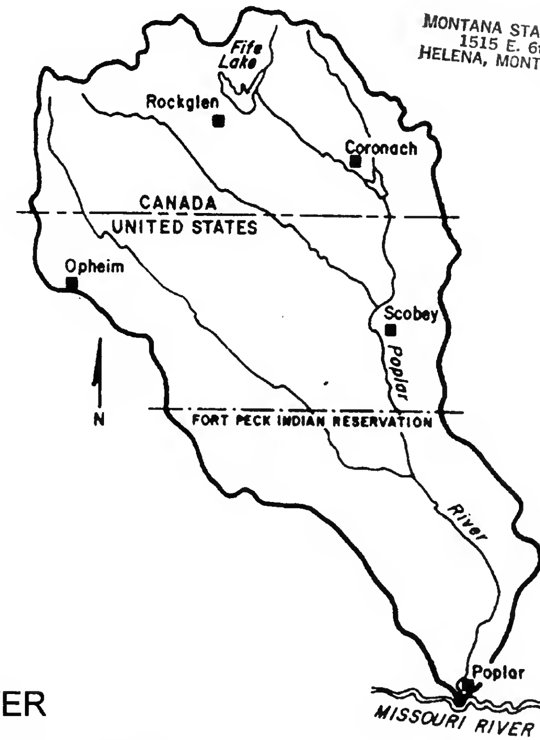
1995 ANNUAL REPORT

to the

GOVERNMENTS OF CANADA, UNITED STATES, SASKATCHEWAN AND MONTANA



by the

POPLAR RIVER BILATERAL MONITORING COMMITTEE

COVERING CALENDAR YEAR 1995

December 1996

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COVERING CALENDAR YEAR 1995

December, 1996

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 External Affairs
and International Trade Canada
Ottawa, Ontario, Canada

Saskatchewan Environment and
Resource Management
Regina, Saskatchewan, Canada

Ladies and Gentlemen:

Herein is the 15th Annual Report of the Poplar River Bilateral Monitoring Committee. This report discusses the Committee activities of 1995 and presents the proposed schedule for 1996.

During 1995, the Poplar River Bilateral Monitoring Committee continued to fulfil the responsibilities assigned by the governments under the Poplar River Cooperative Monitoring Agreement dated September 23, 1980. Through exchange of Diplomatic Notes, on March 12, 1987, the Arrangement was extended to March 1991. In July 1992, another exchange of Diplomatic Notes extended the Arrangement retroactively from March 31, 1991 to March 31, 1996. In addition, the Arrangement was modified to terminate the quarterly exchange of data and substitute an annual exchange of data.

The enclosed report summarizes current conditions and compares them to guidelines for specific parameter values that were developed by the International Joint Commission under the 1977 Reference from Canada and the United States. After examination and evaluation of the monitoring information for 1995, the Committee finds that the measured conditions meet the recommended objectives. However, the Committee notes that the flow-weighted concentration of total dissolved solids in streamflow in the East Poplar River at the International Boundary continues to increase and is approaching the long-term objective of 1,000 milligrams per litre. The Committee also notes that there is the need to finalize the three unresolved parameters - pH, mercury in fish, and unionized ammonia.

During 1995, monitoring continued in accordance with Technical Monitoring Schedules outlined in 1992 Annual Report of the Poplar River Bilateral Monitoring Committee.

Yours sincerely,

Robert Davis
Chairman, United States Section

Gary Fritz
Member, United States Section

Richard Kellow
Chairman, Canadian Section

Darryl Nargang
Member, Canadian Section

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HIGHLIGHTS FOR 1995

The Poplar River Power Station completed its twelfth full year of operation in 1995. The two 300-megawatt coal-fired units generated 4 472 200 gross megawatt hours of electricity which is about 102 percent of the 1994 power and 103 percent of 1993 power. The average capacity factors for Units No. 1 and 2 was 87.2 percent and 85.3 percent, respectively.

Monitoring information collected in both Canada and the United States during 1995 was exchanged in the spring of 1996. In general, the sampling locations, frequency of collection, and parameters met the requirements identified in the 1995 Technical Monitoring Schedules set forth in the 1994 annual report.

Streamflow in the Poplar River basin was below normal in 1995. The March to October recorded flow for the Poplar River at the International Boundary was 3 340 dam^3 or 33 per cent of the 1931 to 1990 median seasonal flow. The 1995 recorded flow volume of the East Poplar River at the International Boundary was 2 530 dam^3. This volume is 85 per cent of the median annual flow since the completion of the Morrison Dam in 1975. The on-demand release, in accordance with the apportionment recommendations of the International Joint Commission (IJC), entitled Montana to a release of 617 dam^3 from Cookson Reservoir during the twelve month period commencing June 1, 1994. Montana requested this release to be made between April 11 and May 31, 1995. In addition to the minimum flow, a volume of 628 dam^3 was delivered during this period.

It is noted that the 5-year moving flow-weighted concentrations of total dissolved solids for the East Poplar River at the International Boundary were continuing to approach the 1 000 milligrams per litre objective. The calculated 5-year flow-weighted concentration of total dissolved solids for 1995 was 989 milligrams per litre. However, the concentration of boron for 1995 was 1.84 milligrams per litre, below its objective of 2.5 milligrams per litre.

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. On March 12, 1987, the Arrangement was extended by the Governments for four years to March 1991. The Arrangement was further extended for another five years to March 1996, following a request from the Committee in 1991. 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. This report is the fifteenth in the series. 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 Government 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 forthcoming year. 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 1995, the members of the Committee included: Mr. J. A. Moreland, U.S. Geological Survey, United States representative and Cochair; Mr. R. Kellow, Environment Canada, Canadian representative and Cochair; Mr. G. Fritz, Montana Department of Natural Resources and Conservation, Montana representative; Mr. D. D. Nargang, Saskatchewan Environment and Resource Management, Saskatchewan representative; Mr. C.W. Tande, Daniels County Commissioner, Montana local ex-officio representative; and Mr. J.R. Totten, Reeve, R.M. of Hart Butte, Saskatchewan local ex-officio representative.

2.2 Meetings

The Committee met on August 2 and 3, 1995, in Helena, Montana. Delegated representatives of Governments, with the exception of the two ex-officio members from Montana and Saskatchewan, attended the meeting. In addition to Committee members, several technical advisors representing Federal, State and Provincial agencies participated in the meeting. During the meeting, the Committee reviewed the operational status of the Poplar Power Plant and associated coal mining activities; examined data collected in 1994 including surface water-quality and quantity, ground water-quality and quantity, and air quality; established the Technical Monitoring Schedules for 1996; discussed proposed changes in water-quality objectives and the possibility of replacing the flow-weighing method currently used to compute total dissolved solids and boron. The Committee also prepared the first draft of the 1994 annual Report to Governments.

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, the Committee undertook a review of water-quality objectives.

The Committee approved changes in water-quality objectives recommended by the 1991 subcommittee which was formed to review the objectives. Revised objectives approved by the Committee are listed in Table 2.1.

The Committee 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. Objectives for unionized ammonia, pH, and mercury in fish tissue and the rational for using flow-weighted averages in the determinations of total dissolved solids and boron will require additional study.

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 information will be reported and exchanged whenever warranted. No unusual conditions occurred during 1995 which warranted special reporting.

Table 2.1 Water-quality Objectives

PARAMETER	PRESENT OBJECTIVE	RECOMMENDATION	NEW OBJECTIVE
Boron - total	3.5/2.5[1]	Discontinue flow weighting	?
TDS	1500/1000[1]	Discontinue flow weighting	?
Aluminum, dissolved	0.1	Discontinue	---
Ammonia, un-ionized	0.02	Base objective on temperature and pH (table to be done later)	---
Cadmium, total	0.0012	Continue as is	0.0012
Chromium, total	0.05	Discontinue	---
Copper, dissolved	0.005	Discontinue	---
Copper, total	1.0	Continue as is	1.0
Fluoride, dissolved	1.5	Continue as is	1.5
Lead, total	0.03	Continue as is	0.03
Mercury, dissolved	0.0002	Change to total	0.0002
Mercury, fish (mg/kg)	0.5	Discuss with fisheries people	?
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)	10.0	Continue as is	10.0
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 (need to determine what is natural)	6.5[4]
Coliform (no./100 ml)			
Fecal	2,000	Discontinue	---
Total	20,000	Discontinue	---

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 <1500 TDS.
2. 5.0 (minimum April 10 to May 15), 4.0 (minimum remainder of year).
3. Natural temperature (April 10 to May 15), <30 degree Celsius (remainder of year)
4. Less than 0.5 pH units above natural, minimum pH=6.5.

3.0 WATER AND AIR: MONITORING AND INTERPRETATIONS

3.1 Poplar River Power Station Operation

In 1995, the average capacity factor for Unit No. 1 was 87.2 percent. The average capacity factor for Unit No. 2 was 85.3 percent. The capacity factors are based on the maximum generation rating of 297.8 MW/h for Unit No. 1 and 294.0 MW/h for Unit No. 2. Total power generated from both units was 4 472 200 gross megawatt-hours which is about 102 percent of 1994 power and 103 percent of 1993 power.

There was no major construction activity during 1995 as compared to 1994 when Ash Lagoon #3 South was constructed. A minor construction project was started in the fall of 1995 to install a new discharge culvert between Ash Lagoons 1 and 2.

3.2 East Poplar River

3.2.1 Streamflow

Streamflow in the Poplar River basin was below normal in 1995. The March to October recorded flow of the Poplar River at the International Boundary, an indicator of natural flow in the basin, was 3 340 cubic decameters (dam^3) or 33 percent of the 1931 to 1990 median seasonal flow. However, timely precipitation sustained above-average flows in the normally dry late-summer months after below-average snowmelt runoff in the spring. A comparison of 1995 mean monthly discharge with the 1961-90 median flow is shown in Figure 3.1.

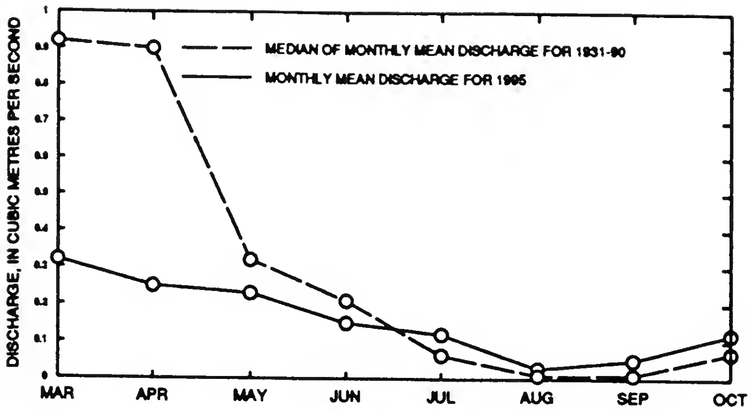


Figure 3.1 **Discharge during 1995 as Compared with the Median Discharge from 1931-1990 for Poplar River at the International Boundary.**

The 1995 recorded flow volume of the East Poplar River at the International Boundary was 2 530 dam^3. This volume is 85% of the median annual flow since the completion of Morrison Dam in 1975.

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 not officially adopted by the two countries, the Poplar River Bilateral Monitoring Committee has adhered to the Apportionment Recommendations in each of its annual reports. Annex 3 contains the apportionment recommendation.

3.2.3 Minimum Flows

The recorded volume of the Poplar River at the International Boundary from March 1 to May 31, 1995 was 2 110 dam^3. 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 of 0.028 m^3/s for the period June 1, 1995 to May 31, 1996. The minimum flow for the period January 1 to May 31, 1995 had previously been determined on the basis of the Poplar River flow volume for March 1 to May 31, 1994. A hydrograph of the East Poplar River at the International Boundary and the minimum flow as recommended by the IJC are shown in Figure 3.2.

Daily flows during 1995 occasionally fell below the recommended minimum during the winter months because of beaver activity, ice conditions, and severe cold spells. The deficit volume for January through March, 1995, was 10 dam^3 - an average of 0.001 m^3/s per day.

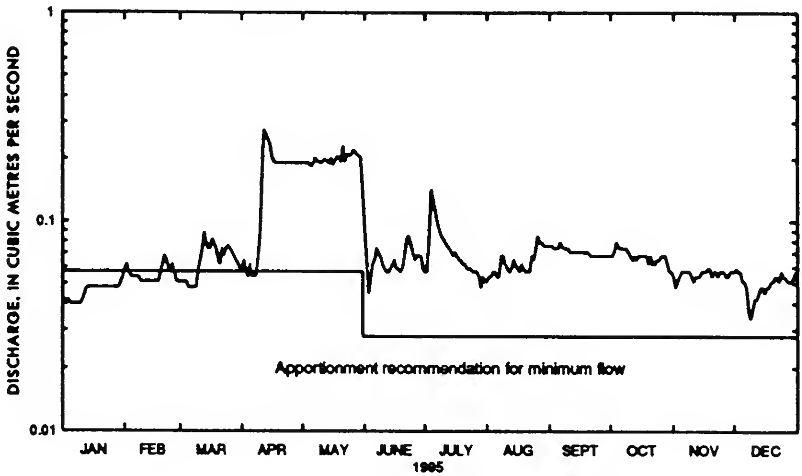


Figure 3.2 **Flow Hydrograph of the East Poplar River at the International Boundary.**

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 during the twelve month period commencing June 1. Based on the runoff volume of 13 200 dam^3 recorded at the Poplar River at the International Boundary gaging station during the March 1 to May 31, 1994 period, Montana was entitled to a release of 617 dam^3 from Cookson Reservoir during the twelve month period commencing June 1, 1994. Montana requested this release to be made between April 11 and May 31, 1995. In addition to the minimum flow, a volume of 628 dam^3 was delivered during this period.

3.2.5 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 1500 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 1000 mg/L or less for TDS in the East Poplar River at the International Boundary.***

For the period prior to 1982, three-month moving flow-weighted concentrations (FWC) for boron and TDS were calculated solely from monthly monitoring results. Since the beginning of 1982, the US Geological Survey (USGS) has monitored specific conductance daily in the East Poplar River at the International boundary, allowing estimates of daily boron and TDS concentration to be derived from the regression relationship with specific conductance. Thus, three-month FWCs for the period 1982 to 1995 have been calculated from both the results of monthly monitoring and the daily concentration estimates.

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 five-year moving FWCs which were 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, FWCs were calculated from the five year period preceding each plotted point. For example, the FWC for December 1995 refers to the FWC of the period December 1990 to December 1995. 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

There is an inverse relationship between TDS and streamflow at the International Boundary station. During periods of high runoff, such as spring freshet, TDS drops as the proportion of streamflow derived ultimately 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 natural ground-water has a higher ionic strength than the surface water entering the river, the TDS of the stream increases markedly during low flow conditions.

TDS grab sample data collected by Environment Canada and the USGS in 1995 are shown in Figure 3.3. TDS ranged from 899 mg/L on 6-July to 1 194 mg/L on 9-May. The proposed short-term objective for TDS is 1 500 mg/L. A time plot of the three-month moving FWCs for TDS is presented in Figure 3.4. No exceedences of the objective have been observed during any three month period since 1975. The three-month FWC's remained confined within a narrow range centred around a mean of approximately 984 mg/L (regression generated data) and 1 039 mg/L (grab sample data).

Figure 3.3: TDS Concentrations for 1995 Grab Samples from East Poplar River at the International Boundary

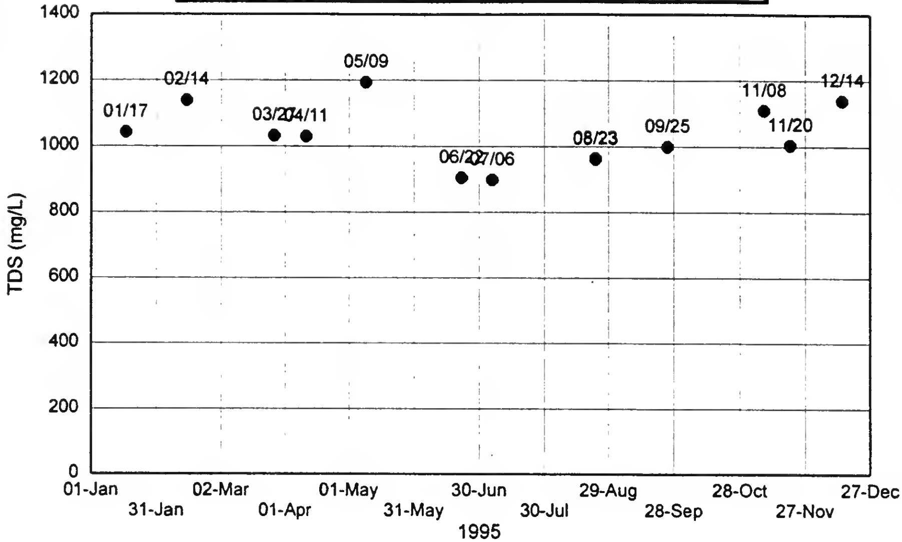
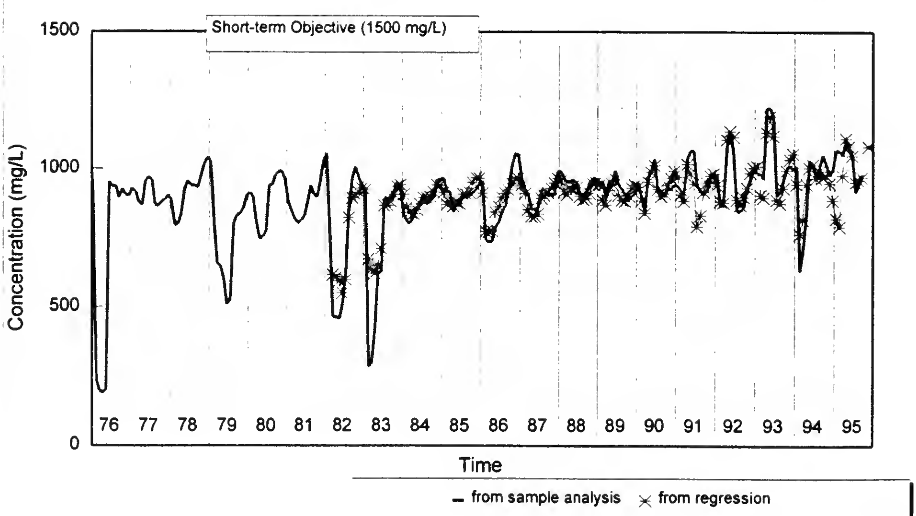


Figure 3.4: Three Month Moving Flow-Weighted TDS Concentrations for East Poplar River at the International Boundary



Five-year FWC's for TDS at 989 mg/L (Figure 3.5) for 1995 continued to approach, but remained below the long-term objective of 1000 mg/L. The maximum monthly value calculated in 1995 was 981 mg/L. This gradual increase in five-year FWC for TDS is due to low surface runoff in the late eighties/early nineties, particularly reflected in the spring flows, which has not allowed for sufficient flushing of Cookson Reservoir.

A linear regression analysis was applied to the daily TDS values, as generated from the daily specific conductance readings from 1982 to 1995 (Figure 3.6). The regression line shows a gradual increase in TDS over this period. The positive trend is probably due to drought conditions in southern Saskatchewan during the latter part of the 1980's, and the early 1990's. Hence, a larger overall contribution of ground-water to the flow in the East Poplar River. The upward trend could also be attributed in part to higher rates of evaporation from Cookson Reservoir during the hot, dry period of the late 1980's, and to the fact that the Reservoir has received very little flushing over the period of record, due to the need to conserve cooling water. It should be understood though, that this regression line has a low R-squared value, which means that it is only a very general indicator of long-term trends, and should not be thought of as a predictive tool.

The relationship between TDS and conductivity generated from data collected from 1975 to 1995 is as follows:

$$\mathbf{TDS = (0.639 \times specific\ conductance) + 11.286}$$
$$\mathbf{(R^2 = 0.87,\ n = 517)}$$

Figure 3.5: Five-Year Moving Flow-Weighted TDS Concentrations for East Poplar River at the International Boundary

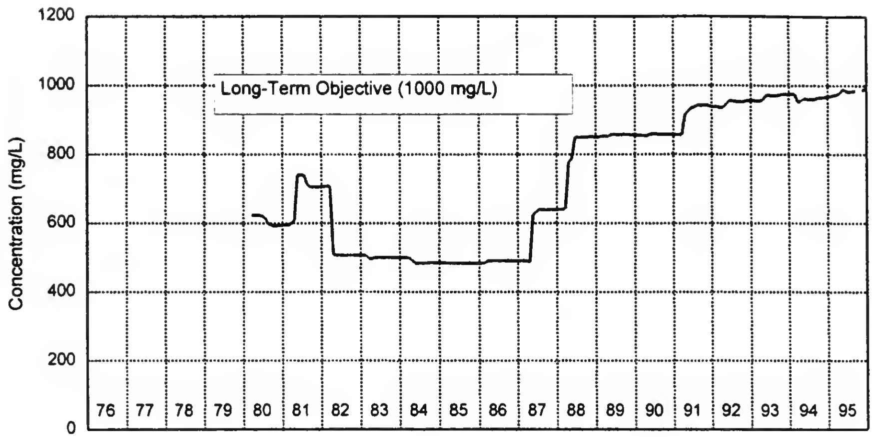
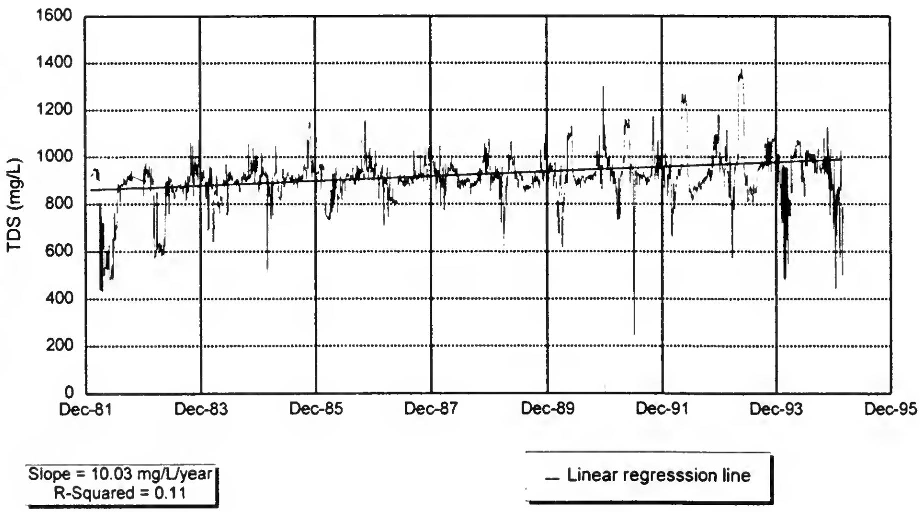


Figure 3.6: Daily TDS Concentration, 1982 to 1995, East Poplar River at the International Boundary



3.2.5.2 Boron

During 1995, boron concentrations in the East Poplar River at the International Boundary varied from 0.94 (9-May) to 2.2 mg/L (14-February, and 14-December) (Figure 3.7).

Three-month boron FWC's for the period of record are shown in Figure 3.8. The short-term objective of 3.5 mg/L was not exceeded for the period 1975-1995. It can be seen that the data derived from grab samples and that derived from regression with specific conductance are similar, with the highs and lows in some degree of correspondence. This indicates that the regression generation of boron (and TDS) values is in general terms, a valid procedure.

The five-year boron FWC's displayed in Figure 3.9 remained well below the long-term objective of 2.5 mg/L. From mid 1993 to the end of the data period there is a distinct drop in the computed values.

The relationship between boron and conductivity at the East Poplar River sampling location during the period 1975 to 1995 is described by the equation:

$$\textbf{boron} = (0.0013 \times \textbf{specific conductance}) - 0.092$$
$$(R^2 = 0.61, n = 517)$$

As shown in Figure 3.10, the straight line generated by the regression analysis of boron (dependent variable) over time (independent variable) shows a positive slope of 0.025 mg/L/year. Again, as was the case with TDS, this is only a general indicator of a long-term behaviour. It should not be considered a predictive tool, without a more detailed analysis of weather, ground-water conditions, and conditions imposed by the power station.

Figure 3.7: Boron Concentrations for 1995 Grab Samples from East Poplar River at the International Boundary

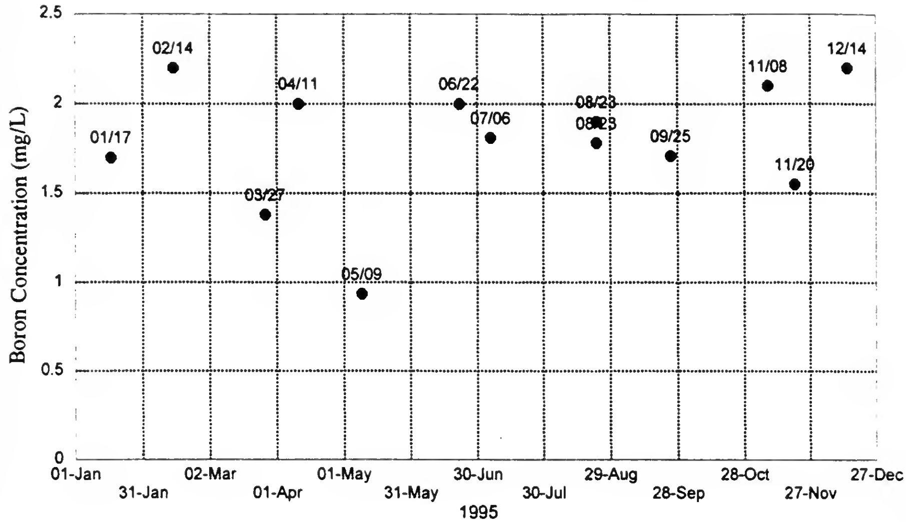


Figure 3.8: Three Month Moving Flow-Weighted Boron Concentrations for East Poplar River at the International Boundary

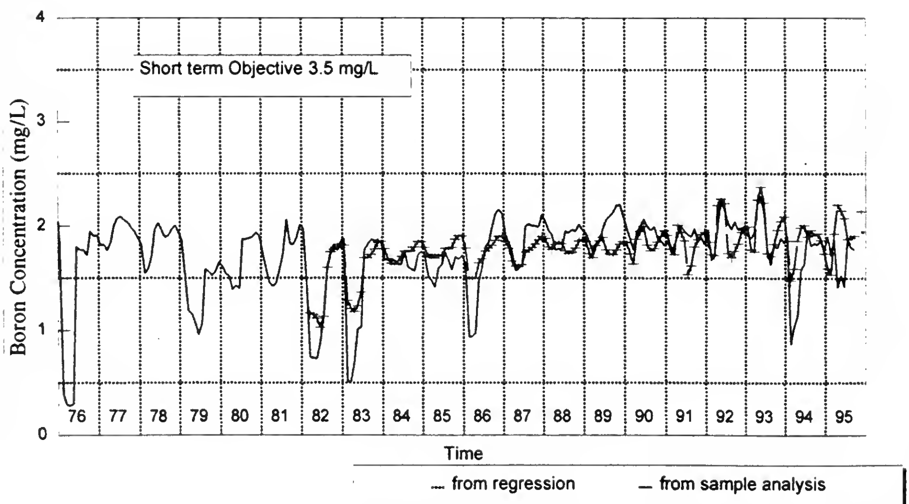


Figure 3.9: Five-Year Moving Flow-Weighted Boron Concentration for East Poplar River at the International Boundary

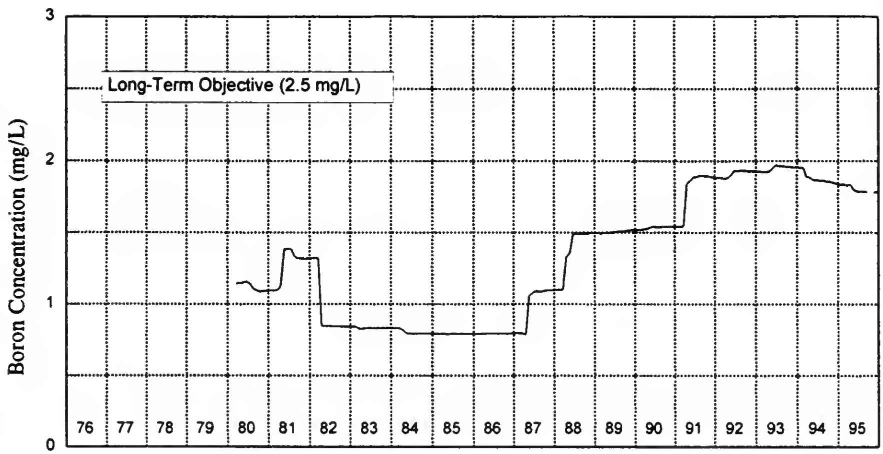
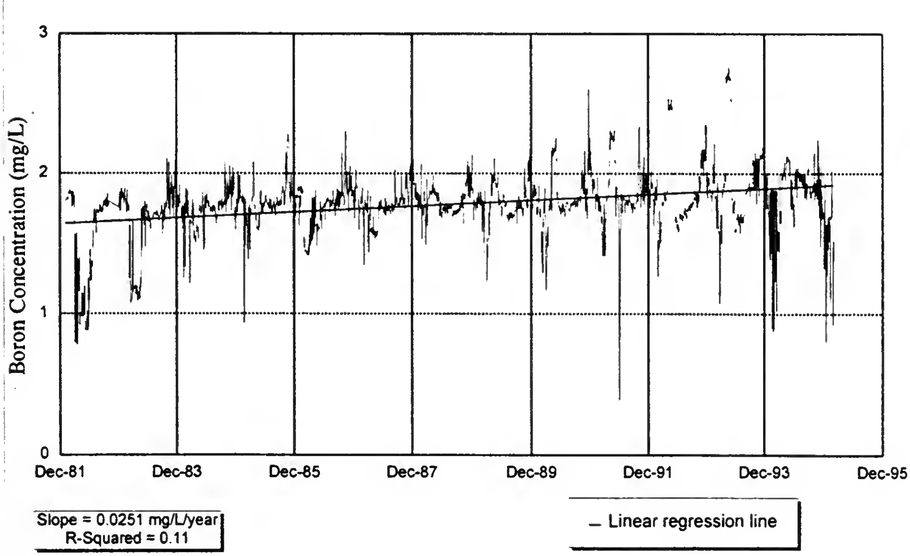


Figure 3.10: Daily Boron Concentration, 1982 to 1995, East Poplar River at the International Boundary



3.2.5.3 Other Water-Quality Variables

Table 3.1 contains the multipurpose water-quality objectives for the East Poplar River at the 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 exceedences over the course of the year. In the table, multiple replicate samples collected during the annual quality control exercise are treated as a single sample, but any exceedences noted in the suite of replicate sample is charged against the single sample noted. There were no exceedences for any parameter measured. The January 17 Canadian sample revealed a dissolved oxygen concentration of 4 mg/L, which is equal to the objective value. Dissolved oxygen levels can be expected to be lower during ice-covered conditions, and low-flow summer conditions where oxygen has been reduced by biological activity.

Table 3.1 lists the updated multipurpose water-quality objectives for the East Poplar River at the International Boundary, recommended by the International Poplar River Water-Quality Board to the IJC. Revisions to the objectives were made in 1992 as outlined in the 1992 annual report. Objectives for un-ionized ammonia, mercury in fish, and pH require further definition. No excursions occurred in 1995.

Table 3.1 Recommended Water-Quality Objectives and Excursions, 1995 Sampling Program, East Poplar River at the 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-total	3.5/2.5 (1)	6	9	Nil
Total Dissolved Solids	1500/1000 (1)	6	9	Nil
Objectives recommended by International Poplar River Water-Quality Board to IJC (Revised in 1992)				
Ammonia un-ionized (as N)	Base objective on temperature and pH (to be defined)	6	9	No Objective
Cadmium-total	0.0012	1	9	Nil
Copper-total	1.0	1	9	Nil
Fluoride-dissolved	1.5	6	9	Nil
Lead-total	0.03	1	9	Nil
Mercury-total	0.0002	--	9	Nil
Mercury-whole fish (mg Hg/Kg)	0.5	--	--	
Nitrate (as N)	10.0	6	9	Nil
Oxygen-dissolved	4.0/5.0 (2)	6	7	Nil
Sodium adsorption ratio (SAR)	10.0	6	9	Nil
Sulphate-dissolved	800.0	6	9	Nil
Zinc-total	0.03	1	9	Nil
Water Temperature (Celsius)	30.0 (3)	6	7	Nil
pH (pH Units)	6.5 (4)	6	7	Nil

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

2. Objective applies only during open water. 5.0 (minimum April 10 to May 15), 4.0 (minimum remainder of year).

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

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

3.3 GROUND-WATER

3.3.1 OPERATIONS

In 1995, SaskPower continued to operate their supplementary ground-water supply to Cookson Reservoir. The 1995 total of 5 376 dam^3 of ground-water produced from the supplementary supply was slightly less than the 1994 production of 5 485 dam^3. SaskPower has an approval to produce an annual volume of 5 500 dam^3.

SaskPower's 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. Production was reasonably consistent throughout most of the year with the exception of July and August when there was a reduction in pumping. In July and August, with the exception of well 11A, wells which do not supply water to domestic users were turned off. Therefore, from mid-July to late August, only 5-6 wells were pumped, as opposed to the remainder of the year when up to 19 wells were pumped. Reduced summer pumping assists in maximizing flows into Cookson Reservoir by minimizing evaporative losses in Girard Creek and ensures that the SaskPower's allocation is not exceeded.

Operation of SaskPower's salinity project continued in 1995 with production from 7 wells, with a total volume of 1 017 dam^3 pumped during the year. This represents a slight reduction from the 1994 pumped volume of 1 095 dam^3. (An eighth well is located along the International Boundary, but has never been operated). As in previous years, the majority of the water was pumped from wells PW87103 and PW87104 on the east side of the river and PW90108 on the west side of the river.

3.3.2 Ground-Water Levels

3.3.2.1 Saskatchewan

There does not appear to be any major changes in the cone of depression in the Hart Coal seam as a result of the supplementary supply project. The 1 m drawdown contour is at or near the International Boundary, much as it has been for the past several years (Figure 3.11). As a result of the map for 1996 being generated by a computer contouring package, there are some differences in the manner in which the contours are drawn, but these differences are minor. The reasonably consistent drawdowns over the past several years (over which the volumes pumped have been fairly consistent) indicate the aquifer system has approached a semi-equilibrium state.

The December 1995 drawdown map for the Empress sands (Figure 3.12) indicates that there was a significant increase in both the extent and magnitude of drawdowns from salinity project pumping. This increase occurred even with a slight reduction of pumping, which demonstrates the impacts of fluctuations in recharge on the project. Recharge in 1995 was lower than in 1993 and 1994. The goal of the project is to lower water levels in the Empress sands below the reservoir by 2-3 metres. This had been established prior to the significant recharge which started in June 1993, and led to drawdowns below the targeted level of 2-3 metres. The drawdown map shows that a 2-3 metre drawdown cone has been re-established on the west side, while drawdowns are 1-1½ metres on the east side. Pumping will target maintenance of the present drawdowns on the west side and expansion of drawdowns on the east to 2-3 metres.

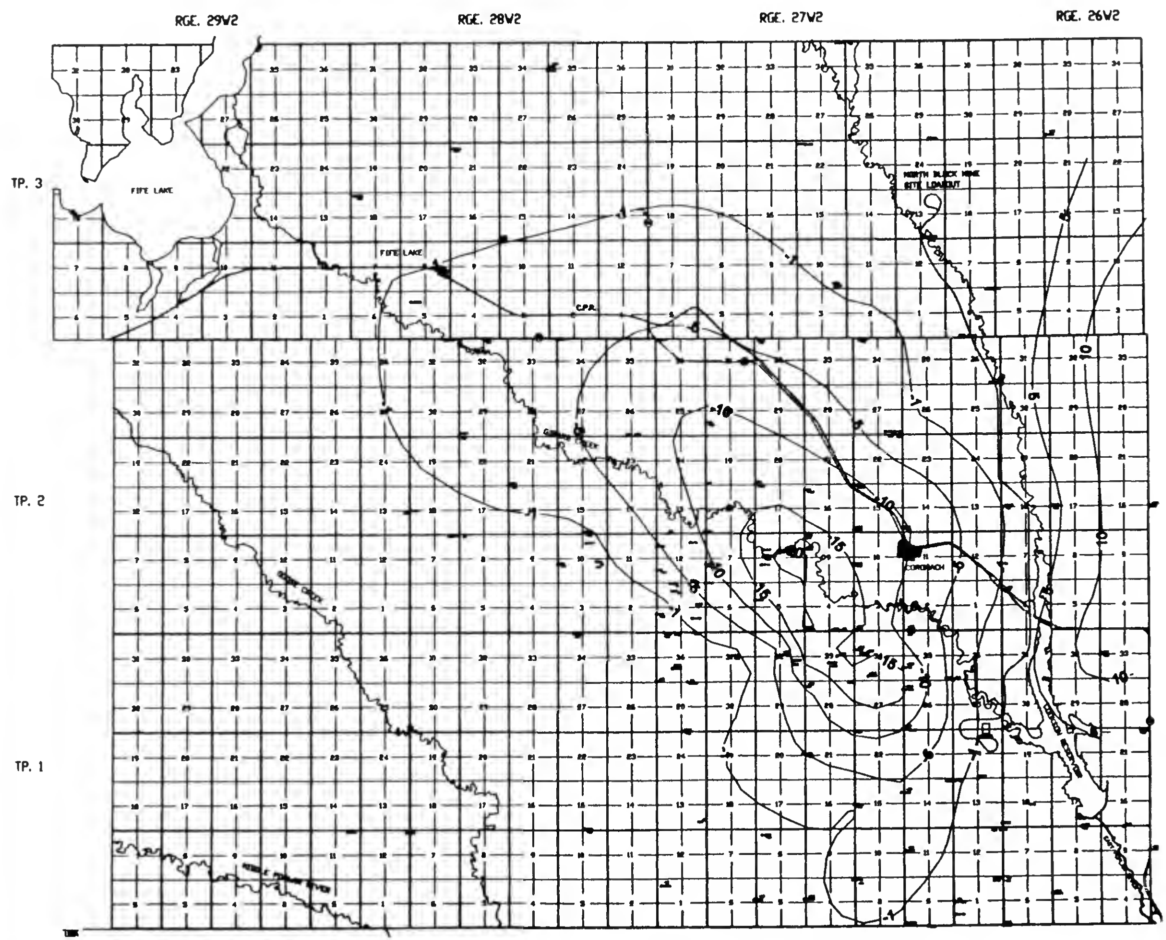


Figure 3.11 Drawdown for Hart Seam Aquifer as of December 1995

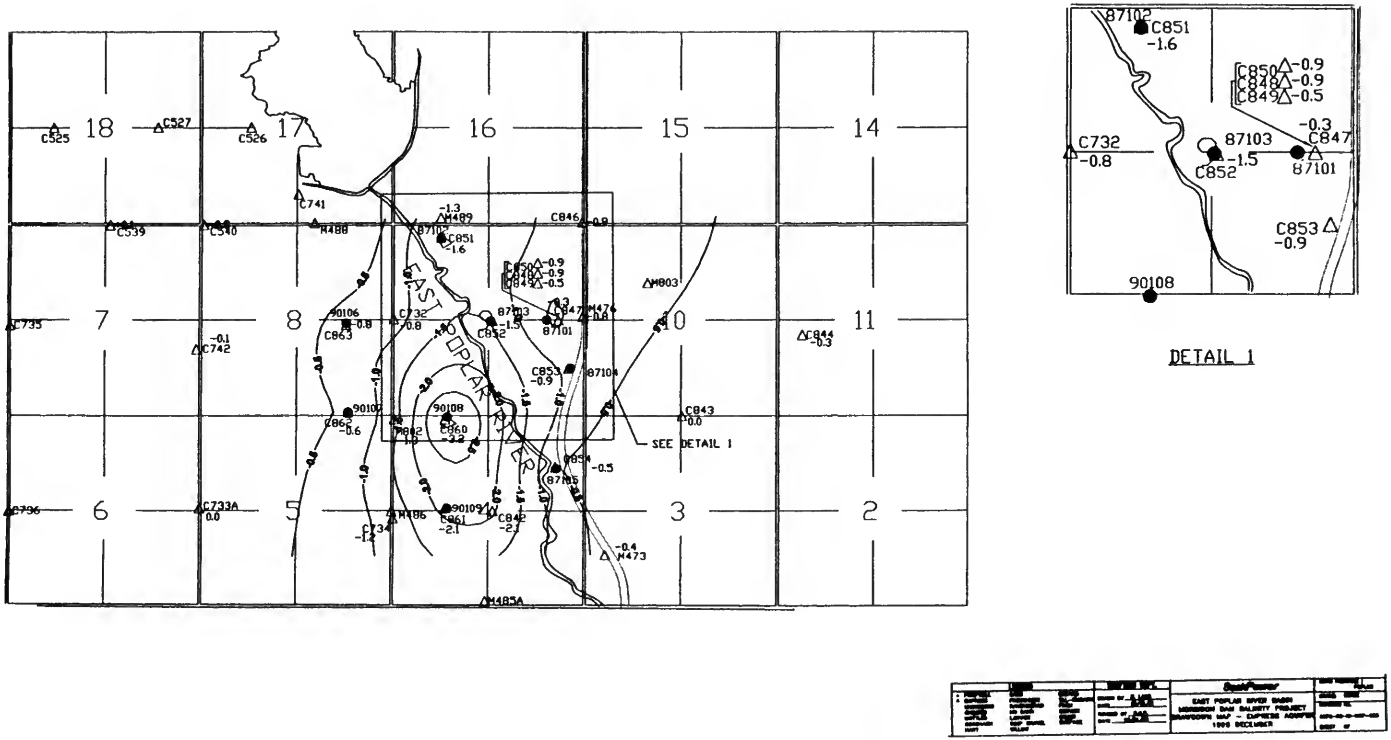


Figure 3.12 Cone of Depression in the Empress Sands Due to the Salinity Control Project as of December 1995

3.3.2.1.1 Frenchman Groundwater Project

Given the low water levels in Cookson Reservoir throughout the early to mid-1990s, SaskPower undertook an evaluation of the Frenchman (Hell Creek) formation as an additional supplementary supply and subsequently submitted an application for 360 dam^3/year from the aquifer . There was some written opposition to the project from local residents and concerns were also submitted by the State of Montana and the United States Geological Survey due to potential drawdowns occurring across the International Boundary. The application is still under consideration.

3.3.2.2 Montana

After an increase in water levels in 1994 due to an excellent recharge year, water levels in Wells 5, 8, 16, 19, 22, and 23 declined in 1995 reflecting a return to normal seasonal fluctuations. Monitoring Wells 6, 7, 9, 11, 13 and 17 fluctuated in response to seasonal changes (Figure 3.13).

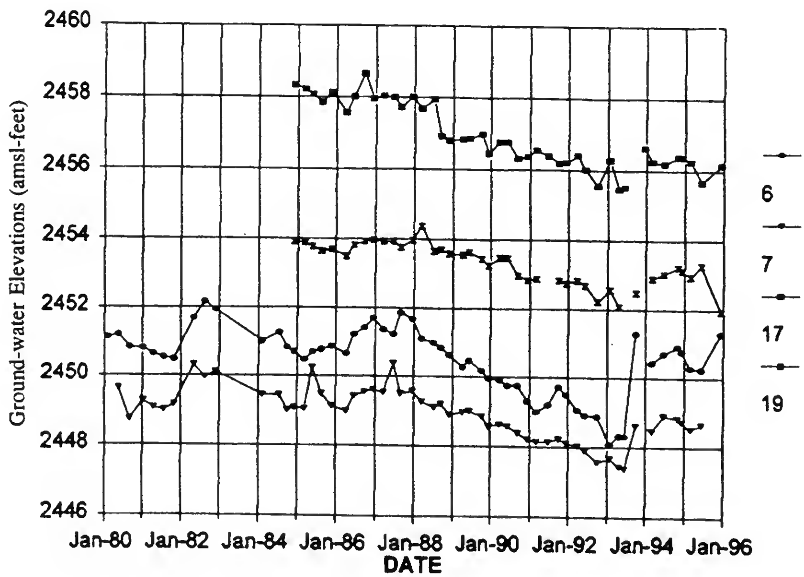


Figure 3.13 Hydrograph of Selected Wells

3.3.3 Ground-Water-Quality

3.3.3.1 Saskatchewan

The Water-quality from the Supplementary Water Supply Project discharge points has been consistent with no trends indicated. A summary of the more frequently tested parameters during 1995 is provided in Table 3.2. Statistical averages of the results since 1990 are included in this table. Water-quality from the wells has a positive influence on the quality of water in the reservoir for most parameters.

Table 3.2 Water-Quality Statistics for Water Pumped Supplementary Water Supply Project Wells

	1990-1995 Average	1995 Average
pH (units)	7.6	7.4
Conductivity (uS/cm)	1387	1400
Total dissolved solids	921	937
Total suspended solids	3.3	2.4
Boron	1.2	1.3
Sodium	180	180
Sulphate	248	228
Nitrate	0.3	0.1
Cyanide	<2	<2
Iron	1.2	1.0
Manganese	0.2	0.2
Units in mg/L except as noted		

The Water-Quality of the common discharge point from the Salinity Control Project wells is generally better than the Water-Quality in Cookson Reservoir. Average results from the common discharge point for 1995, plus an average of the 1990-1995 results, are provided in Table 3.3. Results have been consistent since 1990.

Table 3.3 Water-Quality Statistics for Water Pumped from Salinity Control Project Wells Sampled at the Discharge Pipe

	1990-1995 Average	1995 Average
pH (units)	7.5	7.3
Conductivity (uS/cm)	1415	1362
Total dissolved solids	946	928
Boron	1.6	1.6
Calcium	104	106
Magnesium	58	59
Sodium	147	153
Potassium	7.3	7.5
Arsenic (ug/L)	11.1	8.6
Aluminum	0.02	0.03
Barium	0.03	0.03
Cadmium	<0.001	<0.001
Iron	4.1	4.2
Manganese	0.14	0.14
Chloride	5.5	6.8
Strontium	1.7	1.7
Nitrate	0.1	<0.003
Sulphate	313	313
Units in mg/L except as noted.		

Ground-water quality in the vicinity of the ash lagoons can potentially be affected by leachate movement through the ash lagoon liner systems. 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 asses leachate movement.

The ground-water monitoring program was expanded in 1994 as a result of Ash Lagoon #3 South construction. In total 20 new pneumatic piezometers and 28 new standpipe piezometers were completed within their target zones. Testing of these piezometers began in 1995. Due to the limited amount of data collected to date from these piezometers, a meaningful review is not yet possible.

Piezometers 867A, 868A and 871A are completed immediately above the liner system, within the ash stack of Ash Lagoon #1. The 1995 monitoring results continue to suggest confirmation of the trend first observed in 1993 that the boron concentration decreases with depth within the ash stack. The effect of ash thickness on leachate quality is, however, not completely understood.

The chemistry of water immediately above the liner systems is therefore suspected 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. New piezometers 886A, 887A, 890A and 893A have been completed above the liner system of new Ash Lagoon #3 South and are now being monitored. Future monitoring of all piezometers completed above the lagoon liner systems will continue with the purpose of confirming the boron trend noted above 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. Relative to the 1994 position, the size and extent of the ground-water mound has not significantly changed. The mound extends from the east side of Ash Lagoon 2, where levels have increased 7 metres, to the west side of the polishing pond, where levels have increased 4 metres. Oxidized till piezometers located closer to the reservoir have shown a decreasing trend in piezometric levels reacting to lower reservoir levels.

The greatest changes in chloride and boron concentrations within the oxidized till, have occurred where piezometric levels have changed the most. This is an expected result as changing piezometric levels suggest ground-water movement. Increasing boron concentrations on the east and south side of Ash Lagoon 2, together with decreasing chloride concentrations suggests leachate influence. On the west-side of the polishing pond the boron concentrations have not significantly changed.

Little change in boron or chloride concentrations has been observed for most of the oxidized till piezometers located by the reservoir. The most significant change in samples from any of these piezometers has been C719 where chloride concentrations have decreased 93 mg/l overall since 1983 to 18 mg/l. The change in quality is suspected to be the result of reservoir influence rather than ash lagoon influence.

A ground-water mound has developed in the unoxidized till, similar to that in the oxidized till, extending from the east side of Ash Lagoon 2 to the west side of the Polishing Pond. The ground-water mound is known to be discontinuous as piezometers 764D and 871C are located within the mound area and are reacting to reservoir levels. A review of boron and chloride concentrations does not show any significant trends.

The piezometric surface of the Empress gravels indicate a regional flow from northwest to southeast below Morrison Dam. Monitoring since 1983 generally shows that the piezometric surface in the lagoon area reacts to the reservoir level. Results for Empress gravel Water-Quality do not indicate any leachate influence with the majority of piezometers showing little change in boron or chloride concentrations from background values.

Sand lens piezometers C712B, C766 and C767 are located between the polishing pond and the cooling water canal. C767 is located on the top of dyke G and C766 and C712B are located at the toe of dyke G. These piezometers have historically been of interest as the sand lens provides a preferential pathway for leachate migration.

A review of the boron concentrations for C766 shows an increasing trend up to October 1988 when levels peaked at 12.6 mg/l. Boron concentration decreased to 6.99 mg/l in April 1990, then began increasing again peaking at 35.2 mg/l in June 1993 before falling to 26.7 mg/l in October 1993. The boron concentration began an increasing trend throughout 1994 and peaked at 43 mg/l in May, 1995, the highest recorded concentration to date, before decreasing to near 35 mg/l in October, 1995. The chloride concentration for C766 has shown little movement since 1987 and remains within the 20 to 30 mg/l range, similar to the ash lagoon surface water concentration.

Up to April 1988 the boron concentration for C767 was increasing and peaked at 49.4 mg/l. From this peak the boron concentration has steadily decreased to the end of 1991 where the concentration levelled off near 5 mg/l. The October 1995 result is 5.28 mg/l. The reduction in boron concentrations for samples from C767 suggest the movement of a slug of leachate and not a continuous plume. There has been an increasing trend in chloride for C767 ranging from 25 mg/l in 1989 to 75 mg/l in 1991. Since 1991 the concentration has remained near 70 mg/l with an October 1994 result of 73.4 mg/l. In 1995 the concentration showed a moderate increase, ranging between 94 and 99 mg/l.

Boron concentrations for piezometer 712B were initially below 1.0 mg/l until an increasing trend began in 1987 with the concentration peaking in April 1992 at 26.6 mg/l. The boron concentration then decreased and levelled off near 18 mg/l with an October 1995 result of 20 mg/l. Chloride concentrations trended down for C712B to 50 mg/l in 1988 from over 200 mg/l in 1984. Since 1988 chloride levels have changed little with an October 1995 result of 50.8 mg/l.

In 1994 it was reported that no vertical seepage or liner permeability could be calculated for Ash Lagoon #3 North due to the measured pore pressure exceeding what the lagoon water level could physically produce. As expected this situation has corrected.

The total calculated seepage from the ash lagoons in 1995 was determined to be 1.61 litres per second. This value is not significantly different from the 1994 and 1993 calculated seepage rates of 1.67 and 1.62 litres per second, respectively. There was a negligible total calculated seepage rate for Ash Lagoon #3 South at 0.001 litres per second. This result was not unexpected as the lagoon has only been in service since May, 1995 and no gradients have developed.

Liner permeabilities for all lagoons except Ash Lagoon 3 South remain in the order of 10^{9}cm/sec. The liner permeability determined for Ash Lagoon 3 South, based on the above permeability, is not considered realistic and was not reported.

3.3.3.2 Montana

Samples were collected from monitoring wells 7, 16, and 24 during 1995. Well 7 is completed in Hart Coal, well 16 is completed in the Fort Union Formation, and well 24 is completed in alluvium. No significant changes in water quality was observed. Graphs of total dissolved solids for selected wells are shown in Figure 3.14.

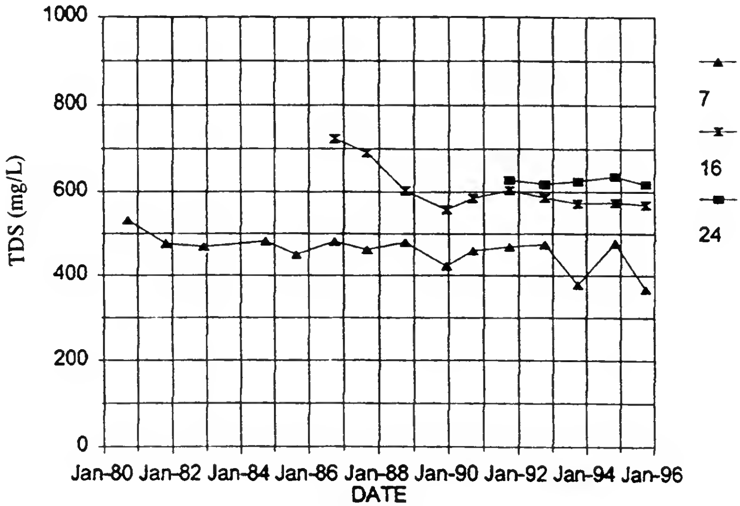


Figure 3.14 Total Dissolved Solids in Samples from Montana Wells.

3.4 Cookson Reservoir

3.4.1 Storage

On January 1, 1995, Cookson Reservoir storage was 29 440 dam^3, or 63% of the full supply volume. The 1995 maximum, minimum and period elevations and volumes are shown in Table 3.4. In addition to runoff, reservoir levels were augmented by groundwater pumping. Wells in the abandoned west block mine site supplied 5 376 dam^3 to Girard Creek. Approximately 70% of this flow volume reached Cookson Reservoir. Wells in the soil salinity project area supplied 1 017 dam^3 directly to the reservoir.

Table 3.4 Cookson Reservoir Storage Statistics for 1995

Date	Elevation (m)	Contents (dam^3)
January 1	751.00	29 440
April 3	751.07	29 860
December 2	750.66	27 400
December 31	750.68	27 510
Full Supply Level	753.00	43 400

The Poplar River Power Station is dependent on water from Cookson Reservoir for cooling. Power plan 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 1995 recorded levels and associated operating levels are shown in Figure 3.15. As the result of a below normal spring runoff in the basin and some minor rainfall runoff during the summer, water levels remained relatively steady throughout the year.

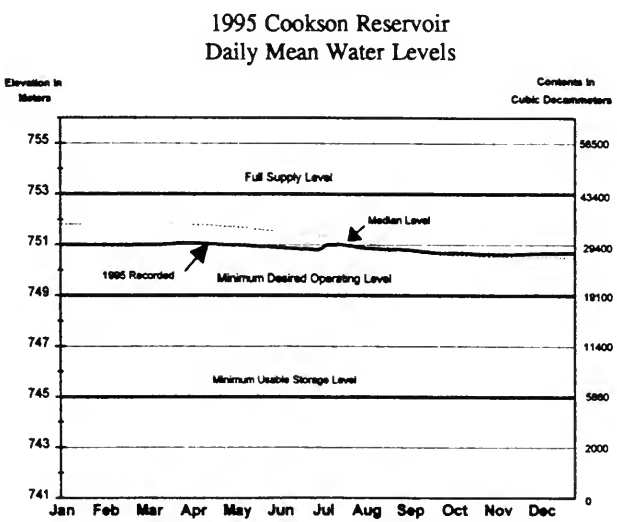


Figure 3.15 Cookson Reservoir Mean Daily Water Levels for 1995 and Median Monthly Water Levels for 1981-1991.

3.4.2 Water-Quality

The 1995 spring runoff had little positive impact on Cookson Reservoir water-quality. At the end of 1995, boron concentrations in the reservoir were about 2.4 mg/L compared to about 2.4 mg/L at the end of 1994. Similarly, TDS increased from 1 250 mg/L at the end of 1994 to about 1 400 mg/L at the end of 1995. Water-quality conditions at the end of 1995 were similar to year-end conditions in 1993 and early 1992.

3.5 Air-Quality

SaskPower's ambient SO_2 monitoring for 1995 recorded no violations of SERM's hourly and 24-hour average standards at 0.17 and 0.06 ppm, respectively. The highest hourly value was recorded at 0.0413 ppm in June, 1995.

Total suspended particulate concentrations for 1995 obtained from SaskPower's monitor did not exceed SERM's 24-hour standard of 120ug/m^3. The highest recorded concentration was 60.6 ug/m^3 in June, 1994. The geometric mean for the high-volume suspended particulate sampler was 15.7 ug/m^3.

3.6 Quality Control

3.6.1 Streamflow

To test the comparability of Streamflow measurements made by the U.S. Geological Survey (USGS) and Environment Canada (EC), similar measurements were made on the East Poplar River at the International Boundary on August 23, 1995 by personnel from both agencies. The discharge data shown in Table 3.5 are similar although not identical indicating the difficulty of obtaining the same measurements of small discharge using conventional current-metre methods. The computations were made using the theoretical discharge of the 90^0 V-notch weir of 0.067 m^3/s.

Table 3.5 Streamflow Measurement Results for August 23, 1995

Agency	Time CST	Width (m)	Mean Area (m^2)	Velocity (m/s)	Gauge Height (m)	Discharge (m^3/s)
EC	1430	1.4	0.131	0.469	1.567	0.061
USGS	1450	1.4	0.147	0.448	1.567	0.066

3.6.2 Water-Quality

Quality control sampling was carried out at the East Poplar River at the International Boundary on August 23, 1995. Participating agencies included the United States Geological Survey (USGS), Environment Canada, Saskatchewan Environment and Resource Management and SaskPower Corp.

Sets of triplicate samples were split from USGS sampling churns and submitted to the respective laboratories for analyses. Field procedures were identical to those used since 1986.

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

1996

CANADA-UNITED STATES

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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 Governments. Changes in the sampling locations and parameters may be made by Governments based on the recommendations of the committee.

Significant additional information 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 is also being collected on either a routine or specific studies basis by various agencies.

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

1996

CANADA

STREAMFLOW MONITORING

Responsible Agency: Environment Canada

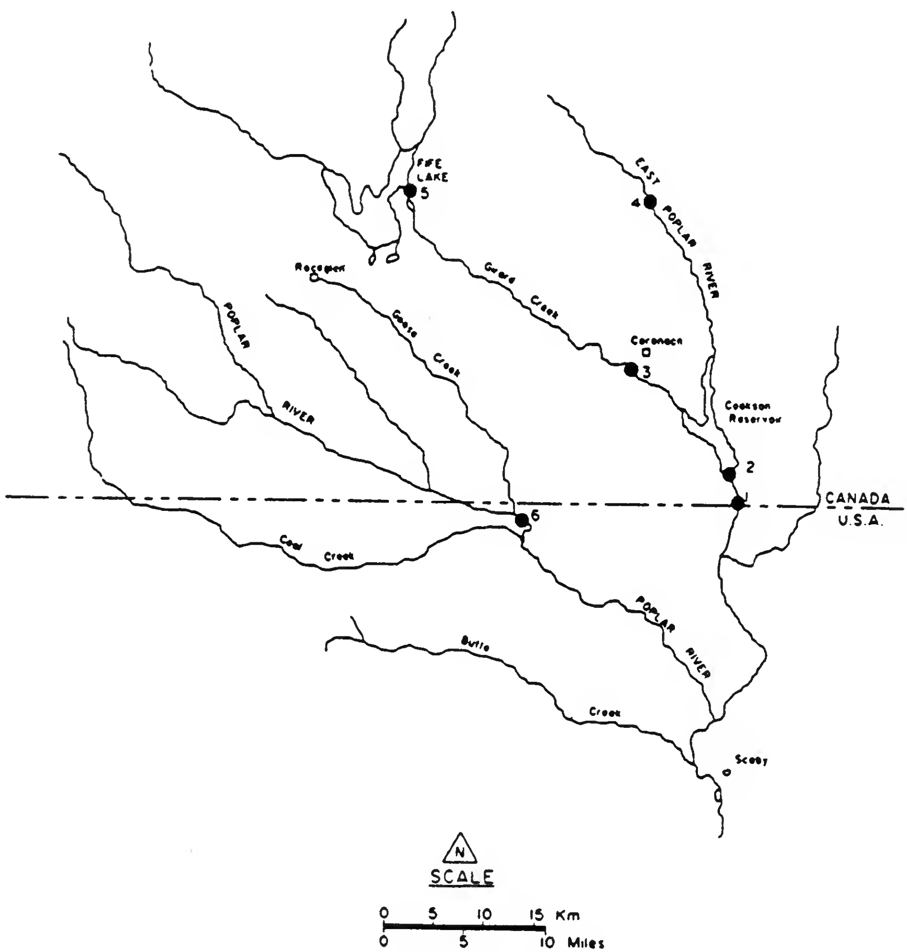
Daily mean discharge or levels and instantaneous monthly extremes as normally published in surface water data publications.

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 Sask Water during periods of outflow only.

*** - Sask Water took over the monitoring responsibility effective July 1/92.



HYDROMETRIC GAUGING STATIONS (CANADA)

SURFACE-WATER-QUALITY

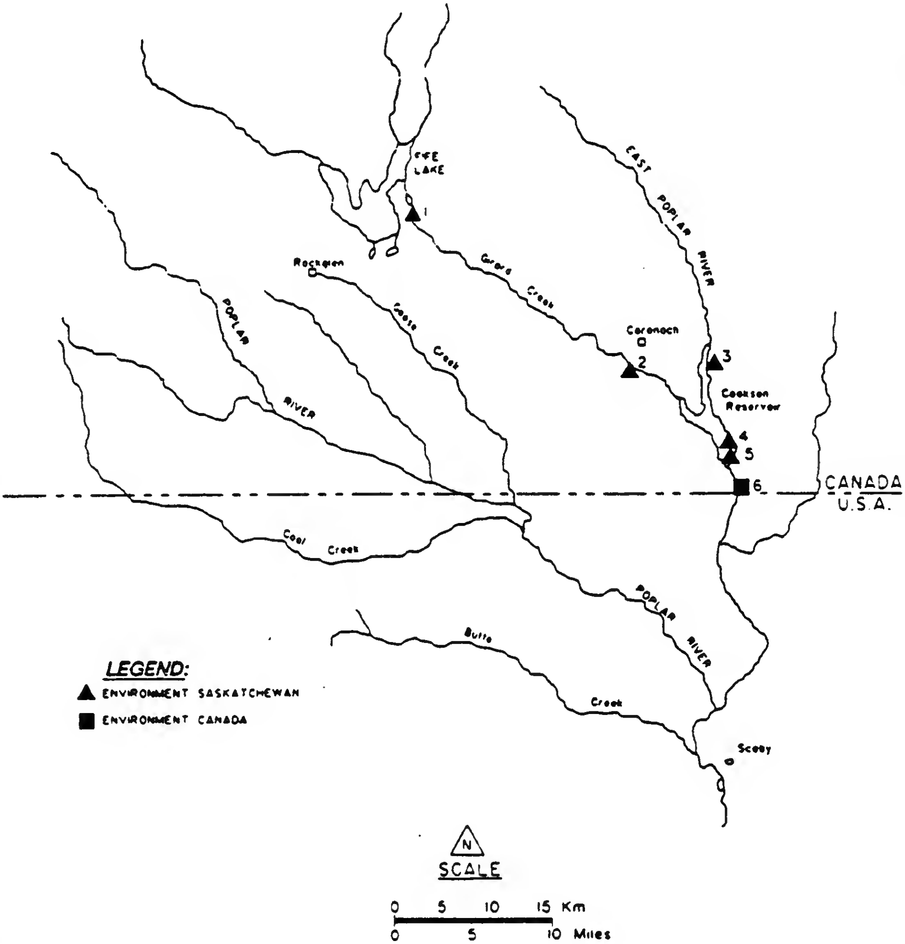
Sampling Locations

Responsible Agency: Saskatchewan Environment and Resource Management		
No. on Map	**Station No.**	**Station Name**
1	7904	Fife Lake Overflow
2	12412 Discontinued	Girard Creek at Coronach Reservoir Outflow
3	12377 Discontinued	Upper End of Cookson Reservoir at Highway 36
4	12368	Cookson Reservoir near Dam
5	12386 Discontinued	East Poplar River at Culvert Immediately Below Cookson Reservoir

Responsible Agency: Environment Canada		
No. on Map	**Station No.**	**Station Name**
6	00SA11AE0008	East Poplar River at International Boundary

Responsible Agency: Environment Canada			
NAQUADAT* Code	Parameter	Analytical Method	Sampling Frequency Station No. 6
10151	Alkalinity-phenolphthalein	Potentiometric Titration	BM
10111	Alkalinity-total	Potentiometric Titration	BM
13102	Aluminum-dissolved	AA-Direct	BM
13302	Aluminum-extracted	AA-Direct	BM
07570	Ammonia-free	Calculated	BM
07540	Ammonia-total	Automated Colourimetric	BM
33108	Arsenic-dissolved	ICAP-hydride	BM
56001	Barium-total	AA-Direct	BM
06201	Bicarbonates	Calculated	BM
05211	Boron-dissolved	ICAP	BM
96360	Bromoxynil	Gas Chromatography	BM
48002	Cadmium-total	AA Solvent Extraction	BM
20103	Calcium	AA-Direct	BM
06104	Carbon-dissolved organic	Automated IR Detection	BM
06901	Carbon-particulate	Elemental Analyzer	BM
06002	Carbon-total organic	Calculated	BM
06301	Carbonates	Calculated	BM
17206	Chloride	Automated Colourimetric	BM
06717	Chlorophyll a	Spectrophotometric	BM
24003	Chromium-total	AA-Solvent Extraction	BM
27002	Cobalt-total	AA-Solvent Extraction	BM
36012	Coliform-fecal	Membrane Filtration	BM
36002	Coliform-total	Membrane Filtration	BM
02021	Colour	Comparator	BM
02041	Conductivity	Wheatstone Bridge	BM
29005	Copper-total	AA-Solvent Extraction	BM
06610	Cyanide	Automated UV-Colourimetric	BM
09117	Fluoride-dissolved	Electrometric	BM
06401	Free Carbon Dioxide	Calculated	BM
10602	Hardness	Calculated	BM
17811	Hexachlorobenzene	Gas Chromatography	BM
08501	Hydroxide	Calculated	BM
26104	Iron-dissolved	AA-Direct	BM
82002	Lead-total	AA-Solvent Extraction	BM
12102	Magnesium	AA-Direct	BM
25104	Manganese-dissolved	AA-Direct	BM
80011	Mercury-total	Flameless AA	BM
07901	N-particulate	Elemental Analyzer	BM
07651	N-total dissolved	Automated UV Colourimetric	BM
10401	NFR	Gravimetric	BM
28002	Nickel-total	AA-Solvent Extraction	BM
07110	Nitrate/Nitrite	Colourimetric	BM
07603	Nitrogen-total	Calculated	BM
10650	Non-Carbonate Hardness	Calculated	BM
18XXX	Organo Chlorines	Gas Chromatography	BM
08101	Oxygen-dissolved	Winkler	BM
15901	P-particulate	Calculated	BM
15465	P-total dissolved	Automated Colourimetric	BM
185XX	Phenoxy Herbicides	Gas Chromatography	BM
15423	Phosphorus-total	Colourimetric (TRAACS)	BM
19103	Potassium	Flame Emission	BM
11250	Percent Sodium	Calculated	BM
00210	Saturation Index	Calculated	BM
34108	Selenium-dissolved	ICAP-hydride	BM
14108	Silica	Automated Colourimetric	BM
11103	Sodium	Flame Emission	BM
00211	Stability Index	Calculated	BM
16306	Sulphate	Automated Colourimetric	BM
00201	TDS	Calculated	BM
02061	Temperature	Digital Thermometer	BM
02073	Turbidity	Nephelometry	BM
23002	Vanadium-total	AA-Solvent Extraction	BM
30005	Zinc-total	AA-Solvent Extraction	BM
10301	pH	Electrometric	BM
92111	Uranium	Fluometric	MC

* - Computer Storage and Retrieval System -- Environment Canada
AA - Atomic Absorption
IR - Infrared
UV - Ultraviolet
NFR - Nonfilterable Residue
MC - Monthly Composite
BM - Bimonthly (Alternate months sampled by U.S.G.S.)
ICAP - Inductively Coupled Argon Plasma.



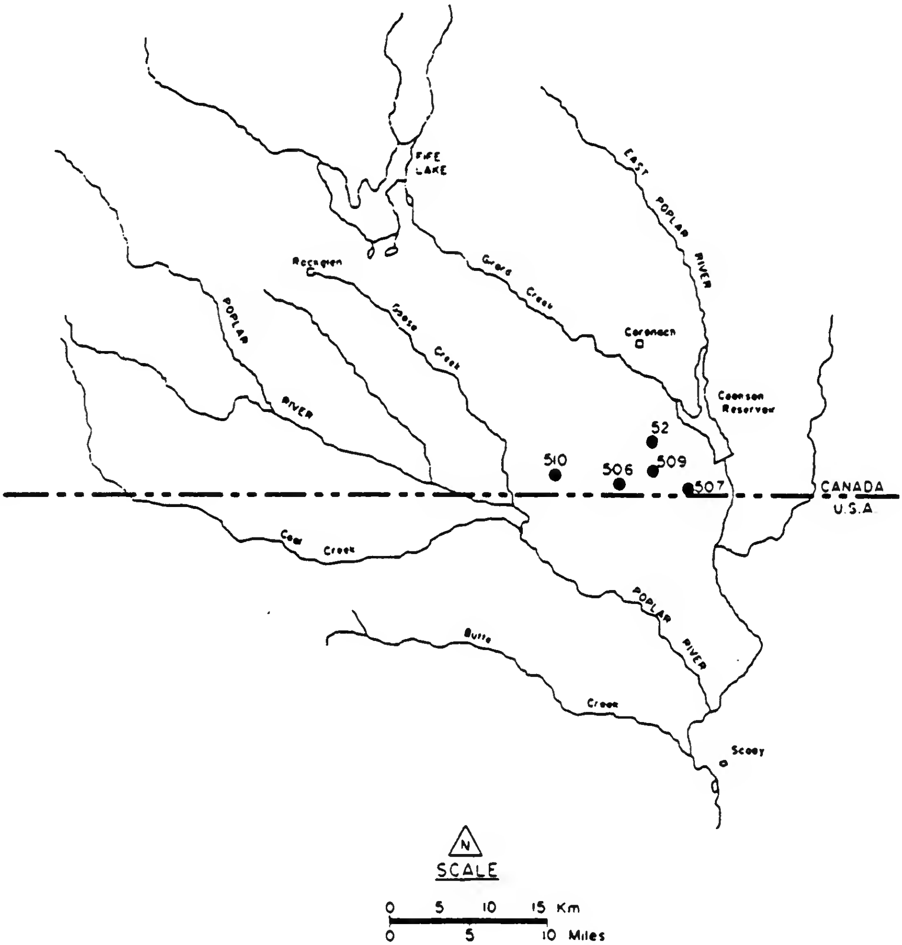
SURFACE-WATER-QUALITY MONITORING STATIONS (CANADA)

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

Responsible Agency: Saskatchewan Environment and Resource Management

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)
506A	SW 4-1-27 W3	748.27	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)
510	NW 1-1-28 W3	769.34	28 - 29 (in layered coal and clay)



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

GROUND-WATER PIEZOMETER MONITORING - POPLAR RIVER POWER STATION AREA

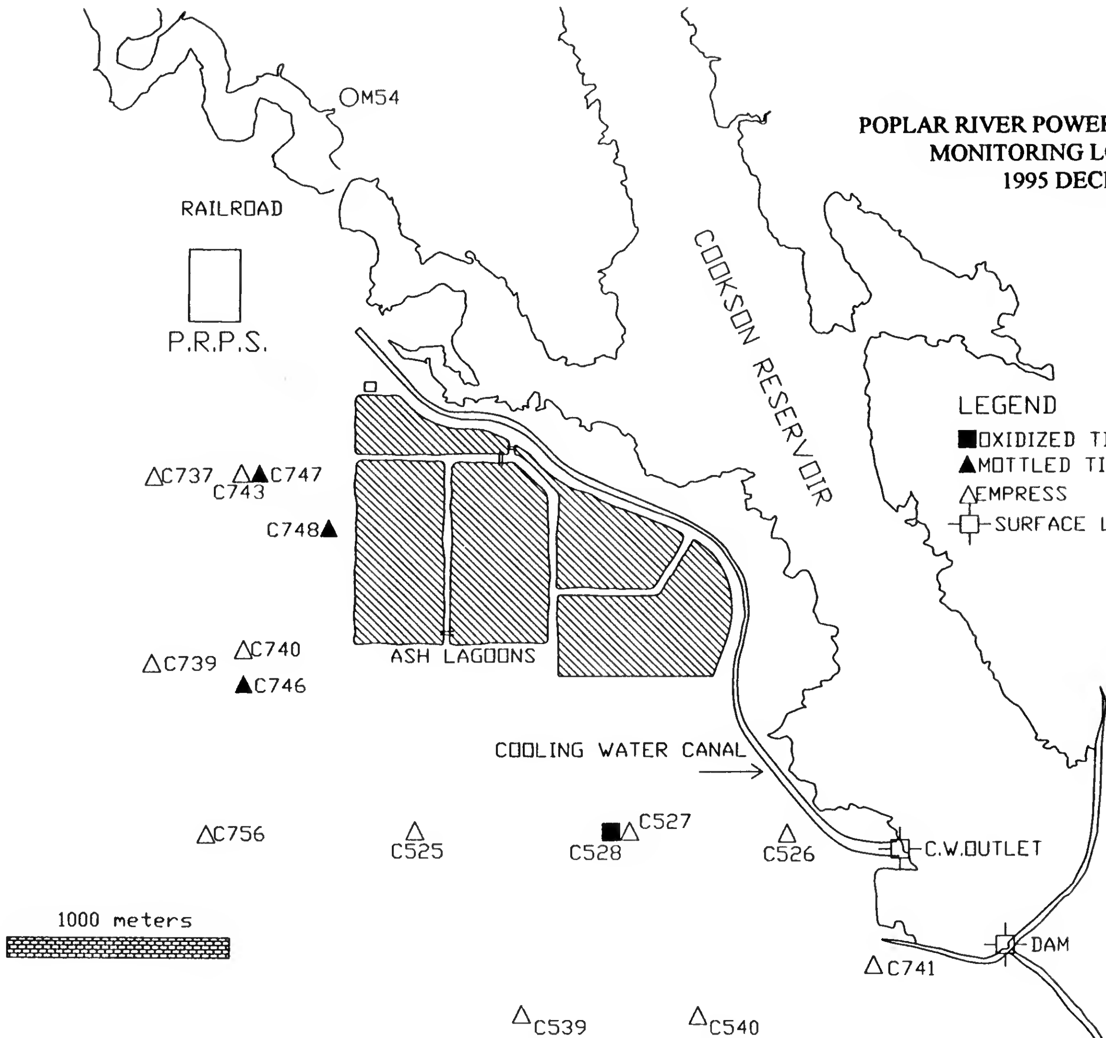
SPC Piezometer Number	Completion Formation
525	Empress
526	Empress
527	Empress
528	Oxidized
539	Empress
540	Empress
737	Empress
739	Empress
740	Empress
741	Empress
743	Empress
746	Mottled Till
747	Mottled Till
748	Mottled Till
756	Empress

water levels measured quarterly

SPC Piezometer Number	Completion Formation
739	Empress

samples collected annually

POPLAR RIVER POWER STATION MONITORING LOCATIONS 1995 DECEMBER



GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--WATER LEVEL

SPC Piezometer Number	Completion Formation
529	Empress
532	Empress
533	Empress
534	Oxidized Till
535	Empress
536	Empress
537	Empress
538	Empress
542	Empress
653A	Unoxidized Till
654	Unoxidized Till
655A	Unoxidized Till
655B	Unoxidized Till
711	Oxidized Till
712A	Unoxidized Till
712B	Intra Till Sand
712C	Mottled Till
712D	Oxidized till
713	Oxidized Till
714A	Unoxidized Till
714B	Mottled Till
714C	Oxidized Till
714D	Oxidized Till
714E	Empress
715	Oxidized Till
716	Oxidized Till
717	Oxidized Till
718	Mottled Till
719	Oxidized Till
720	Oxidized Till
721	Oxidized Till
722	Oxidized Till
723	Oxidized Till
724	Mottled Till
725	Oxidized Till
726A	Oxidized Till
726B	Mottled Till

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--WATER LEVEL (Continued)

SPC Piezometer Number	Completion Formation
726C	Oxidized Till
726E	Empress
727A	Unoxidized Till
727B	Mottled Till
727C	Oxidized Till
728A	Oxidized Till
728B	Unoxidized Till
728C	Mottled Till
728D	Oxidized Till
728E	Empress
731	Empress
732	Empress
733	Empress
734	Empress
742	Empress
745	Oxidized Till
749	Mottled Till
750	Unoxidized Till
751	Unoxidized Till
752	Unoxidized Till
753	Oxidized Till
757	Unoxidized Till
758	Intra Till Sand
763A	Mottled Till
763B	Oxidized Till
763C	Mottled Till
763D	Unoxidized Till
763E	Empress
764B	Mottled Till
764C	Oxidized Till
764D	Unoxidized Till
764E	Empress
765A	Empress
765B	Unoxidized Till
765C	Oxidized Till
765D	Oxidized Till
765E	Mottled Till
766A	Empress

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--WATER LEVEL (Continued)

SPC Piezometer Number	Completion Formation
766	Intra Till Sand
767A	Empress
767B	Unoxidized Till
767	Intra Till Sand
768A	Empress
768B	Unoxidized Till
768C	Oxidized Till
775A	Oxidized Till
775C	Unoxidized Till
776A	Oxidized Till
776B	Oxidized Till
867B	Oxidized Till
867C	Unoxidized Till
868B	Oxidized Till
868C	Unoxidized Till
869B	Oxidized Till
869C	Unoxidized Till
870E	Empress
871B	Oxidized Till
871C	Unoxidized Till
872B	Oxidized Till
872C	Unoxidized Till
873E	Empress
885B	Oxidized Till
885C	Oxidized Till
885D	Unoxidized Till
885E	Empress
886A	Ash Stack
886B	Oxidized Till
886C	Oxidized Till
886D	Unoxidized Till
886E	Empress
887B	Oxidized Till
887C	Oxidized Till
887D	Unoxidized Till
887E	Empress
888B	Oxidized Till
888C	Oxidized Till

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA–WATER LEVEL (Continued)

SPC Piezometer Number	Completion Formation
888D	Unoxidized Till
888E	Empress
889B	Oxidized Till
889C	Oxidized Till
889D	Unoxidized Till
889E	Empress
890B	Oxidized Till
890C	Oxidized Till
890D	Unoxidized Till
890E	Empress
891B	Oxidized Till
891C	Oxidized Till
891D	Unoxidized Till
891E	Empress
892B	Oxidized Till
892C	Oxidized Till
892D	Unoxidized Till
892E	Empress
893B	Oxidized Till
893C	Oxidized Till
893D	Unoxidized Till
893E	Empress
894B	Oxidized Till
894C	Oxidized Till
894D	Unoxidized Till
894E	Empress
895B	Oxidized Till
895C	Oxidized Till
895D	Unoxidized Till
895E	Empress

Water levels measured quarterly

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--QUALITY

SPC Piezometer Number	Completion Formation
529	Empress
532	Empress
533	Empress
534	Oxidized Till
538	Empress
653A	Unoxidized Till
655A	Unoxidized Till
712A	Unoxidized Till
712B	Intra Till Sand
712C	Mottled Till
712D	Oxidized till
713	Oxidized Till
714A	Unoxidized Till
714C	Oxidized Till
714D	Oxidized Till
714E	Empress
715	Oxidized Till
716	Oxidized Till
718	Mottled Till
719	Oxidized Till
726A	Oxidized Till
726C	Oxidized Till
726E	Empress
728A	Oxidized Till
728B	Unoxidized Till
728C	Mottled Till
728D	Oxidized Till
731	Empress
732	Empress
733	Empress
734	Empress
742	Empress
745	Oxidized Till
749	Mottled Till
750	Unoxidized Till
751	Unoxidized Till
752	Unoxidized Till
753	Oxidized Till

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--QUALITY (Continued)

SPC Piezometer Number	Completion Formation
757	Unoxidized Till
758	Intra Till Sand
763A	Mottled Till
763B	Oxidized Till
763D	Unoxidized Till
763E	Empress
766	Intra Till Sand
767	Intra Till Sand
775A	Oxidized Till
775C	Unoxidized Till
776A	Oxidized Till
776B	Oxidized Till
867A	Ash Stack
867B	Oxidized Till
867C	Unoxidized Till
868A	Ash Stack
868B	Oxidized Till
868C	Unoxidized Till
869B	Oxidized Till
869C	Unoxidized Till
870E	Empress
871A	Ash Stack
871B	Oxidized Till
871C	Unoxidized Till
872B	Oxidized Till
872C	Unoxidized Till
873E	Empress
885B	Oxidized Till
885C	Oxidized Till
885D	Unoxidized Till
885E	Empress
886A	Ash Stack
886B	Oxidized Till
886C	Oxidized Till
886D	Unoxidized Till
886E	Empress
887A	Ash Stack
887B	Oxidized Till

GROUND-WATER PIEZOMETER MONITORING--
ASH LAGOON AREA--QUALITY (Continued)

SPC Piezometer Number	Completion Formation
887C	Oxidized Till
887D	Unoxidized Till
887E	Empress
888B	Oxidized Till
888C	Oxidized Till
888D	Unoxidized Till
888E	Empress
889B	Oxidized Till
889C	Oxidized Till
889D	Unoxidized Till
889E	Empress
890A	Ash Stack
890B	Oxidized Till
890C	Oxidized Till
890D	Unoxidized Till
890E	Empress
891B	Oxidized Till
891C	Oxidized Till
891D	Unoxidized Till
891E	Empress
892B	Oxidized Till
892C	Oxidized Till
892D	Unoxidized Till
892E	Empress
893A	Ash Stack
893B	Oxidized Till
893C	Oxidized Till
893D	Unoxidized Till
893E	Empress
894B	Oxidized Till
894C	Oxidized Till
894D	Unoxidized Till
894E	Empress
895B	Oxidized Till
895C	Oxidized Till
895D	Unoxidized Till
895E	Empress

Samples collected annually

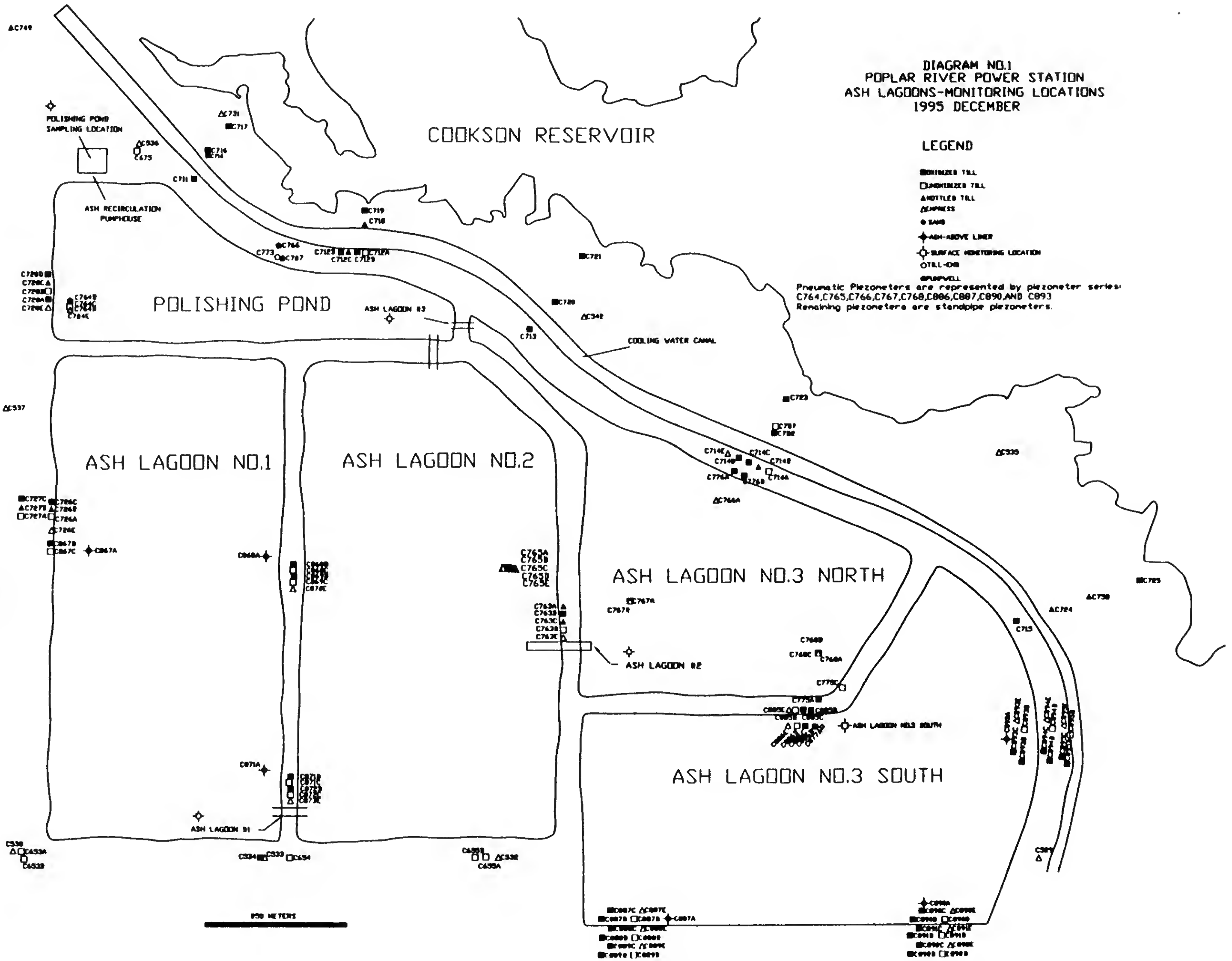


DIAGRAM NO.1
POPLAR RIVER POWER STATION
ASH LAGOONS-MONITORING LOCATIONS
1995 DECEMBER
LEGEND
Pneumatic Piezometers are represented by piezometer series:
C764,C765,C766,C767,C768,C886,C887,C890,AND C893
Remaining piezometers are standpipe piezometers.
COOKSON RESERVOIR
POLISHING POND
POLISHING POND SAMPLING LOCATION
ASH RECIRCULATION PUMPHOUSE
COOLING WATER CANAL
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
850 METERS

PARAMETERS

Responsible Agency: Saskatchewan Environment and Resource Management			
ESQUADAT* Code	Parameter	Analytical method	Sampling Frequency Station No.: Piezometers
10101	Alkalinity-tot	Pot-Titration	A
13105	Aluminum-Diss	AA-Direct	3**
33104	Arsenic-Diss	Flameless AA	A
56104	Barium-Diss	AA-Direct	A
06201	Bicarbonates	Calculated	A
06106	Boron-Diss	Colourimetry	3**
48102	Cadmium-Diss	AA-Solvent Extract (MIBK)	A
20103	Calcium-Diss	AA-Direct	A
06301	Carbonates	Calculated	A
17203	Chloride-Diss	Colourimetry	A
24104	Chromium-Diss	AA-Direct	A
27102	Cobalt-Diss	AA-Solvent Extract (MIBK)	A
02011	Colour	Comparator	A
02041	Conductivity	Conductivity Meter	A
29105	Copper-Diss	AA-Solvent Extract (MIBK)	4**
09103	Fluoride-Diss	Specific Ion Electrode	A
26104	Iron-Diss	AA-Direct	A
82103	Lead-Diss	AA-Solvent Extract (MIBK)	A
12102	Magnesium-Diss	AA-Direct	A
25104	Manganese-Diss	AA-Direct	A
80111	Mercury-Diss	Flameless AA	A
42102	Molybdenum-Diss	AA-Solvent Extract (N-Butyl acetate)	A
10301	pH	Electrometric	3**
19103	Potassium-Diss	Flame Photometry	A
34105	Selenium-Diss	Hydride generation	A
14102	Silica-Diss	Colourimetry	A
11103	Sodium-Diss	Flame Photometry	A
38101	Strontium-Diss	AA-Direct	3**
16306	Sulphate-Diss	Colourimetry	3**
10451	TDS	Gravimetric	3**
92111	Uranium-Diss	Fluorometry	3**
23104	Vanadium-Diss	AA-Direct	A
97025	Water Level		4
30105	Zinc-Diss	AA-Solvent Extract (MIBK)	A

No zinc or iron for Piezometers C531 to C538

* Computer storage and retrieval system

– Saskatchewan Environment and Resource Management

** Analyze annually for these Piezometers Nos.

SYMBOLS: AA - Atomic absorption

A - Annually

3 - 3 times/year

AA - Solvent Extract (MIBK) - sample acidified and extracted with Methyl Isobutyl Ketone.

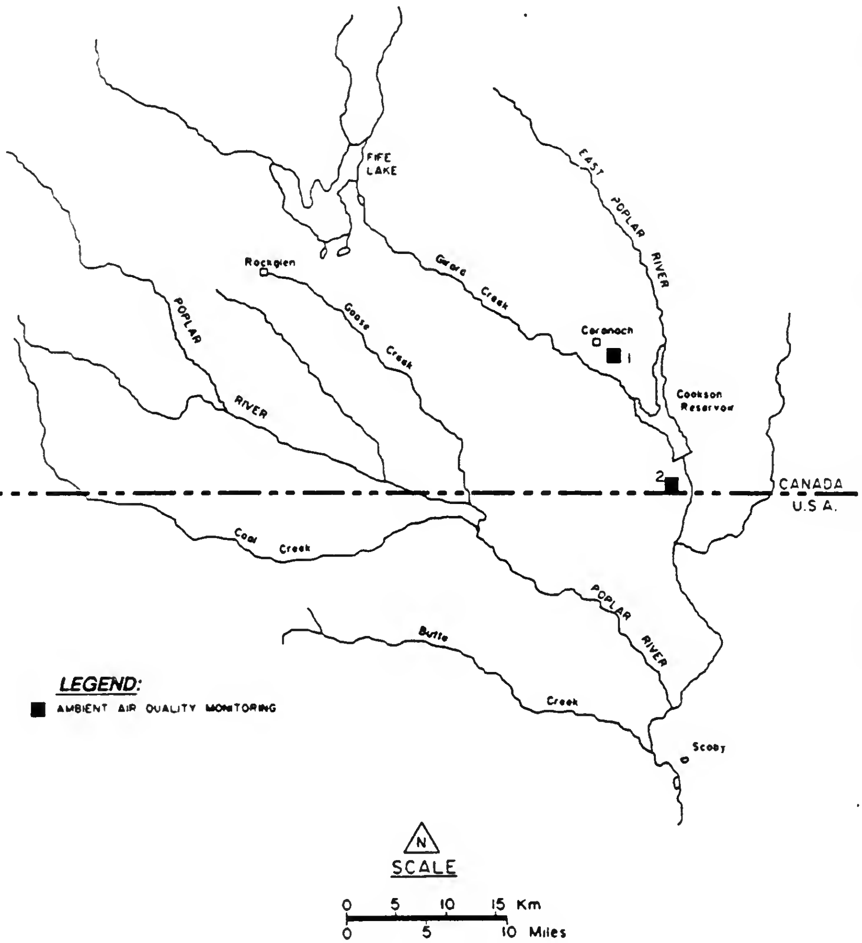
4 - 4 times/year

AMBIENT AIR-QUALITY MONITORING

Responsible Agency: Saskatchewan Environment and Public Safety			
NO. ON MAP	**LOCATION**	**PARAMETERS**	**REPORTING FREQUENCY**
1	Coronach (Discontinued)	Sulphur Dioxide	Continuous monitoring with hourly averages as summary statistics.
		Wind speed and direction	Continuous monitoring with hourly averages as summary statistics.
		Total Suspended Particulate	24-hour samples on a 6-day cycle, corresponding to the National Air Pollution Surveillance Sampling Schedule.
2	International Boundary *	Sulphur Dioxide	Continuous monitoring with hourly averages as summary statistics.
		Total Suspended Particulate	24-hour samples on 6-day cycle, corresponding to the National Air Pollution Surveillance Sampling Schedule.

METHODS	
Sulphur Dioxide	Saskatchewan Environment and Public Safety Colourimetric Titration, Pulsed Fluorescence
Total Suspended Particulate	Saskatchewan Environment and Public Safety High Volume Method

* This station operated by SaskPower.



AMBIENT AIR-QUALITY MONITORING (CANADA)

POPLAR RIVER

COOPERATIVE MONITORING ARRANGEMENT

TECHNICAL MONITORING SCHEDULES

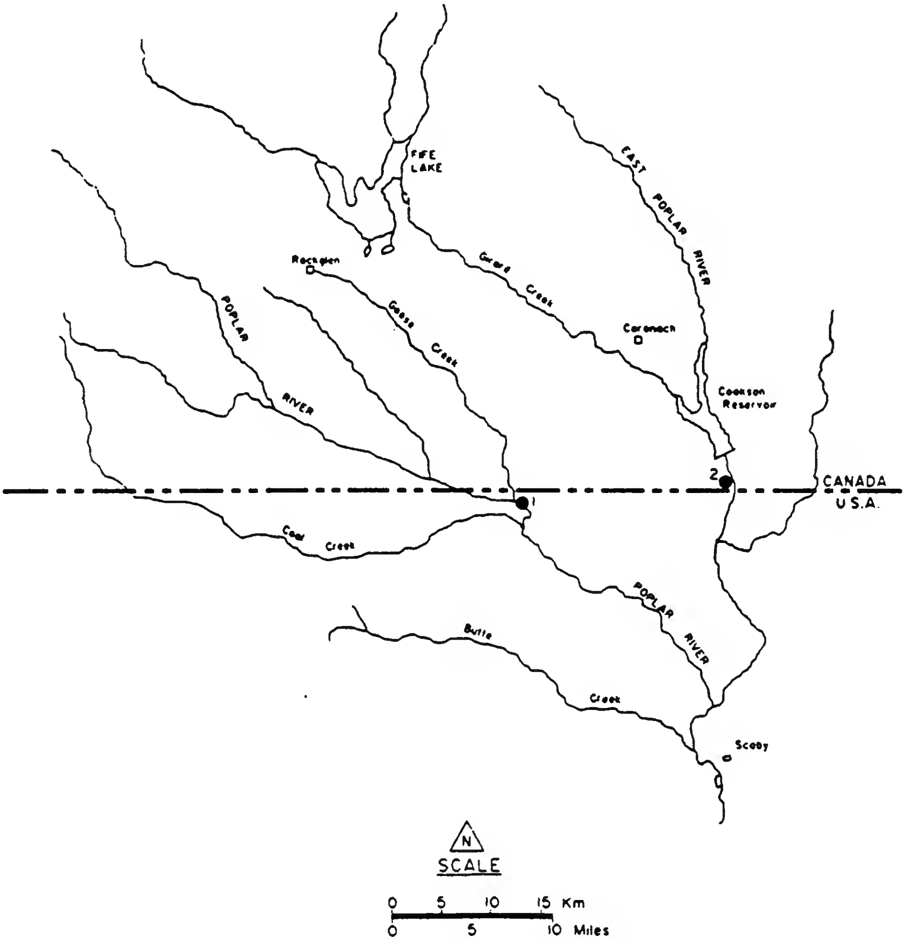
1996

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 Location

Responsible Agency: U.S. Geological Survey

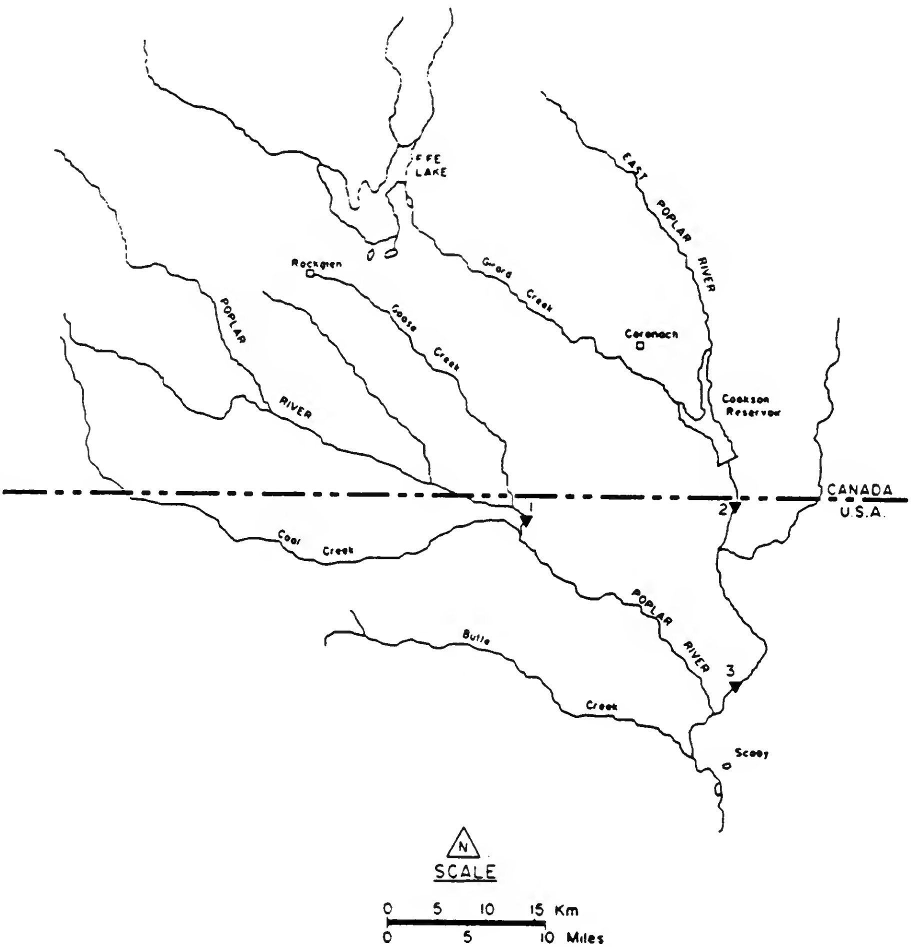
No. on Map	USGS Station No.	Station Name
1	06178000	Poplar River at International Boundary
2	06178500	East Poplar River at International Boundary
3	06179000	East Poplar River near Scobey

PARAMETERS

WATSTORE*			SAMPLING FREQUENCY NO.		
Code	Parameter	Analytical Method	1	2	3
90410	Alkalinity - lab	Elect. Titration	M	BM	BM
01106	Aluminum - diss	AE, DC Plasma	SA	SA	SA
00610	Ammonia - tot	Colorimetric	M	BM	BM
00625	Ammonia +Org N-tot	Colorimetric	M	BM	BM
01000	Arsenic - diss	AA, hydride	SA	SA	SA
01002	Arsenic - tot	AA, hydride	A	A	A
01010	Beryllium - diss	ICP	SA	SA	SA
01012	Beryllium - tot/rec	AA - Persulfate	A	A	A
01020	Boron - diss	AE, DC Plasma	M	BM	BM
01025	Cadmium - diss	AA, GF	SA	SA	SA
01027	Cadmium - tot/rec	AA, GF - Persulfate	A	A	A
00915	Calcium	ICP	M	BM	BM
00680	Carbon - tot Org	Wet Oxidation	SA	SA	SA
00940	Chloride - diss	Colorimetric	M	BM	BM
01030	Chromium - diss	AE, DC Plasma	SA	SA	SA
01034	Chromium - tot/rec	AE, DC Plasma Persulfate	A	A	A
00080	Colour	Electrometric, visual	M	BM	BM
00095	Conductivity	Wheatstone Bridge	M	D	BM
01040	Copper - diss	AA, GF	SA	SA	SA
01042	Copper - tot/rec	AA, GF - Persulfate	A	A	A
00061	Discharge - inst	Direct measurement	M	BM	BM
00950	Fluoride	Electrometric	M	BM	BM
01046	Iron - diss	AE, ICP	M	BM	BM
01045	Iron - tot/rec	AA-Persulfate	A	A	A
01049	Lead - diss	AA, GF	SA	SA	SA
01051	Lead - tot/rec	AA, GF - Persulfate	A	A	A
00925	Magnesium - diss	AA	M	BM	BM
01056	Manganese - diss	ICP	SA	SA	SA
01055	Manganese - tot/rec	AA-Persulfate	A	A	A
01065	Nickel - diss	AA, GF	SA	SA	SA
01067	Nickel - tot/rec	AA, GF - Persulfate	A	A	A
00615	Nitrite - tot	Colorimetric	M	BM	BM
00630	Nitrate + Nitrite - tot	Colorimetric	M	BM	BM
00300	Oxygen-diss	Winkler/meter	M	BM	BM
70507	Phos, Ortho-tot	Colorimetric	M	BM	BM
00400	pH	Electrometric	M	BM	BM
00665	Phosphorous - tot	Colorimetric	M	BM	BM
00935	Potassium - diss	AA	M	BM	BM
00931	SAR	Calculated	M	BM	BM
80154	Sediment - conc.	Filtration-Gravimetric	M	BM	BM
80155	Sediment - load	Calculated	M	BM	BM
01145	Selenium - diss	AA, hydride	SA	SA	SA
01147	Selenium tot	AA, hydride	A	A	A
00955	Silica	ICP	M	BM	BM
00930	Sodium	ICP	M	BM	BM
00945	Sulphate - diss	Turbimetry	M	BM	BM
70301	Total Dissolved Solids	Calculated	M	BM	BM
00010	Temp Water	Stem Thermometer	M	BM	BM
00020	Temp Air	Stem Thermometer	M	BM	BM
00076	Turbidity	Nephelometric	M	BM	BM
80020	Uranium - diss	Spectrometry	-	MC	-
01090	Zinc - diss	ICP	SA	SA	SA
01092	Zinc - tot/rec	AA-Persulfate	A	A	A

SYMBOLS: **C** - continuous; **D** - daily; **M** - monthly; **BM** - bimonthly; **MC** - monthly composite;
A - annually at high flow; **SA** - semi-annually at low and high flow; **GF** - graphite furnace
AA - atomic absorption; **tot** - total; **rec** - recoverable; **diss** - dissolved;
AE - atomic absorption; **DC** - direct current; **ICP** - inductively coupled plasma;

* - Computer storage and retrieval system - USGS



SURFACE-WATER-QUALITY MONITORING STATIONS (UNITED STATES)

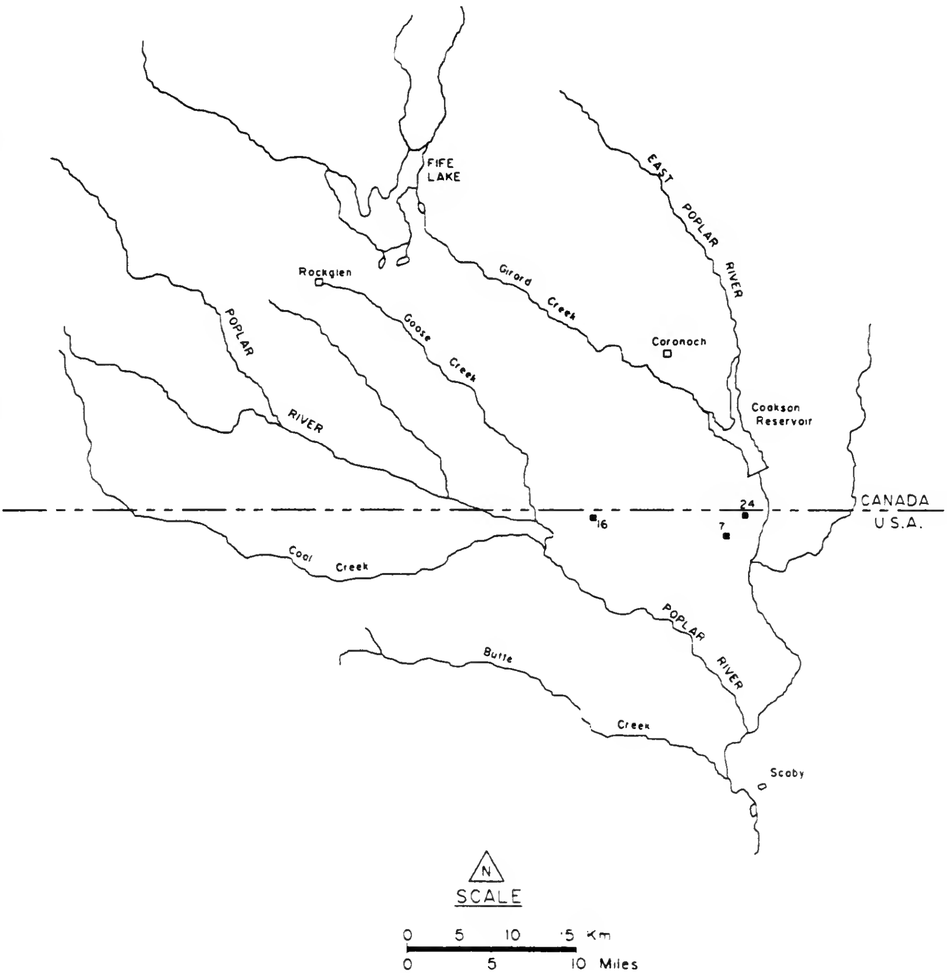
GROUND-WATER-QUALITY MONITORING -- Station Locations

Responsible Agency: Montana Bureau of Mines and Geology					
Map Number	**Well Location**	**Total Depth (a) (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.
00440	Bicarbonates	Electrometric Titration	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 analysed.
01020	Boron-diss	Emission Plasma, ICP	
00915	Calcium	Emission Plasma	
00445	Carbonates	Electrometric Titration	
00940	Chloride	Ion Chromatography	
00095	Conductivity	Wheatstone Bridge	
01040	Copper-diss	Emission Plasma, ICP	
00950	Fluoride	Ion Chromatography	
01046	Irondiss	Emission Plasma, ICP	
01049	Lead-diss	Emission Plasma, ICP	
01130	Lithium-diss	Emission Plasma, ICP	
00925	Magnesium	Emission Plasma, ICP	
01056	Manganese-diss	Emission Plasma, ICP	
01060	Molybdenum	Emission Plasma, ICP	
00630	Nitrate	Ion Chromatography	
00400	pH	Electrometric	
00935	Potassium	Emission Plasma, ICP	
01145	Selenium-diss	AA	
00955	Silica	Emission Plasma, ICP	
00930	Sodium	Emission Plasma, ICP	
01080	Strontium-diss	Emission Plasma, ICP	
00445	Sulphate	Ion Chromatography	
00190	Zinc-diss	Emission Plasma, ICP	
70301	TDS	Calculated	

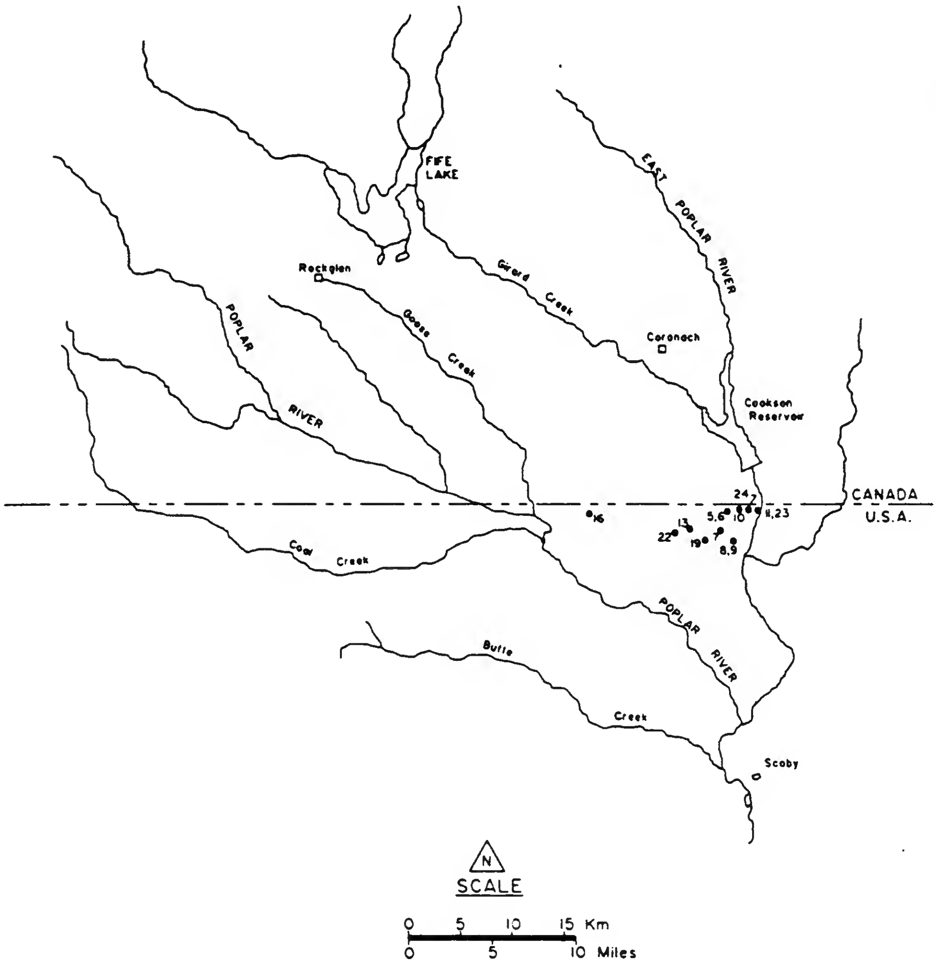
SYMBOLS: AA - Atomic Absorption;
** - Computer storage and retrieval system – EPA   ICP - Inductively Coupled Plasma Unit



GROUND-WATER-QUALITY MONITORING (UNITED STATES)

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

Responsible Agency: Montana Bureau of Mines and Geology	
No. on Map	**Sampling**
2 to 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 feet 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 acres-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

METRIC CONVERSION FACTORS

METRIC 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 ftm^2 = 10.7636 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