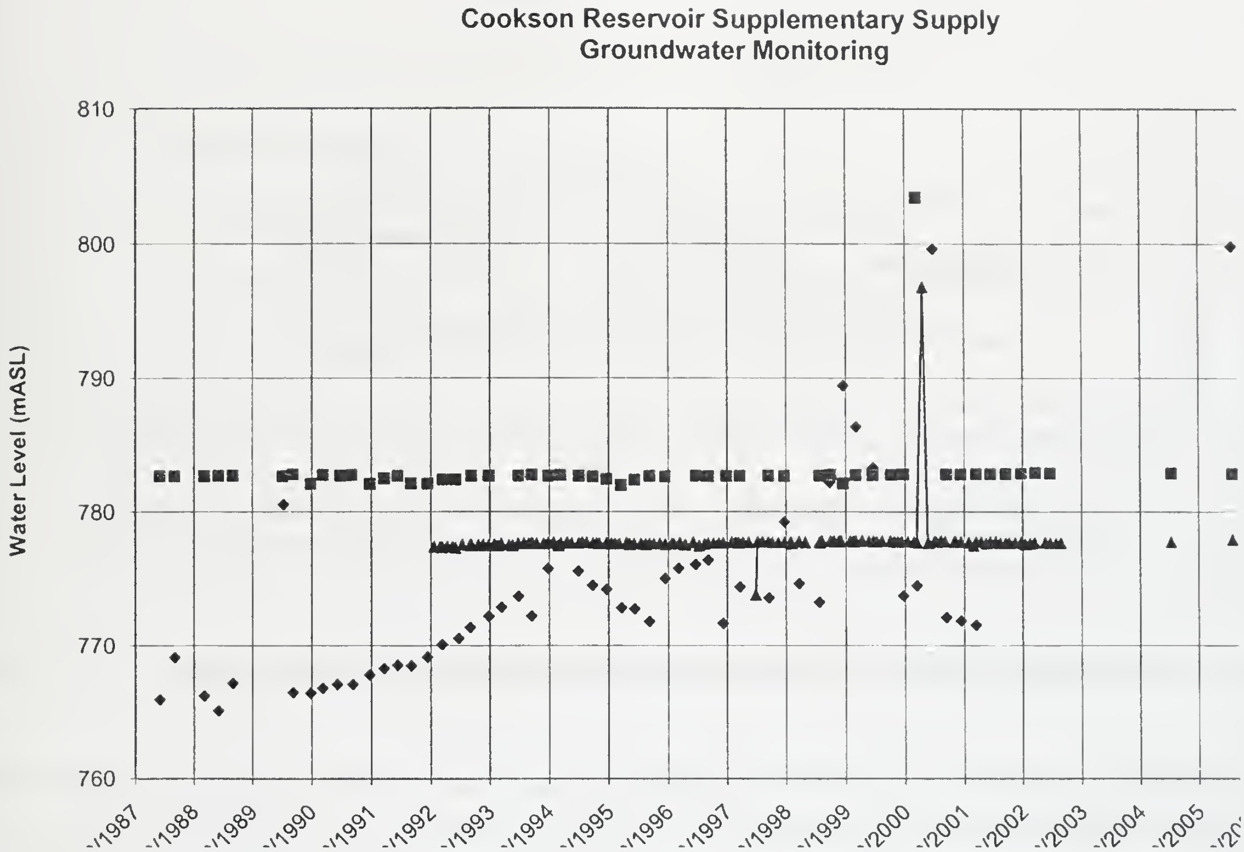


Figure 3.15 Hydrograph of Selected Wells Completed in the Hart Coal Seam

3.3.2.2 Montana

Hydrographs from monitoring wells completed in the Fort Union Formation and/or the Hart Coal Seam (wells 6, 7, 9, 13, 16, 17, 19, and 22) exhibit two general patterns. Water levels in wells 9, 13, 17, and 19 have changed less than 5 ft (1.5 m) since the time monitoring began in 1987. Water levels generally declined between 1987 and 1992-1994; since 1994, water-level trends are flat or slowly rising. Water-level hydrographs from wells 17 and 19 are shown on Figure 3.16. Offsets noted in the legend for Figure 3.16 have been applied to make the hydrographs more readable. Water-level data used to construct the hydrographs in Figure 3.16 can be accessed through the Montana Ground Water Information Center (GWIC) database at http://mbmggwic.mtech.edu.

Water levels in wells 6, 7, 16, and 22 have changed as much as 12 ft (3.7 m) but generally declined from the beginning of monitoring to the mid 1990s before beginning to rise. Water-level hydrographs for wells 6 and 7 are shown on Figure 3.16.

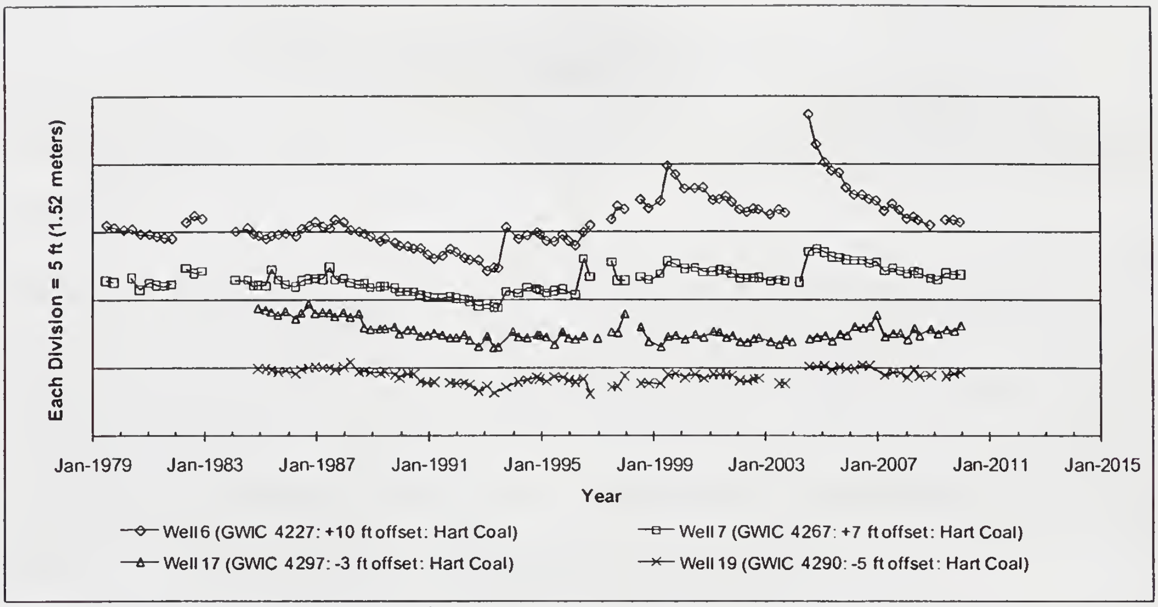


Figure 3.16 Hydrographs of Selected Wells - Fort Union and Hart Coal Aquifers

Heavy snow accumulation and subsequent melting caused water levels to rise to near record highs in wells 6, 7, 9, 16, 19, and 22 during 2004 and 2005. Water levels in wells 6 and 16 have fallen since 2004-2005, and are now about 1 ft (0.3 m) below their 2003 altitudes. Water levels in wells 7 and 9 remain about one ft (0.3 m) above their 2003 altitudes and the water level in well 22 is at the same altitude as 2003. There was no apparent short-term response to the snow melt event in wells 13 and 17, but water levels in these wells rose between late 2003 and early 2007. Since 2007, water levels in well 13 are relatively unchanged. Water levels in well 17 reached a peak in 2006 before declining to near 2003 levels in 2007. Water levels in well 17 have risen about 0.5 ft (0.2 m) since 2007.

The potentiometric surface in the Fox Hills/Hell Creek artesian aquifer (well 11-Figure 3.17) has shown little fluctuation during the 1979-2009 monitoring period, but the entire record shows a slight long-term downward trend.

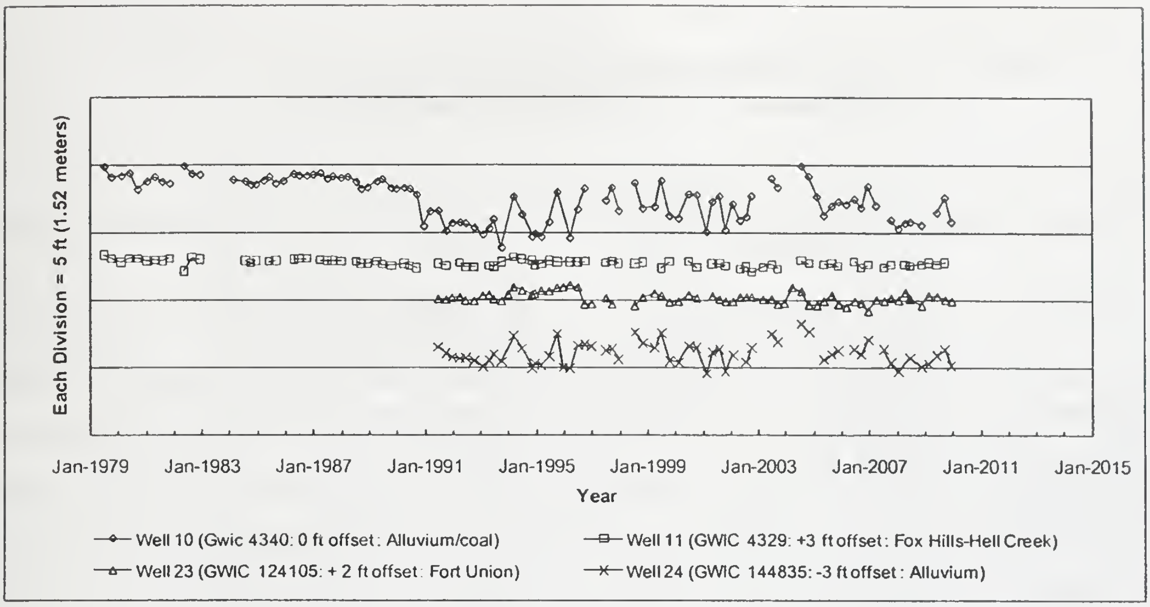


Figure 3.17 Hydrographs of Selected Wells - Alluvium and Fox Hills/Hell Creek Aquifers

Water levels in monitoring wells 5, 8, 10, 23, and 24 completed in alluvium and/or outwash show seasonal change caused by climate and/or precipitation. Heavy snow accumulation and melt in early 2004 caused upward water-level response during the remainder of that year. In subsequent years water levels steadily declined returning to pre-melt 2003 elevations between 2004 (Well 23) and 2008 (Well 5). Hydrographs from selected alluvial/outwash wells (10, 23, and 24) and the Fox Hills/Hell Creek well (11) are shown in figure 3.17. Offsets noted in the legend have been applied to the data to make the hydrographs more readable. Measurements from wells 11 and 24 where the wellhead was noted as being frozen are not included. Water-level data used to construct the hydrographs in Figure 3.17 can be accessed through the Montana Ground Water Information Center (GWIC) database at http://mbmggwic.mtech.edu.

3.3.3 Ground-Water Quality

3.3.3.1 Saskatchewan

The water quality from the Poplar River Power Station's Supplementary Water Supply Project discharge points has been consistent with no trends indicated. A summary of the more frequently tested parameters during 2009 is provided in Table 3.3. Result averages for the 1992-2008 periods are also included in this table for comparison.

TABLE 3.3 Water-Quality Statistics for Water Pumped from Supplementary Water Supply Project Wells*

	1992 to 2008 Average	2009 Average
pH (units)	8.1	8.3
Conductivity (µs/cm)	1,289	1,415
Total Dissolved Solids	887	946
Total Suspended Solids	11	5
Boron	1.2	1.3
Sodium	172	188
Cyanide (µg/L)	0.0006	0.000001
Iron	0.3	0.1
Manganese	0.1	0.03
Mercury (µg/L)	0.08	0.01
Calcium	68	54
Magnesium	52	58
Sulfate	273	290
Nitrate	0.05	0.31

*All units mg/L unless otherwise noted. *Sampled at Site "C3" on Girard Creek.

Average results from the common discharge point for the Soil Salinity Project for 2009, plus an average of the 1992-2008 results are provided in Table 3.4. Results have remained relatively consistent since 1992.

TABLE 3.4 Water-Quality Statistics for Water Pumped from Soil Salinity Project Wells Sampled at the Discharge Pipe*

	1992-2008 Average	2009 Average
pH (units)	7.6	7.9
Conductivity (μs/cm)	1,446	1,599
Total Dissolved Solids	1,000	1,090
Boron	1.6	1.8
Calcium	104	88
Magnesium	49	60
Sodium	156	222
Potassium	7.5	7.5
Arsenic (μg/L)	11.5	14.5
Aluminum	0.06	0.004
Barium	0.035	0.027
Cadmium	0.015	0.001
Iron	4.1	3.6
Manganese	0.131	0.101
Molybdenum	0.015	0.002
Strontium	1.742	1.475
Vanadium	0.015	0.002
Uranium (μg/L)	0.619	0.900
Mercury (μ/L)	0.08	0.02
Sulfate	325	368
Chloride	6.5	8.0
Nitrate	0.051	0.180

*All concentrations are mg/L unless otherwise noted.

Leachate movement through the ash lagoon liner systems can potentially affect ground-water quality in the vicinity of the ash lagoons. The piezometers listed in the Technical Monitoring Schedules are used to assess leachate movement and calculate seepage rates. Piezometric water level, boron, and chloride are the chosen indicator parameters to assess leachate movement.

The chemistry of water immediately above the liner systems is expected to differ from the surface water of the lagoons. Meaningful information is only available from piezometers installed within Ash Lagoon # 1 where ash has been deposited for many years. Future monitoring of all piezometers completed below the lagoon liner systems will continue with the purpose of confirming the boron trend noted below and to improve the understanding of leachate quality and flow from the ash lagoons.

The piezometric surface measurements for the oxidized till continue to show the presence of a ground-water mound beneath the ash lagoons. The mound extends from the center of the Ash Lagoon # 1 to the southeast side of Ash Lagoon # 2. Isolated ground-water mounds have developed within the area of the oxidized till ground-water mound. Piezometers located in the oxidized till suggest limited leachate activity. No seepage activity is evident in the unoxidized till.

The greatest changes in chloride and boron concentrations within the oxidized till have occurred where piezometric levels have changed the most. Although increasing water levels do not automatically suggest that the water affecting the piezometers is leachate, changing piezometric levels do suggest ground-water movement. On the west side of the Polishing Pond, the boron levels have changed only slightly in the oxidized till piezometers C728A and C728D, where the chloride levels have changed more significantly. The chloride level for C728A had decreased from 403 mg/L in 1983 to 249 mg/L in 2006; piezometer C728A has been repaired and will be returned to the monitoring schedule in 2010. The chloride level for C728D has increased from 185 mg/L in 1983 to 379 mg/L in 2009. Although these piezometers are close in proximity and installed at the same level, they are being influenced by different water. Chloride results for C728A suggest initial seepage and it is to be expected that over time the same observation will be seen in C728D.

The piezometric surface of the Empress Gravel indicates a regional flow from northwest to southeast below Morrison Dam. As a general observation, Empress piezometers respond to changing reservoir levels. Results for the Empress layer do not indicate seepage activity with the majority of the analyses showing little real change in boron or chloride results. Piezometer C712B has been monitored for several years. Historically, boron levels were below 1 mg/L. From 1992 to 2009, boron levels have remained relatively steady between 12 and 20 mg/L.

3.3.3.2 Montana

Samples were collected from monitoring wells 7, 16, and 24 during 2009. Well 7 is completed in the Hart Coal, well 16 is completed in the Fort Union Formation, and well 24 is completed in alluvium. Total dissolved solids (TDS) concentrations in samples from wells 7 and 24 continued slight downward trends that began in 2006. The most recent TDS concentration in well 16 appears anomalously low. Production rates from well 16 have decreased to the point where only enough water can be pumped to rinse and bottle the samples. MBMG will attempt to re-develop the well in 2010. Changes in TDS with time for wells 7, 16, and 24 are shown in Figure 3.18. Water-chemistry data used to construct the graphs in Figure 3.18 can be accessed through the Montana Ground Water Information Center (GWIC) database at http://mbmggwic.mtech.edu.

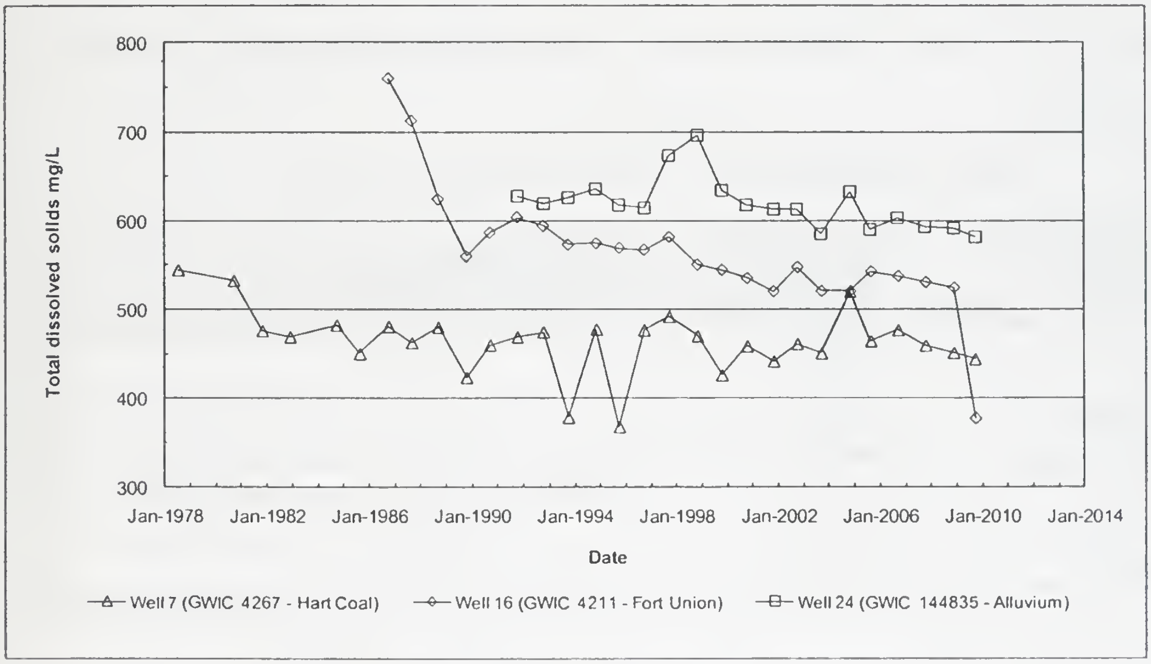


Figure 3.18 Total Dissolved Solids in Samples from Montana Wells.

In addition to the regularly scheduled sampling, Montana collected inorganic samples from wells 5, 6, 8, 9, 10, 11, 19, 22, and 23. Analytical results from these samples are available from the GWIC database at http://mbmggwic.mtech.edu.

3.4 Cookson Reservoir

3.4.1 Storage

On January 1, 2009, Cookson Reservoir storage was 24,360 dam^3 or 56 % of the full supply volume. The 2009 maximum, minimum and period elevations and volumes are shown in Table 3.5.

Spring inflows into the reservoir were above normal in 2009. A release was made in May to meet the recommended Poplar River basin demand release for the 2008-2009 apportionment year. No releases were required to maintain the recommended apportionment target flow at the International Boundary for the remainder of the year.

In addition to runoff, reservoir levels were augmented by groundwater pumping. Wells in the abandoned west block mine site supplied 3,291 dam^3 to Girard Creek. It is estimated that less than 70% of this flow volume reached Cookson Reservoir. Wells in the soil salinity project area supplied 527 dam^3.

Table 3.5 Cookson Reservoir Storage Statistics for 2009

Date	Elevation (m)	Contents (dam^3)
January 1	750.10	24,360
May 8 (Maximum)	752.22	37,530
March 14 (Minimum)	750.09	24,300
December 31	751.35	31,570
Full Supply Level	753.00	43,410

The Poplar River Power Station is dependent on water from Cookson Reservoir for cooling. Power plant operation is not adversely affected until reservoir levels drop below 749.0 metres. The dead storage level for cooling water used in the generation process is 745.0 metres. The 2009 recorded levels and associated operating levels are shown in Figure 3.19.

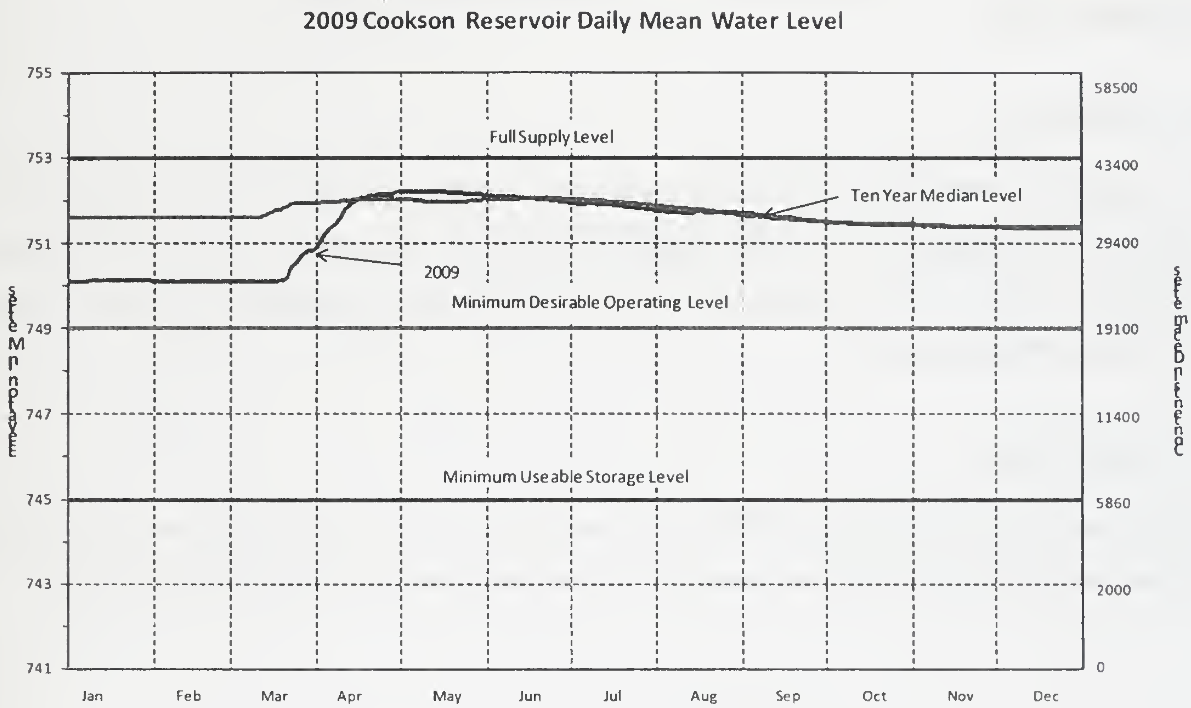


Figure 3.19 Cookson Reservoir Daily Mean Water Levels for 2009 and Median Daily Water Levels, 1999-2008

3.4.2 Water Quality

The period from 1987 to 1993 saw very low volumes of surface-water run-off to Cookson Reservoir. Consequently, total dissolved solids (TDS) in the reservoir increased steadily from approximately 780 mg/L to over 1,800 mg/L. Since 1993, higher run-off volumes have improved reservoir water quality. The average TDS level in Cookson Reservoir in 2009 was 1,304 mg/L, down slightly from the 2008 average level of 1,434 mg/L. Run-off and reservoir volumes continues to significantly influence the water quality of the reservoir as it has done in the past.

3.5 Air Quality

SaskPower's ambient SO_2 monitoring for 2009 recorded no values greater than Saskatchewan Environment's one-hour average standard of 0.17 ppm and the 24-hour average standard of 0.06 ppm. The 2009 geometric mean for the high-volume suspended-particulate sampler was 15.0 $\mu g/m^3$ and 2009 was the eighteenth consecutive year of below-average standard particulate readings.

3.6 Quality Control

3.6.1 Streamflow

No comparative current-meter discharge measurements were made in 2009 at the East Poplar River at International Boundary site between personnel from the U.S. Geological Survey (USGS) and Environment Canada (EC) to confirm streamflow measurement comparability because of poor measuring conditions at the site.

3.6.2 Water Quality

No joint sampling was performed in 2009 at the East Poplar River at International Boundary due to continued suspension in the collection of surface-water-quality samples by Environment Canada.

ANNEX 1

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

CANADA-UNITED STATES

September 23, 1980

POPLAR RIVER COOPERATIVE MONITORING ARRANGEMENT

I. PURPOSE

This Arrangement will provide for the exchange of data collected as described in the attached Technical Monitoring Schedules in water-quality, water quantity and air quality monitoring programs being conducted in Canada and the United States at or near the International Boundary in response to SaskPower development. This Arrangement will also provide for the dissemination of the data in each country and will assure its comparability and assist in its technical interpretation.

The Arrangement will replace and expand upon the quarterly information exchange program instituted between Canada and the United States in 1976.

II. PARTICIPATING GOVERNMENTS

Governments and government agencies participating in the Arrangement are:

Government of Canada: Environment Canada
Government of the Province of Saskatchewan:
Saskatchewan Environment and Resource Management
Government of the United States of America: United States Geological Survey
Government of the State of Montana: Executive Office

III. POPLAR RIVER MONITORING COMMITTEE: TERMS OF REFERENCE

A binational committee called the Poplar River Bilateral Monitoring Committee will be established to carry out responsibilities assigned to it under this Arrangement. The Committee will operate in accordance with the following terms of reference:

A. Membership

The Committee will be composed of four representatives, one from each of the participating Governments. It will be jointly chaired by the Government of Canada and the Government of the United States. There will be a Canadian Section and a United States Section. The participating Governments will notify each other of any changes in membership on the Committee. Co-chairpersons may by mutual agreement invite agency technical experts to participate in the work of the Committee.

The Governor of the State of Montana may also appoint a chief elective official of local government to participate as an ex-officio member of the Committee in its technical deliberations. The Saskatchewan Minister of the Environment may also appoint a similar local representative.

B. Functions of the Committee

The role of the Committee will be to fulfil the purpose of the Arrangement by ensuring the exchange of monitored data in accordance with the attached Technical Monitoring Schedules, and its collation and technical interpretation in reports to Governments on implementation of the Arrangement. In addition, the Committee will review the existing monitoring systems to ensure their adequacy and may recommend to the Canadian and United States Governments any modifications to improve the Technical Monitoring Schedules.

1. Information Exchange

Each Co-chairperson will be responsible for transmitting to his counterpart Co-chairperson on a regular, and not less than quarterly basis, the data provided by the cooperative monitoring agencies in accordance with the Technical Monitoring Schedules.

2. Reports

(a) The Committee will prepare a joint Annual Report to the participating governments, and may at any time prepare joint Special Reports.

(b) Annual Reports will

i) summarize the main activities of the Committee in the year under Report and the data which has been exchanged under the Arrangement;

ii) draw to the attention of the participating governments any definitive changes in the monitored parameters, based on collation and technical interpretation of exchanged data (i.e. the utilization of summary, statistical and other appropriate techniques);

iii) draw to the attention of the participating governments any recommendations regarding the adequacy or redundancy of any scheduled monitoring operations and any proposals regarding modifications to the Technical Monitoring Schedules, based on a continuing review of the monitoring programs including analytical methods to ensure their comparability.

(c) Special Reports may, at any time, draw to the attention of participating governments definitive changes in monitored parameters which may require immediate attention.

(d) Preparation of Reports

Reports will be prepared following consultation with all committee members and will be signed by all Committee members. Reports will be separately forwarded by the Committee Co-chairmen to the participating governments. All annual and special reports will be so distributed.

3. Activities of Canadian and United States Sections

The Canadian and United States section will be separately responsible for:

(a) dissemination of information within their respective countries, and the arrangement of any discussion required with local elected officials;

(b) verification that monitoring operations are being carried out in accordance with the Technical Monitoring Schedules by cooperating monitoring agencies;

(c) receipt and collation of monitored data generated by the cooperating monitoring agencies in their respective countries as specified in the Technical Monitoring Schedules;

(d) if necessary, drawing to the attention of the appropriate government in their respective countries any failure to comply with a scheduled monitoring function on the part of any cooperating agency under the jurisdiction of that government, and requesting that appropriate corrective action be taken.

IV. PROVISION OF DATA

In order to ensure that the Committee is able to carry out the terms of this Arrangement, the participating governments will use their best efforts to have cooperating monitoring agencies, in their respective jurisdictions provide on an ongoing basis all scheduled monitored data for which they are responsible.

V. TERMS OF THE ARRANGEMENT

The Arrangement will be effective for an initial term of five years and may be amended by agreement of the participating governments. It will be subject to review at the end of the initial term and will be renewed thereafter for as long as it is required by the participating governments.

ANNEX 2

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2010

CANADA-UNITED STATES

TABLE OF CONTENTS

PREAMBLE

The Technical Monitoring Schedule lists those water quantity, water-quality and air quality monitoring locations and parameters which form the basis for information exchange and reporting to Governments. The structure of the Committee responsible for ensuring the exchange takes place is described in the Poplar River Cooperative Monitoring Arrangement.

The monitoring locations and parameters listed herein have been reviewed by the Poplar River Bilateral Monitoring Committee and represent the basic technical information needed to identify any definitive changes in water quantity, water quality and air quality at the International Boundary. The Schedule was initially submitted to Governments for approval as an attachment to the 1981 report to Governments. Changes in the sampling locations and parameters may be made by Governments based on the recommendations of the Committee.

Additional information has been or is being collected by agencies on both sides of the International Boundary, primarily for project management or basin-wide baseline data purposes. This additional information is usually available upon request from the collecting agency and forms part of the pool of technical information which may be drawn upon by Governments for specific study purposes. Examples of additional information are water-quantity, water-quality, ground-water and air-quality data collected at points in the Poplar River basin not of direct concern to the Committee. In addition, supplemental information on parameters such as vegetation, soils, fish and waterfowl populations and aquatic vegetation has been collected on either a routine or specific-studies basis by various agencies.

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2010

CANADA

STREAMFLOW MONITORING

Daily mean discharge or levels and instantaneous monthly extremes as normally published in surface-water-data publications.

Responsible Agencies: Environment Canada; Saskatchewan Watershed Authority		
No. on Map	**Station No.**	**Station Name**
1*	11AE003 (06178500)	East Poplar River at International Boundary
2	11AE013***	Cookson Reservoir near Coronach
3	11AE015***	Girard Creek near Coronach Cookson Reservoir
4	11AE014***	East Poplar River above Cookson Reservoir
5		Fife Lake Overflow**
6*	11AE008 (06178000)	Poplar River at International Boundary

* International gauging station.

** Miscellaneous measurements of outflow to be made by Saskatchewan Watershed Authority (SWA) during periods of outflow only.

*** SWA took over the monitoring responsibility effective July 1/92.

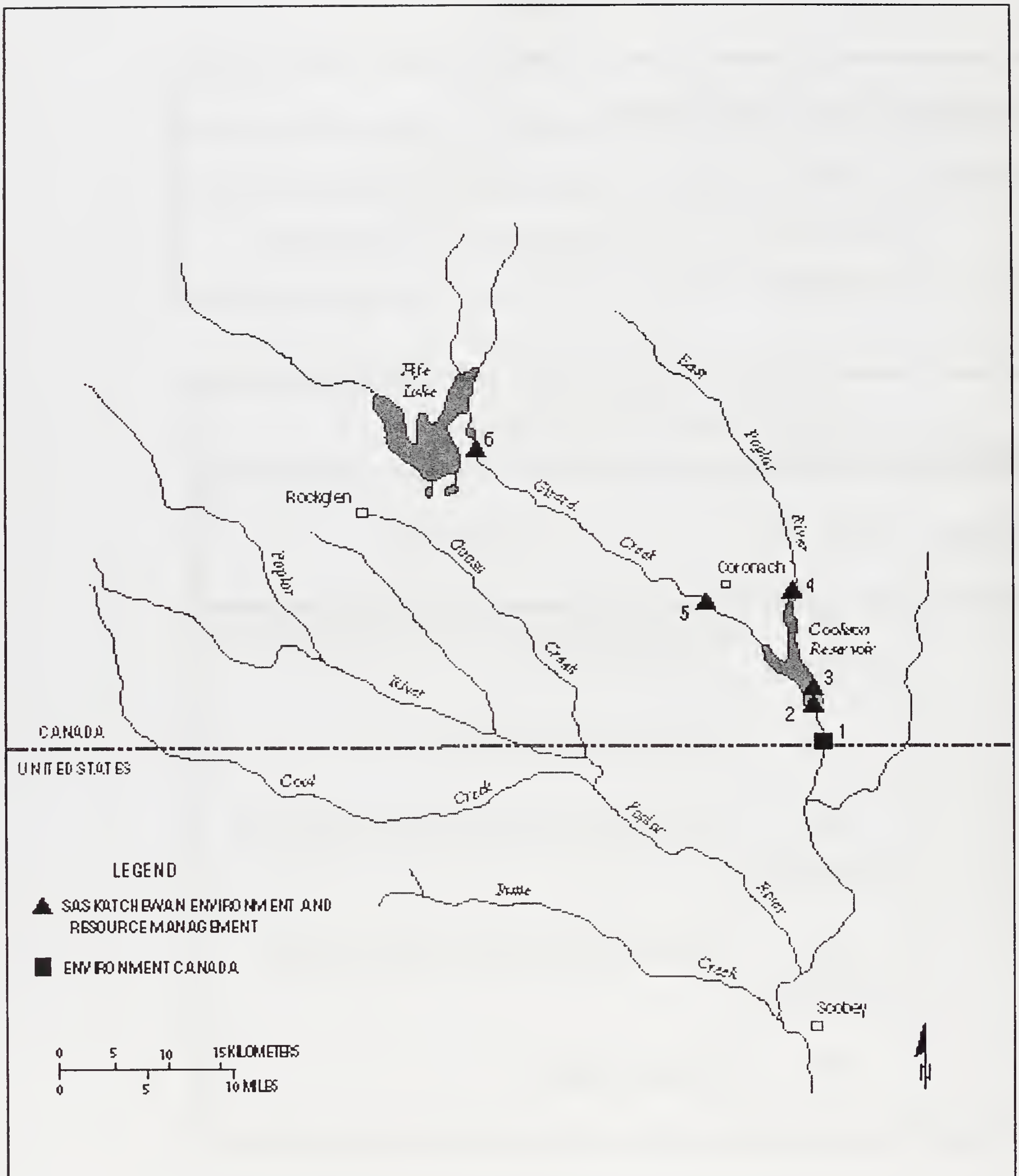
SURFACE-WATER-QUALITY MONITORING

Sampling Locations

Responsible Agency: Environment Canada		
No. on Map	**Station No.**	**Station Name**
1	00SA11AE0008 Suspended	East Poplar River at International Boundary

Responsible Agency: Saskatchewan Environment Data collected by: Sask Power		
No. on Map	**Station No.**	**Station Name**
2	12386 Discontinued	East Poplar River at Culvert immediately below Cookson Reservoir
3	12368	Cookson Reservoir near Dam
4	12377 Discontinued	Upper End of Cookson Reservoir at Highway 36
5	12412 Discontinued	Girard Creek at Coronach, Reservoir Outflow
6	7904	Fife Lake Outflow*

*Sampled only when outflow occurs for a 2-week period, which does not occur every year.



SURFACE-WATER-QUALITY MONITORING STATIONS (CANADA)

PARAMETERS

Responsible Agency: Environment Canada			
ENVIRODAT* Code	Parameter	Analytical Method	Sampling Frequency Station No. 1
10151	Alkalinity-phenolphthalein	Potentiometric Titration	SUS
10111	Alkalinity-total	Potentiometric Titration	SUS
13102	Aluminum-dissolved	AA-Direct	SUS
13302	Aluminum-extracted	AA-Direct	SUS
07540	Ammonia-total	Automated Colourimetric	SUS
33108	Arsenic-dissolved	ICAP-hydride	SUS
56001	Barium-total	AA-Direct	SUS
06201	Bicarbonates	Calculated	SUS
05211	Boron-dissolved	ICAP	SUS
96360	Bromoxynil	Gas Chromatography	SUS
48002	Cadmium-total	AA Solvent Extraction	SUS
20103	Calcium	AA-Direct	SUS
06104	Carbon-dissolved organic	Automated IR Detection	SUS
06901	Carbon-particulate	Elemental Analyzer	SUS
06002	Carbon-total organic	Calculated	SUS
06301	Carbonates	Calculated	SUS
17206	Chloride	Automated Colourimetric	SUS
06717	Chlorophyll a	Spectrophotometric	SUS
24003	Chromium-total	AA-Solvent Extraction	SUS
27002	Cobalt-total	AA-Solvent Extraction	SUS
36012	Coliform-fecal	Membrane Filtration	SUS
36002	Coliform-total	Membrane Filtration	SUS
02021	Colour	Comparator	SUS
02041	Conductivity	Wheatstone Bridge	SUS
06610	Cyanide	Automated UV-Colourimetric	SUS
09117	Fluoride-dissolved	Electrometric	SUS
06401	Free Carbon Dioxide	Calculated	SUS
10602	Hardness	Calculated	SUS
17811	Hexachlorobenzene	Gas Chromatography	SUS
08501	Hydroxide	Calculated	SUS
26104	Iron-dissolved	AA-Direct	SUS
82002	Lead-total	AA-Solvent Extraction	SUS
12102	Magnesium	AA-Direct	SUS
25104	Manganese-dissolved	AA-Direct	SUS
07901	N-particulate	Elemental Analyzer	SUS
07651	N-total dissolved	Automated UV Colourimetric	SUS
10401	NFR	Gravimetric	SUS
28002	Nickel-total	AA-Solvent Extraction	SUS
07110	Nitrate/Nitrite	Colourimetric	SUS
07603	Nitrogen-total	Calculated	SUS
10650	Non-Carbonate Hardness	Calculated	SUS
18XXX	Organo Chlorines	Gas Chromatography	SUS
08101	Oxygen-dissolved	Winkler	SUS
15901	P-particulate	Calculated	SUS
15465	P-total dissolved	Automated Colourimetric	SUS
185XX	Phenoxy Herbicides	Gas Chromatography	SUS
15423	Phosphorus-total	Colourimetric (TRAACS)	SUS
19103	Potassium	Flame Emission	SUS
11250	Percent Sodium	Calculated	SUS
011201	SAR	Calculated	SUS
00210	Saturation Index	Calculated	SUS
34108	Selenium-dissolved	ICAP-hydride	SUS
14108	Silica	Automated Colourimetric	SUS
11103	Sodium	Flame Emission	SUS
00211	Stability Index	Calculated	SUS
16306	Sulphate	Automated Colourimetric	SUS
00201	TDS	Calculated	SUS
02061	Temperature	Digital Thermometer	SUS
02073	Turbidity	Nephelometry	SUS
23002	Vanadium-total	AA-Solvent Extraction	SUS
30005	Zinc-total	AA-Solvent Extraction	SUS
10301	pH	Electrometric	SUS
92111	Uranium	Fluometric	SUS

* - Computer Storage and Retrieval System -- Environment Canada
AA - Atomic Absorption
UV - Ultraviolet
NFR - Nonfilterable Residue
ICAP - Inductively Coupled Argon Plasma.
SUS - Suspended

PARAMETERS

Responsible Agency: Saskatchewan Environment
Data Collected by: SaskPower

ESQUADAT* Code	Parameter	Analytical method	Sampling Frequency Station No.				
			2	3	4	5	6
10151	Alkalinity-phenol	Pot-Titration	DIS	Q	DIS	DIS	OF
10101	Alkalinity-tot	Pot-Titration	DIS	Q	DIS	DIS	OF
13004	Aluminum-tot	AA-Direct	DIS	A	DIS	DIS	
33004	Arsenic-tot	Flameless AA	DIS	A	DIS	DIS	
06201	Bicarbonates	Calculated	DIS	Q	DIS	DIS	OF
05451	Boron-tot	ICAP	DIS	Q	DIS	DIS	W
48002	Cadmium-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
20103	Calcium	AA-Direct	DIS	Q	DIS	DIS	OF
06052	Carbon-tot Inorganic	Infrared	DIS	Q	DIS	DIS	OF
06005	Carbon-tot Organic	Infrared	DIS	Q	DIS	DIS	OF
06301	Carbonates	Calculated	DIS	Q	DIS	DIS	OF
17203	Chloride	Automated Colourimetric	DIS	Q	DIS	DIS	OF
06711	Chlorophyll- 'a'	Spectrophotometry	DIS	Q	DIS	DIS	
24004	Chromium-tot	AA-Direct	DIS	A	DIS	DIS	
36012	Coliform-fec	Membrane filtration	DIS	Q	DIS	DIS	OF
36002	Coliform-tot	Membrane filtration	DIS	Q	DIS	DIS	OF
02041	Conductivity	Conductivity Meter	DIS	Q	DIS	DIS	W
29005	Copper-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
09105	Fluoride	Specific Ion Electrode	DIS	A	DIS	DIS	
82002	Lead-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
12102	Magnesium	AA-Direct	DIS	Q	DIS	DIS	OF
80011	Mercury-tot	Flameless-AA	DIS	A	DIS	DIS	
42102	Molybdenum	AA-Solvent Extract (N-Butyl acetate)	DIS	A	DIS	DIS	
07015	N-TKN	Automated Colourimetric	DIS	Q	DIS	DIS	OF
10401	NFR	Gravimetric	DIS	Q	DIS	DIS	OF
10501	NFR(F)	Gravimetric	DIS	Q	DIS	DIS	OF
28002	Nickel-tot	AA-Solvent Extract (MIBK)	DIS	Q	DIS	DIS	OF
07110	Nitrate + NO_2	Automated Colourimetric	DIS	Q	DIS	DIS	OF
06521	Oil and Grease	Pet Ether Extraction	DIS	A	DIS	DIS	
08102	Oxygen-diss	Meter	DIS	Q	DIS	DIS	OF
15406	Phosphorus-tot	Colourimetry	DIS	Q	DIS	DIS	OF
19103	Potassium	Flame Photometry	DIS	Q	DIS	DIS	OF
34005	Selenium-Ext	Hydride generation	DIS	A	DIS	DIS	
11103	Sodium	Flame Photometry	DIS	Q	DIS	DIS	OF
16306	Sulphate	Colourimetry	DIS	Q	DIS	DIS	OF
10451	TDS	Gravimetric	DIS	Q	DIS	DIS	OF
02061	Temperature	Thermometer	DIS	Q	DIS	DIS	OF
23004	Vanadium-tot	AA-Direct	DIS	A	DIS	DIS	
30005	Zinc-tot	AA-Solvent Extract (MIBK)	DIS	A	DIS	DIS	
10301	pH	Electrometric	DIS	Q	DIS	DIS	W

* Computer storage and retrieval system - Saskatchewan Environment.

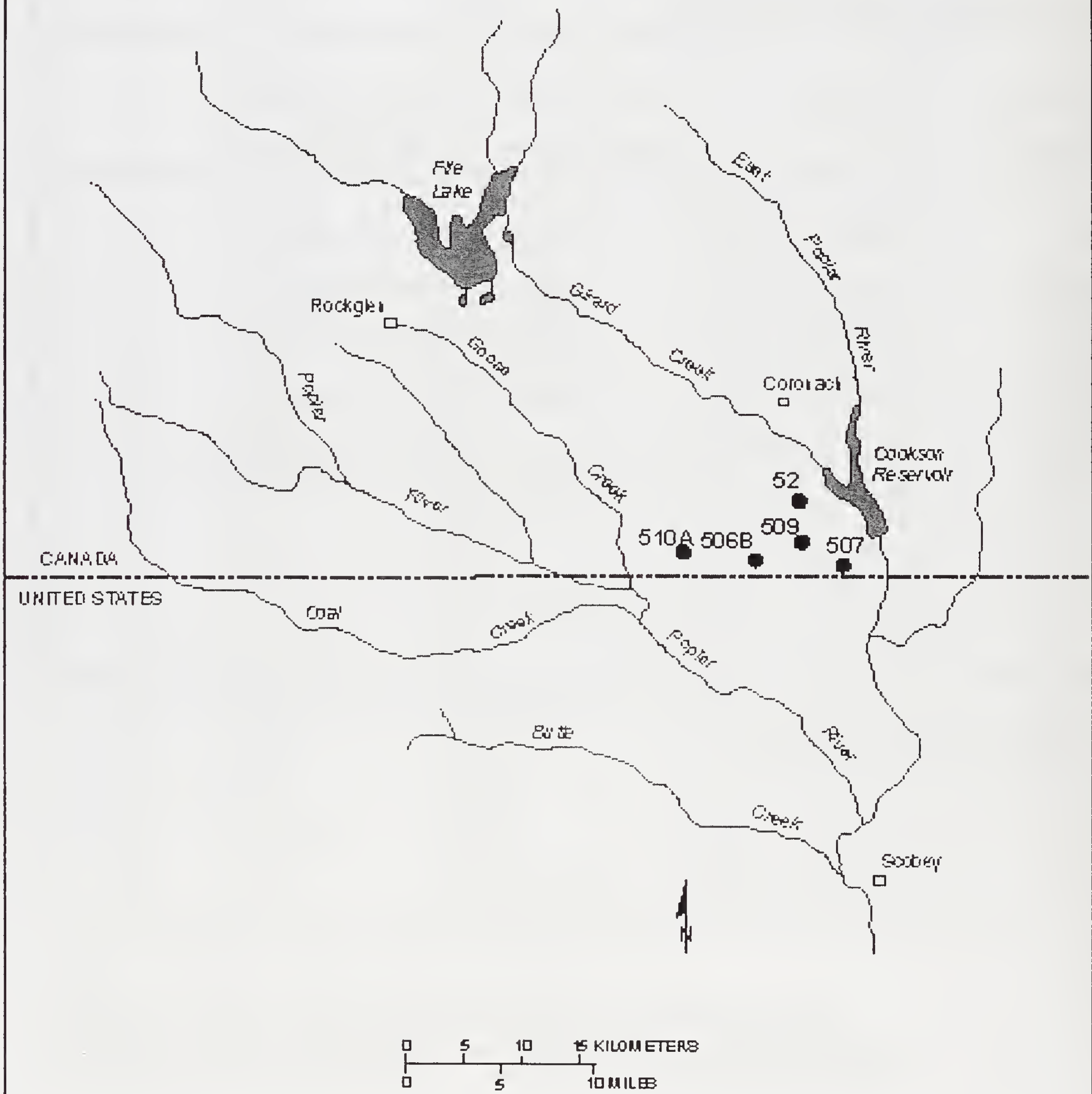
Symbols:
W – Weekly during overflow; OF– Once during each period of overflow greater than 2 weeks' duration;
Q – Quarterly; A – Annually; AA – Atomic Absorption; Pot – Potentiometric; tot – total; Pet – Petroleum;
fec – fecal; diss – dissolved; EXT – extract; NFR – Nonfilterable residue; NFR(F) – Nonfilterable residue, fixed;
ICAP – Inductively Coupled Argon Plasma; (MIBK) – sample acidified and extracted with Methyl Isobutyl Ketone;
DIS - Discontinued.

GROUNDWATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN

DUE TO COAL-SEAM DEWATERING NEAR THE INTERNATIONAL BOUNDARY

Responsible Agency: Saskatchewan Watershed Authority*			
Measurement Frequency: Quarterly			
Piezometer Number	**Location**	**Tip of Screen Elevation (m)**	**Perforation Zone (depth in metres)**
52	NW 14-1-27 W3	738.43	43-49 (in coal)
506B	SW 4-1-27 W3	48.27	81-82 (in coal)
507	SW 6-1-26 W3	725.27	34 - 35 (in coal)
509	NW 11-1-27 W3	725.82	76-77 (in coal)
510A	NW 1-1-28 W3	769.34	28-29 (in coal and clay)

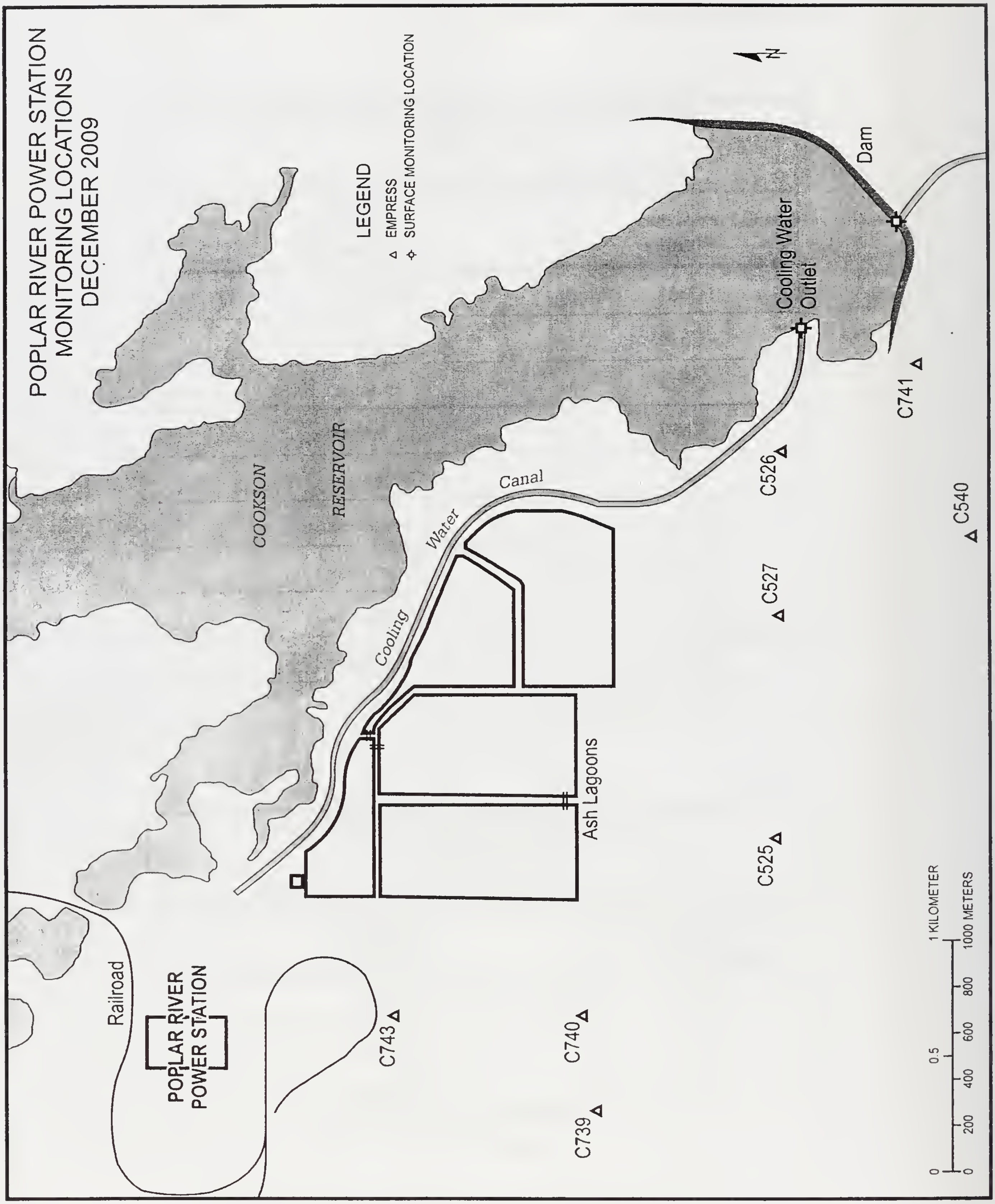
*Data Collected by: SaskPower



GROUND-WATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

GROUNDWATER PIEZOMETER MONITORING POPLAR RIVER POWER STATION AREA--WATER LEVELS	
SPC Piezometer Number	**Completion Formation**
C525	Empress
C526	Empress
C527	Empress
C539	Empress
C540	Empress
C739	Empress
C740	Empress
C741	Empress
C743	Empress

GROUNDWATER PIEZOMETER MONITORING POPLAR RIVER POWER STATION AREA--WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C526	Empress
C540	Empress
C741	Empress


POPLAR RIVER POWER STATION
MONITORING LOCATIONS
DECEMBER 2009
LEGEND
EMPRESS
SURFACE MONITORING LOCATION
N
COOKSON
RESERVOIR
Cooling Water Canal
Cooling Water
Outlet
Dam
Ash Lagoons
Railroad
POPLAR RIVER
POWER STATION
C743
C740
C739
C525
C527
C526
C540
C741
1 KILOMETER
0
0.5
1000 METERS
0
200
400
600
800

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA--WATER LEVEL	
SPC Piezometer Number	**Completion Formation**
C533	Empress
C534	Oxidized Till
C654	Unoxidized Till
C711	Oxidized Till
C712B	Unoxidized Till
C712B	Intra Till Sand
C712C	Mottled Till
C712D	Oxidized Till
C713	Oxidized Till
C714A	Unoxidized Till
C714B	Unoxidized Till
C714C	Oxidized Till
C714D	Oxidized Till
C714B	Empress
C715	Oxidized Till
C717	Oxidized Till
C720	Oxidized Till
C721	Oxidized Till
C72[illegible]	Oxidized Till
C723	Oxidized Till
C725	Oxidized Till
C726E	Unoxidized Till
C728C	Oxidized Till
C726E	Empress
C728C	Mottled Till
C728D	Oxidized Till
C728E	Empress
C741	Empress
C742	Empress
C758	Intra Till Sand

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA--WATER LEVEL	
SPC Piezometer Number	**Completion Formation**
C763A	Mottled Till
C763B	Oxidized Till
C763D	Unoxidized Till
C763E	Empress

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA -- WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C534	Empress
C534	Oxidized Till
C654	Unoxidized Till
C711	Oxidized Till
C712A	Unoxidized Till
C712B	Intra Till Sand
C712C	Mottled Till
C712D	Oxidized Till
C713	Oxidized Till
C714A	Unoxidized Till
C714B	Unoxidized Till
C714C	Oxidized Till
C714A	Oxidized Till
C714E	Empress
C715	Oxidized Till
C717	Oxidized Till
C720	Oxidized Till
C721	Oxidized Till
C722	Oxidized Till
C723	Oxidized Till
C725	Oxidized Till

GROUNDWATER PIEZOMETER MONITORING ASH LAGOON AREA -- WATER QUALITY	
SPC Piezometer Number	**Completion Formation**
C726B	Unoxidized Till
C726C	Oxidized Till
C726E	Empress
C726E	Mottled Till
C728B	Oxidized Till
C728E	Empress
C741	Empress
C742	Empress
C758	Intra Till Sand
C763B	Mottled Till
C763B	Oxidized Till
C763D	Unoxidized Till
C763E	Empress

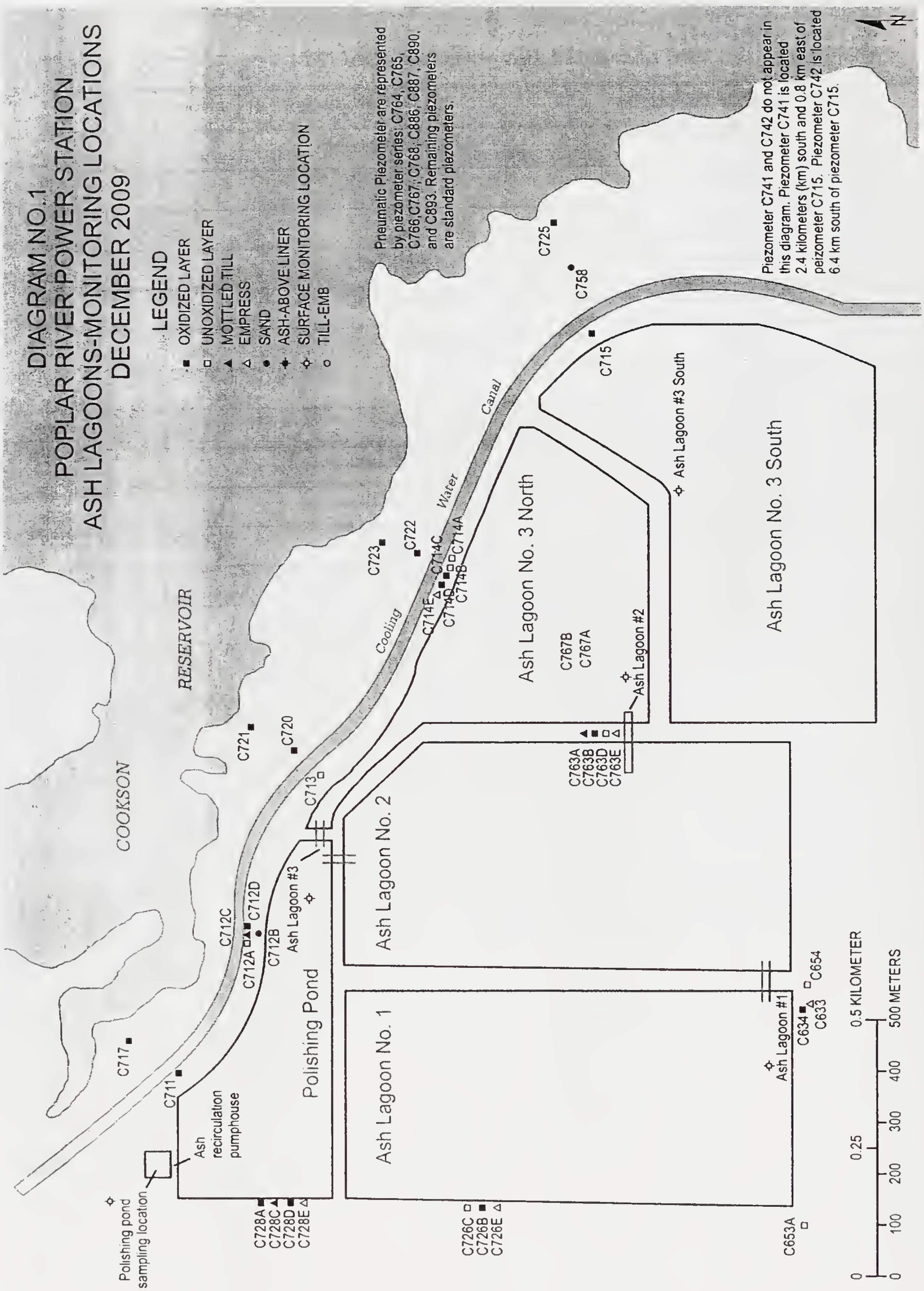


DIAGRAM NO.1
POPLAR RIVER POWER STATION
ASH LAGOONS-MONITORING LOCATIONS
DECEMBER 2009
LEGEND
OXIDIZED LAYER
UNOXIDIZED LAYER
MOTTLED TILL
EMPRESS
SAND
ASH-ABOVE LINER
SURFACE MONITORING LOCATION
TILL-EMB
Pneumatic Piezometer are represented by piezometer series: C764, C765, C766, C767, C768, C886, C887, C890, and C893. Remaining piezometers are standard piezometers.
Piezometer C741 and C742 do not appear in this diagram. Piezometer C741 is located 2.4 kilometers (km) south and 0.8 km east of peizometer C715. Piezometer C742 is located 6.4 km south of piezometer C715.
N
COOKSON
RESERVOIR
Cooling Water Canal
Polishing pond sampling location
Ash recirculation pumphouse
Polishing Pond
Ash Lagoon No. 1
Ash Lagoon No. 2
Ash Lagoon No. 3 North
Ash Lagoon No. 3 South
Ash Lagoon #1
Ash Lagoon #2
Ash Lagoon #3
Ash Lagoon #3 South
C711
C712A
C712B
C712C
C712D
C713
C714A
C714B
C714C
C714D
C714E
C715
C717
C720
C721
C722
C723
C725
C726C
C726B
C726E
C728A
C728C
C728D
C728E
C758
C763A
C763B
C763D
C763E
C767B
C767A
C633
C634
C653A
C654
0 0.25 0.5 KILOMETER
0 100 200 300 400 500 METERS

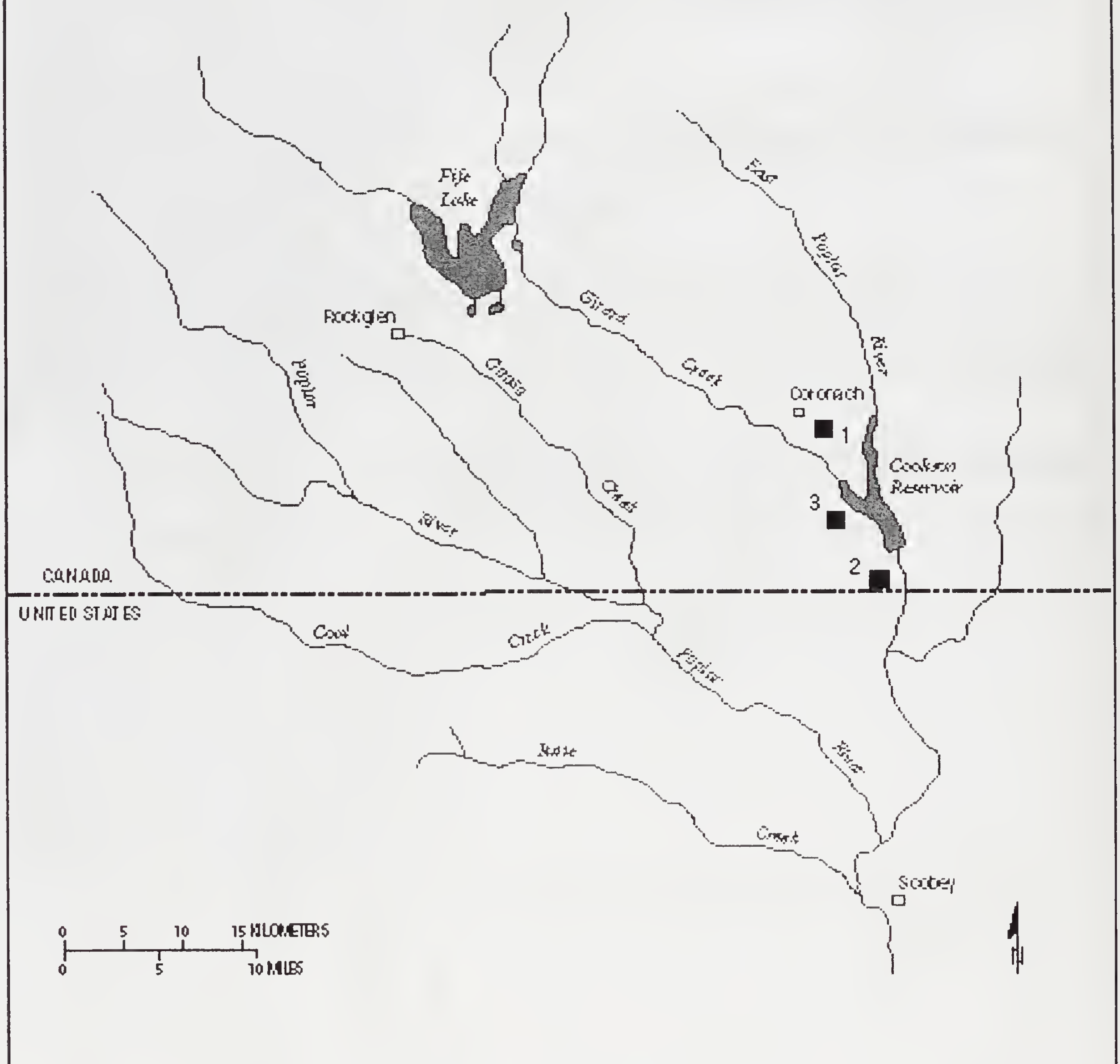
Ambient Air-Quality Monitoring

Responsible Agency: Saskatchewan Environment
Data Collected by: SaskPower

No. On Map	Location	Parameters	Reporting Frequency
1	Coronach (Discontinued)	Sulphur Dioxide Total Suspended Particulate	Continuous monitoring with hourly averages as summary statistics. 24-hour samples on 6-day cycle, corresponding to the national air pollution surveillance sampling schedule.
2	International Boundary	Sulphur Dioxide Total Suspended Particulate	Continuous monitoring with hourly averages as summary statistics. 24-hour samples on 6-day cycle, corresponding to the national air pollution surveillance sampling schedule.
3	Poplar River Power Station	Wind Speed and Direction	Continuous monitoring with hourly averages as summary statistics

METHODS

Sulphur Dioxide	Saskatchewan Environment Pulsed fluorescence
Total Suspended Particulate	Saskatchewan Environment High Volume Method



AMBIENT AIR-QUALITY MONITORING (CANADA)

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

2010

UNITED STATES

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

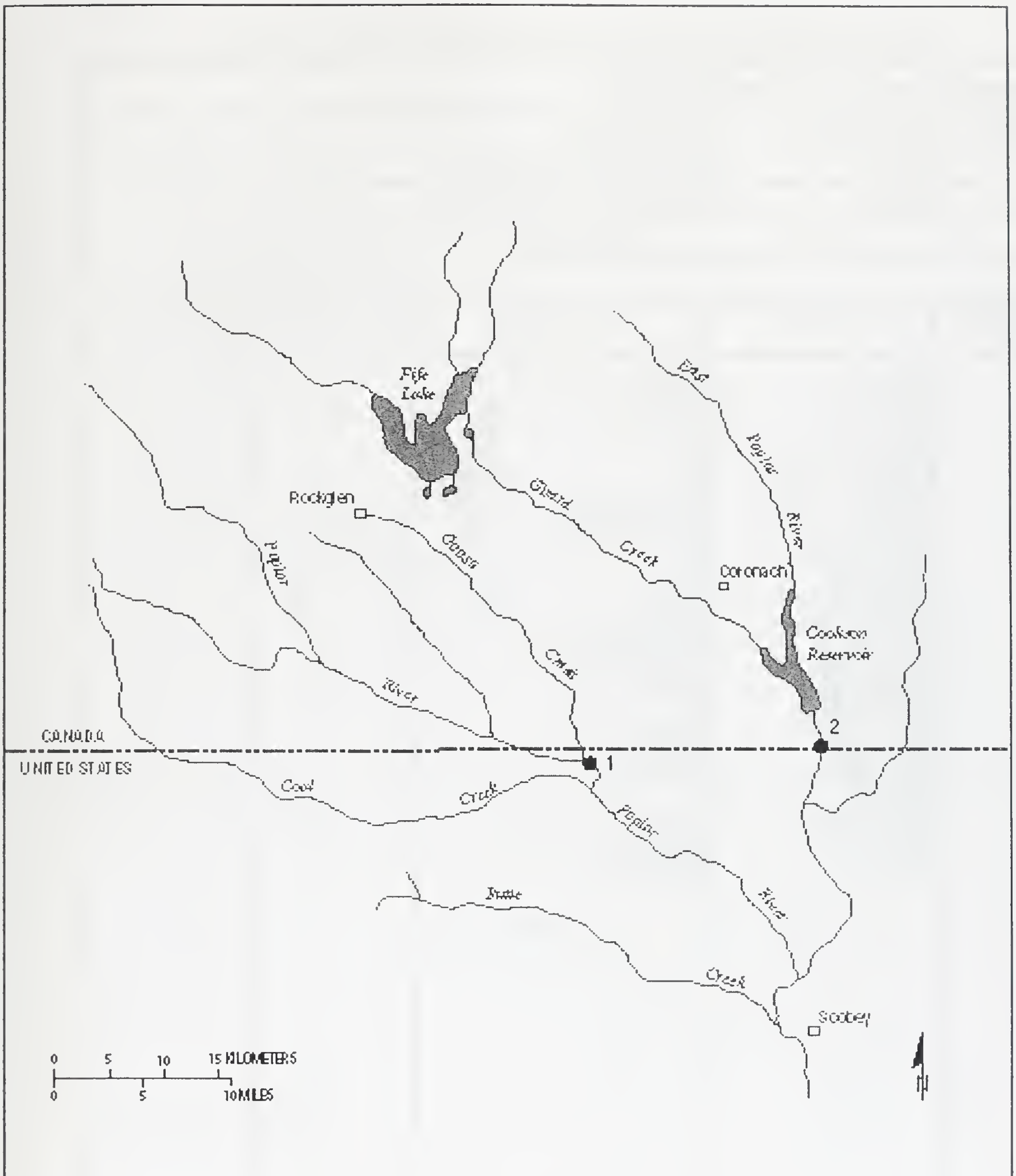
2010

UNITED STATES

STREAMFLOW MONITORING

Responsible Agency: U.S. Geological Survey		
No. on Map	**Station Number**	**Station Name**
1*	06178000 (11AE008)	Poplar River at International Boundary
2*	06178500 (11AE003)	East Poplar River at International Boundary

* International Gauging Station



HYDROMETRIC GAUGING STATIONS (UNITED STATES)

SURFACE-WATER-QUALITY MONITORING -- Station Locations

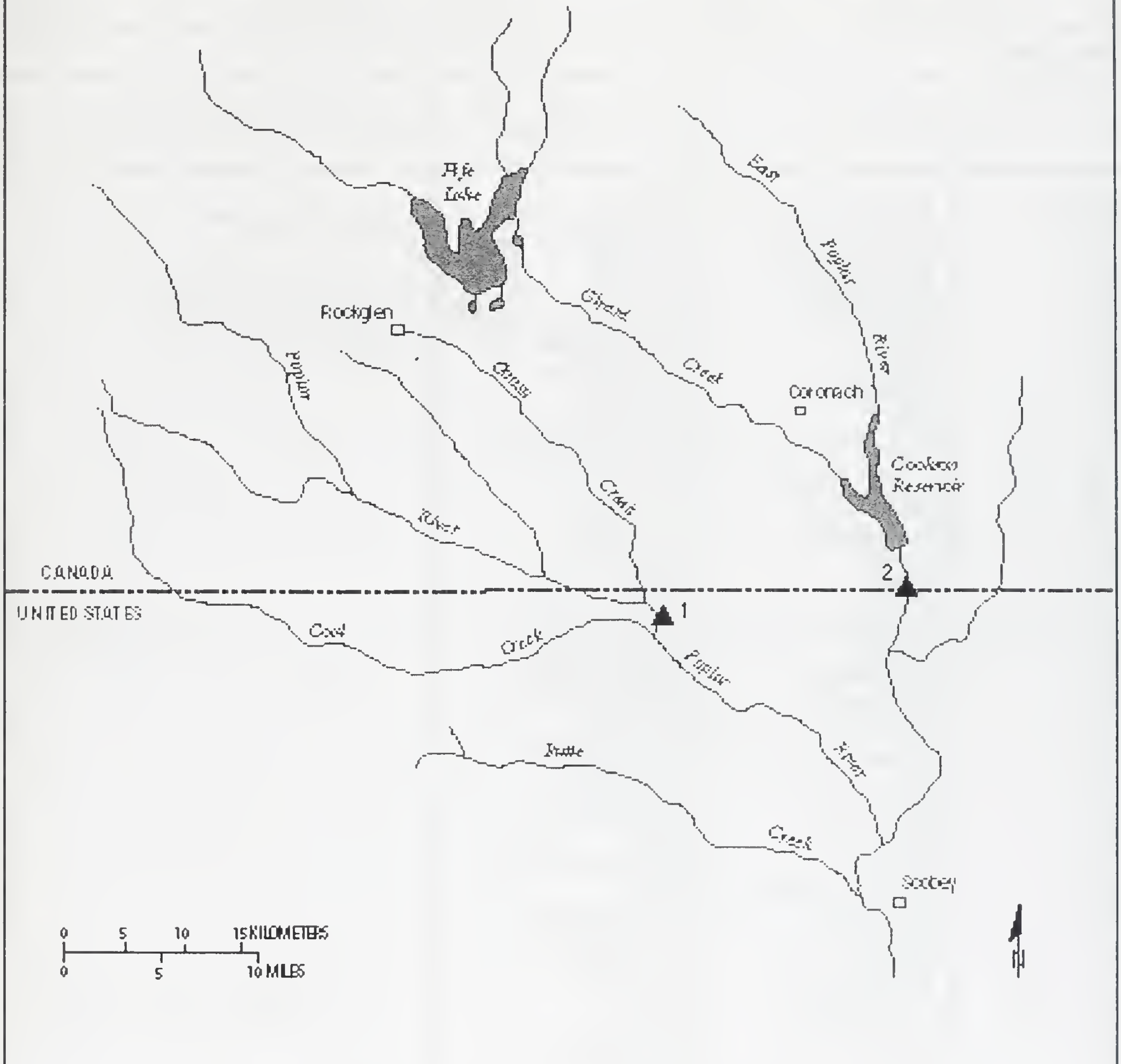
Responsible Agency: U.S. Geological Survey		
No. On Map	**USGS Station No.**	**STATION NAME**
1	06178000	Poplar River at International Boundary
2	06178500	East Poplar River at International Boundary

PARAMETERS

			Annual Sampling Frequency	
Analytical Code	**Parameter**	**Analytical Method**	**Site 1***	**Site 2****
29801	Alkalinity - lab	Fixed endpoint Titration	4	4
00608	Ammonia - diss	Colorimetric	4	4
01002	Arsenic - tot	AA, GF	4	4
00025	Barometric pressure	Barometer, field	4	4
01020	Boron – diss	ICP	4	4
01027	Cadmium - tot/rec	ICP, MS	4	4
00915	Calcium - diss	ICP	4	4
00940	Chloride - diss	IC	4	4
00095	Conductivity	Wheatstone Bridge	4	4
00061	Discharge - inst	Direct measurement	4	4
00900	Hardness		4	4
00950	Fluoride - diss	ISE	4	4
01051	Lead - tot/rec	ICP, MS	4	4
00925	Magnesium - diss	ICP	4	4
00613	Nitrate - diss	Colorimetric	4	4
00631	Nitrate + Nitrite - diss	Colorimetric	4	4
00300	Oxygen-diss	Oxygen membrane, field	4	4
00400	pH	Electrometric, field	4	4
00671	Phos, Ortho-diss	Colorimetric	4	4
00665	Phosphorous - tot	Colorimetric	4	4
00935	Potassium - diss	AA	4	4
00931	SAR	Calculated	4	4
80154	Sediment - conc.	Filtration-Gravimetric	4	4
80155	Sediment - load	Calculated	4	4
00955	Silica - diss	Colorimetric	4	4
00930	Sodium - diss	ICP	4	4
00945	Sulphate - diss	IC	4	4
70301	Total Dissolved Solids	Calculated	4	4
00010	Temp Water	Stem Thermometer	4	4
00020	Temp Air	Stem Thermometer	4	4
01092	Zinc - tot/rec	ICP, MS	4	4

Samples collected obtained during the monthly periods: * -- March - April; May; June; July - September
** -- May; June; July, August - September

Abbreviations: AA - atomic absorption; conc. – concentration; **CVAF** – cold vapor atomic fluorescence; **diss** – dissolved; **GF** - graphite furnace; **IC** - ion exchange chromatography; **ICP** - inductively coupled plasma; **ISE** – ion-selective electrode; **MS** – mass spectrography ; **Org** – organic; **phos.** – phosphate; **tot** – total; **tot/rec** - total recoverable



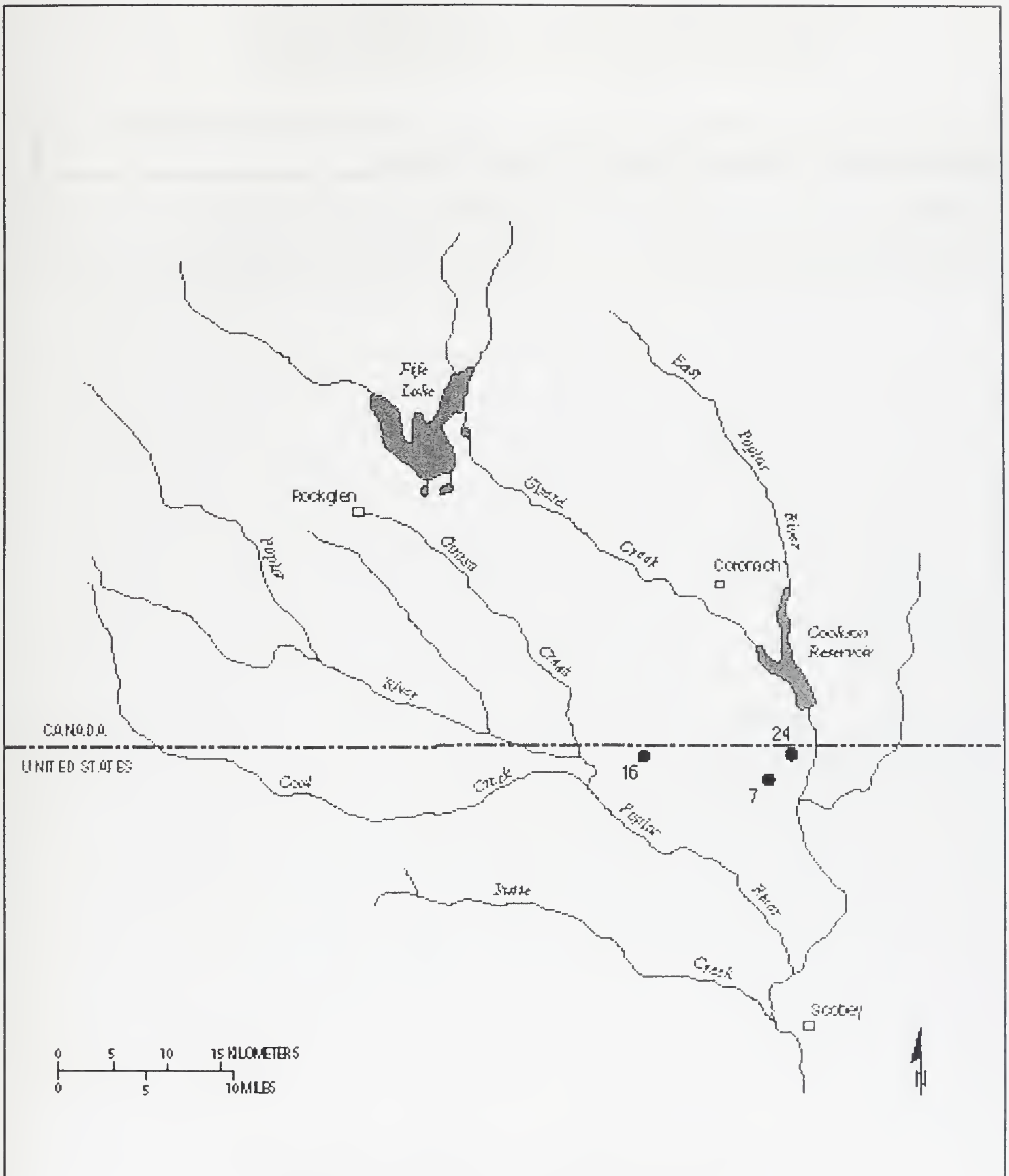
SURFACE-WATER-QUALITY MONITORING STATIONS (UNITED STATES)

GROUND-WATER-QUALITY MONITORING -- Station Locations					
Map Number	**Well Location**	**Total Depth (m)**	**Casing Diameter (cm)**	**Aquifer**	**Perforation Zone (m)**
7	37N47E12BBBB	44.1	10.2	Hart Coal	39-44
16	37N46E3ABAB	25.5	10.2	Fort Union	23-25
24	37N48E5AB	9.6	10.2	Alluvium	9.2-9.6

Parameters

Storet ** Code	Parameter	Analytical Method	Sampling Frequency Station No.
0041001106	Alkalinity	Calculated	Sample collection is annually for all locations identified above. The analytical method descriptions are those of the Montana Bureau of Mines and Geology Laboratory where the samples are analyzed.
01095	Aluminum dissolved	ICP or ICP-MS	
50250	Antimony dissolved	ICP or ICP-MS	
01005	Arsenic dissolved	ICP or ICP-MS	
01010	Barium dissolved	ICP or ICP-MS	
00440	Beryllium dissolved	ICP or ICP-MS	
01020	Bicarbonates	Electrometric Titration	
82298	Boron-diss	Emission Plasma, ICP	
01025	Bromide	Ion Chromatography	
00915	Cadmium,dissolved	ICP or ICP-MS	
00445	Calcium	Emission Plasma	
00940	Carbonates	Electrometric Titration	
01030	Chloride	Ion Chromatography	
01035	Chromium, dissolved	ICP or ICP-MS	
00095	Cobalt, dissolved	ICP or ICP-MS	
01040	Conductivity	Wheatstone Bridge	
00950	Copper, dissolved	ICP or ICP-MS	
09000	Fluoride	Ion Chromatography	
01046	Hardness	Calculated	
01049	Iron-diss	Emission Plasma, ICP	
01130	Lead-diss	Emission Plasma, ICP	
00925	Lithium-diss	Emission Plasma, ICP	
01056	Magnesium	Emission Plasma, ICP	
01060	Manganese-diss	Emission Plasma, ICP	
01065	Molybdenum	Emission Plasma, ICP-MS	
00630	Nickel, dissolved	ICP or ICP-MS	
00671	Nitrate	Ion Chromatography	
00400	Orthophosphate	Ion Chromatography	
00935	pH	Electrometric	
00931	Potassium	Emission Plasma, ICP	
01145	SAR	Calculated	
00955	Selenium-diss	ICP-MS	
01075	Silica	Emission Plasma, ICP-MS	
00930	Silver, dissolved	ICP-MS	
01080	Sodium	Emission Plasma, ICP	
00445	Strontium-diss	Emission Plasma, ICP	
01057	Sulphate	Ion Chromatography	
01150	Thallium, dissolved	ICP or ICP-MS	
28011	Titanium, dissolved	ICP or ICP-MS	
01085	Uranium, dissolved	ICP-MS	
00190	Vanadium, dissoved	ICP or ICP-MS	
01160	Zinc-diss	Emission Plasma, ICP	
*	Zirconium, dissolved	ICP or ICP-MS	
70301	Sum of diss. Constituents	Calculated	
	TDS	Calculated	

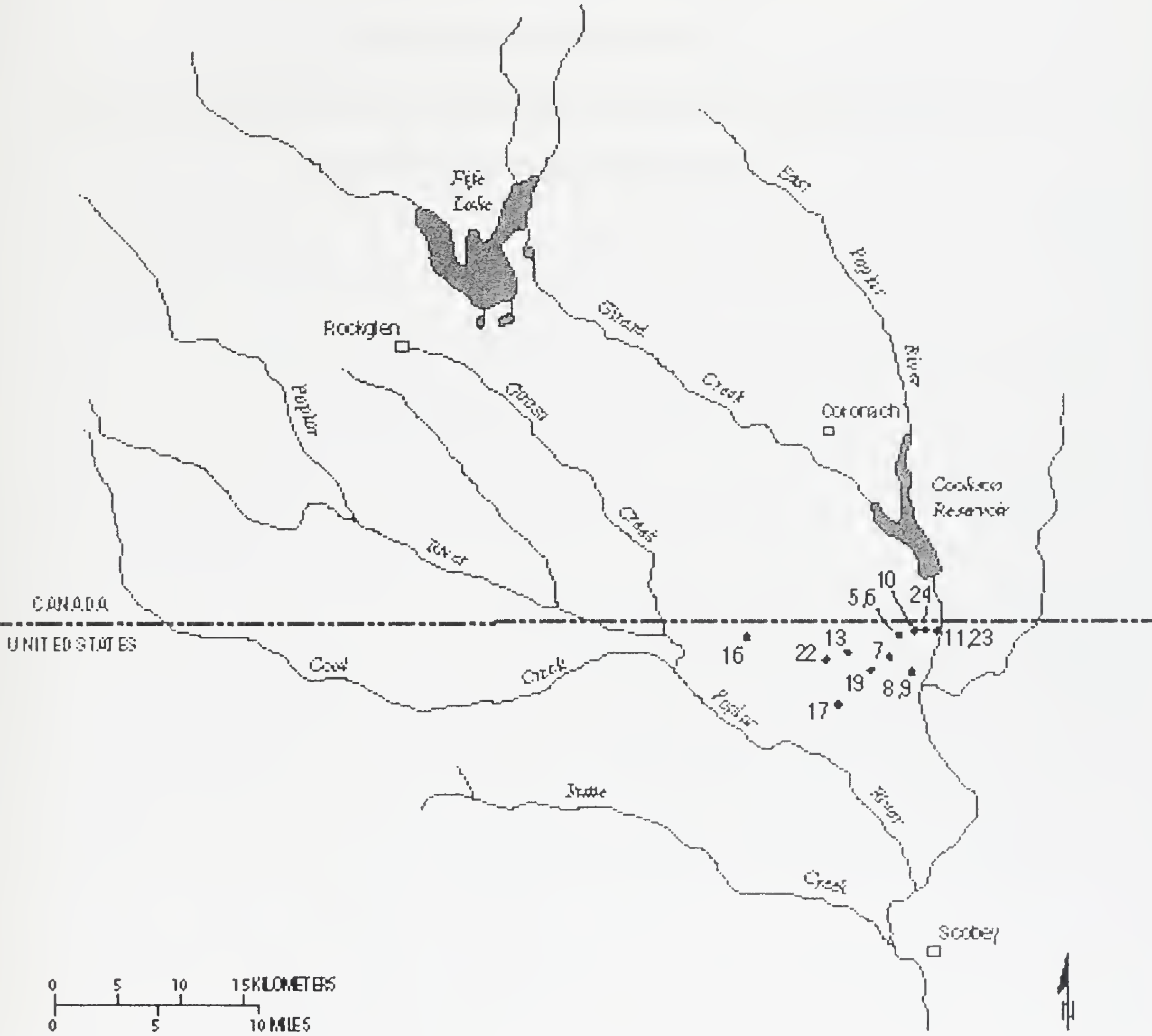
SYMBOLS:
** - Computer storage and retrieval system -- EPA ICP – Inductively Coupled Plasma Unit
cm – centimetre ICP – MS – Inductively Coupled Plasma – Mass Spectrometry diss – dissolved m – metre



GROUND-WATER-QUALITY MONITORING (UNITED STATES)

GROUNDWATER LEVELS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

Responsible Agency: Montana Bureau of Mines and Geology	
No. on Map	**Sampling**
5,6,7,8,9,10,11,13,16,17,19,22,23,24	Determine water levels quarterly



GROUND-WATER PIEZOMETERS TO MONITOR POTENTIAL DRAWDOWN DUE TO COAL-SEAM DEWATERING

ANNEX 3

RECOMMENDED FLOW APPORTIONMENT

IN THE POPLAR RIVER BASIN

BY THE INTERNATIONAL SOURIS-RED RIVERS ENGINEERING BOARD,

POPLAR RIVER TASK FORCE (1976)

*RECOMMENDED FLOW APPORTIONMENT IN THE POPLAR RIVER BASIN

The aggregate natural flow of all streams and tributaries in the Poplar River Basin crossing the International Boundary shall be divided equally between Canada and the United States subject to the following conditions:

1. The total natural flow of the West Fork Poplar River and all its tributaries crossing the International Boundary shall be divided equally between Canada and the United States but the flow at the International Boundary in each tributary shall not be depleted by more than 60 percent of its natural flow.

2. The total natural flow of all remaining streams and tributaries in the Poplar River Basin crossing the International Boundary shall be divided equally between Canada and the United States. Specific conditions of this division are as follows:

   (a) Canada shall deliver to the United States a minimum of 60 percent of the natural flow of the Middle Fork Poplar River at the International Boundary, as determined below the confluence of Goose Creek and Middle Fork.

   (b) The delivery of water from Canada to the United States on the East Poplar River shall be determined on or about the first day of June of each year as follows:

      (i) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period does not exceed 4,690 cubic decameters (3,800 acre-feet), then a continuous minimum flow of 0.028 cubic metres per second (1.0 cubic foot per second) shall be delivered to the United States on the East Poplar River at the International Boundary throughout the succeeding 12 month period commencing June 1st. In addition, a volume of 370 cubic decameters (300 acre-feet) shall be delivered to the United States upon demand at any time during the 12 month period commencing June 1st.

      (ii) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period is greater than 4,690 cubic decameters (3,800 acre-feet), but does not exceed 9,250 cubic decameters (7,500 acre-feet),

* Canada-United States, 1976, Joint studies for flow apportionment, Poplar River Basin, Montana-Saskatchewan: Main Report, International Souris-Red Rivers Board, Poplar River Task Force, 43 pp.

then a continuous minimum flow of 0.057 cubic metres per second (2.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.028 cubic metres per second (1.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 617 cubic decameters (500 acre-feet) shall be delivered to the United States upon demand at any time during the 12-month period commencing June 1st.

(iii) When the total natural flow of the Middle Fork Poplar River, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period is greater than 9,250 cubic decameters (7,500 acre-feet), but does not exceed 14,800 cubic decameters (12,000 acre-feet), then a continuous minimum flow of 0.085 cubic metres per second (3.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.057 cubic metres per second (2.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 617 cubic decameters (500 acre-feet) shall be delivered to the United States upon demand at any time during the 12 month period commencing June 1st.

(iv) When the total natural flow of the Middle Fork Poplar, as determined below the confluence of Goose Creek, during the immediately preceding March 1st to May 31st period exceeds 14,800 cubic decameters (12,000 acre-feet) then a continuous minimum flow of 0.085 cubic metres per second (3.0 cubic feet per second) shall be delivered to the United States on the East Poplar River at the International Boundary during the succeeding period June 1st through August 31st. A minimum delivery of 0.057 cubic metres per second (2.0 cubic feet per second) shall then be maintained from September 1st through to May 31st of the following year. In addition, a volume of 1,230 cubic decameters (1,000 acre-feet) shall be delivered to the United States upon demand at any time during the 12-month period commencing June 1st.

(c) The natural flow at the International Boundary in each of the remaining individual tributaries shall not be depleted by more than 60 percent of its natural flow.

3. The natural flow and division periods for apportionment purposes shall be determined, unless otherwise specified, for periods of time commensurate with the uses and requirements of both countries.

ANNEX 4

CONVERSION FACTORS

CONVERSION FACTORS

ac	=	4,047 m^3 = 0.04047 ha
ac-ft	=	1,233.5 m^3 = 1.2335 dam^3
°C	=	5/9(°F-32)
cm	=	0.3937 in.
cm^2	=	0.155 in^2
dam^3	=	1,000 m^3 = 0.8107 ac-ft
ft^3	=	28.3171 x $10^{-3}m^3$
ha	=	10,000 m^2 = 2.471 ac
hm	=	100 m = 328.08 ft
hm^3	=	1 x 10^6 m^3
I. gpm	=	0.0758 L/s
in	=	2.54 cm
kg	=	2.20462 lb = 1.1 x 10^{-3} tons
km	=	0.62137 miles
km^2	=	0.3861 mi^2
L	=	0.3532 ft^3 = 0.21997 I. gal = 0.26420 U.S. gal
L/s	=	0.035 cfs = 13.193 I. gpm = 15.848 U.S. gpm
m	=	3.2808 ft
m^2	=	10.765 ft^2
m^3	=	1,000 L = 35.3144 ft^3 = 219.97 I. gal= 264.2 U.S. gal
m^3/s	=	35.314 cfs
mm	=	0.00328 ft
tonne	=	1,000 kg = 1.1023 ton (short)
U.S. gpm	=	0.0631 L/s

For Air Samples

ppm = 100 pphm = 1000 x (Molecular Weight of substance/24.45) mg/m^3