Report to

THE INTERNATIONAL JOINT COMMISSION

on

THE DIVISION OF THE WATERS OF

ST. MARY AND MILK RIVERS

by

E. F. DURRANT

representing Canada

and

J. S. CRAGWALL, Jr.

representing United States

1976

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March 8, 1977

INTERNATIONAL JOINT COMMISSION
WASHINGTON, D.C. and OTTAWA, ONTARIO

GENTLEMEN:

In compliance with the provisions of Clause VIII (c) of your order of October 4, 1921, directing the division of the waters of St. Mary and Milk Rivers between the United States and Canada, we are transmitting herewith a report on the operations during the irrigation season ended October 31, 1976.

Respectfully submitted,

E. F. Durrant
Accredited Officer of Her Majesty

J. S. Cragwall, Jr.,
Accredited Officer of the United States

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ENGLISH TO METRIC (SI) CONVERSION

The 1976 Report to the International Joint Commission on the Division of the Waters of the St. Mary and Milk Rivers uses dual units (metric and English) as a transition to future reports which will be entirely in metric units.

The two English units that have been used in previous reports are cfs-days and acre-feet.

A cfs-day is the equivalent volume of one cubic foot per second flowing for 24 hours (60 x 60 x 24) or 86,400 cubic feet.

An acre-foot is the volume of water covering one acre to the depth of one foot and is equal to 43,560 cubic feet.

One cfs-day is equal to 1.9835 acre-feet.

The metric (SI) unit replacing the English units is the cubic decametre (dam^3) and is the volume contained in a cube 10m x 10m x 10m or 1,000 cubic metres.

One cubic metre is equal to 35.315 cubic feet

One cubic decametre is equal to 35,315 cubic feet.

An acre-foot is equal to 1.2335 cubic decametres.

A cfs-day is equal to 2.4466 cubic decametres.

SYNOPSIS

During the 1976 irrigation season (April 1 - October 31) the natural runoff of the St. Mary River and Milk River were below normal, being 98 and 80 percent of the long term natural runoff respectively. The natural runoff of the principal eastern tributaries of the Milk River was also below normal at 93 percent of the long term runoff for the period March 1 to October 31. For the remainder of the year flows are either very low or not utilized extensively by the upstream country.

The natural runoff of the St. Mary River, for the period April 1 to October 31, 1976, was 717,000 cubic decametres (581,000 acre-feet), of which Canada received 496,000 cubic decametres (402,000 acre-feet), 62,000 cubic decametres (50,000 acre-feet) more than its allotment under the 1909 Boundary Waters Treaty.

The natural runoff of the Milk River, for the period April 1 to October 31, 1976 was 118,000 cubic decametres (95,500 acre-feet), of which the United States received more than its allotment of 80,400 cubic decametres (61,500 acre-feet) under the Treaty. Unmeasured minor diversions within Canada and the United States were neglected.

The combined natural runoff of Lodge Creek, Battle Creek and Frenchman River for the period March 1 to October 31, 1976, was 155,000 cubic decametres (125,000 acre-feet) of which the United States received 118,000 cubic decametres (95,300 acre-feet), 40,200 cubic decametres (32,600 acre-feet) more than its allotment under the Treaty.

Although the flows delivered across the International Boundary were deficient for several periods during the year, the deficits were soon refunded and no major problems in the apportionment of water between the two countries occurred in 1976.

INTRODUCTION

Article VI of the Boundary Waters Treaty of 1909 between Great Britain and the United States governs the apportionment of the waters of the St. Mary and Milk Rivers. To comply with this Treaty, representatives of the United States and Canada collected and compiled on a co-operative basis, hydrometric data at forty-six international gauging stations. Additional gauging stations were operated independently by Canada and the United States to obtain data on diversions, reservoir contents, return flows, and index runoff. The majority of this additional information is used to improve the accuracy of natural flow computations.

This report summarizes the natural flow computations during 1976, enlarges on the apportionment of the natural flow and explains any unusual occurrences throughout the year as well as any modifications which have been made or are contemplated for increasing the accuracy of the natural flow computations. Summarized natural flow tables are included in the report proper, whereas the detailed natural flow computations are included in Appendix A. The daily discharge data for 1976 are included in Appendix B.

In accordance with the metric conversion schedule established by the International Joint Commission, the 1976 report uses metric (SI) units first, followed by English units in parenthesis. Tables are shown, for example Table 1, by the results in metric (SI) units first, followed by the respective English unit table, Table 1-A. The format for Appendices A and B of the report remain unchanged for 1976, using English units only.

Mr. E. F. Durrant, Director, Western & Northern Region, Inland Waters Directorate, as Accredited Officer of Her Majesty, was represented in the field by Mr. R. D. May, District Engineer, Calgary, Alberta and Mr. D. A. Davis, District Engineer, Regina, Saskatchewan. Mr. J. S. Cragwall, Jr., Chief Hydrologist, United States Geological Survey, as Accredited Officer of the United States was represented in the field by Mr. G. M. Pike, District Chief, Helena, Montana. This report has been prepared jointly by personnel of the Water Survey of Canada and the United States Geological Survey under the supervision of Messrs. R. D. May, D. A. Davis and G. M. Pike.

During the 1976 irrigation season the natural runoff of the St. Mary River, Milk River and the principal Eastern Tributaries of the Milk River was below normal, being 98% and 80% of the average long term natural flows for the St. Mary and Milk Rivers respectively. The corresponding values for the Eastern Tributaries were 74% for Lodge Creek, 100% for Battle Creek and 99% for the Frenchman River. The flow across the boundary for the Eastern Tributaries was deficient within a small number of apportionment periods. These deficits were soon refunded and no problems in apportionment of flows were encountered during the 1976 irrigation season.

The annual conference between the staffs of the field officers was held in Helena, Montana on February 1-2, 1977. Streamflow records collected jointly by Canada and the United States were reviewed and approved. Mutual problems and changes in computational procedures were discussed and a schedule of field operations for 1977 adopted.

The draft report "Water Use Development on the Eastern Tributaries of the Milk River", prepared by Water Survey of Canada, Saskatchewan District was discussed and preparation of the final report authorized. The report documents the present level of development in seven eastern tributary basins (Whitewater Creek, Rock Creek, Horse Creek, East Fork Battle Creek, Woodpile Coulee, McEachern Creek, Lyons Creek) and determines the effect of this development on a median runoff. The recommendations in the report concerning changes to the hydrometric network and information reported will be reviewed in detail by the Accredited Officers and presented to the International Joint Commission as a separate submission.

Approval was also given to use of a return flow coefficient of 35 percent for the Gaff Ditch project in the Battle Creek basin based on a study of hydrometric record collected over a period of four years for that purpose.

ST. MARY RIVER

During the irrigation season (April 1 to October 31), Canada's share of the natural flow of the St. Mary River at the International Boundary is, as stipulated by the 1921 Order, to be three-quarters of the natural flow up to a total flow of 666 cfs[1], with anything above that quantity to be divided equally between Canada and the United States. During the non-irrigation season the entire flow is to be divided equally between the two countries.

To comply with the above order, field engineers of both countries made semi-monthly computations of the daily natural flow of St. Mary River during the 1976 irrigation season. Regular interim reports of these computations were sent to all agencies involved in the water use and distribution of the flow of the St. Mary River, in order to keep them informed as to the amount of water available, as well as to ensure that any appropriation by the United States in excess of her share could be adjusted by a subsequent delivery of an equivalent amount at the earliest opportunity.

No tentative computations and interim reports are made during the non-irrigation season, as normally the only usage by the United States during this period is storage in Lake Sherburne.

Lake Sherburne, the only storage reservoir in the St. Mary River Basin in the United States, is used to store the United States share of flows for diversion to the Milk River. This water is later utilized by the United States, after passing through Canada, for irrigation in the lower Milk River valley.

Storage in Lake Sherburne was 11,000 cubic decametres (8,930 acre-feet) on October 31, 1975, and had increased to 46,300 cubic decametres (37,500 acre-feet) just prior to the irrigation season on March 31, 1976.

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[1]666 cfs converts to 18.9 cubic metres/second.

The storage reached a maximum of 83,900 cubic decametres (68,000 acre-feet) on July 14, and had declined to 10,400 cubic decametres (8,450 acre-feet) by the end of the irrigation season on October 31. A new stage-capacity curve for Lake Sherburne was used in 1976. This curve was developed from the results of a joint survey by Canada and the United States using automated electronic sounding equipment. The 1975 report erroneously stated that the new stage-capacity curve was used in 1975, when it should have stated it was used starting October 1, 1975.

Water was diverted from the St. Mary River into the St. Mary Canal from April 19 to October 6. The total recorded flow past the gauging station on the St. Mary Canal at St. Mary Crossing was 256,000 cubic decametres (207,000 acre-feet). Any seepage from the canal between the point of diversion and the crossing of the St. Mary River is assumed to return to the river and eventually become available to Canada.

The total natural flow of the St. Mary River at the International Boundary for the period November 1, 1975 to October 31, 1976 was 865,000 cubic decametres (701,000 acre-feet), of which 717,000 cubic decametres (581,000 acre-feet) occurred during the irrigation season, April 1 to October 31, 1976. For the irrigation season, the Canadian and United States shares were 434,000 cubic decametres (352,000 acre-feet) and 283,000 cubic decametres (229,000 acre-feet), respectively. A total runoff of 496,000 cubic decametres (402,000 acre-feet) was recorded at the International boundary which is 114% of the Canadian share. The computed natural flow during the irrigation season was 98 percent of the average of the previous seventy-three years of record.

In order to provide advance information on the probable runoff in the St. Mary River basin, the fifty-fifth annual international snow survey was conducted on April 28 and 29, 1976.

Table 1, which follows, summarizes the apportionment of the waters of the St. Mary River.

TABLE 1

SUMMARY OF DIVISION OF ST. MARY RIVER AND DIVERSION TO MILK RIVER

1976

Quantities in Cubic Decametres

MONTH	St. Mary River at International Boundary				Excess Rec'd by Canada	Storage Lake Sherburne	Total Available for Diversion	St. Mary Canal at St. Mary Crossing	Milk * River at Eastern Crossing
	Recorded Flow	Natural Flow	U.S. Share	Canada Share					
April	40,736	53,396	16,087	37,308	3,428	7,782	8,305	4,876	28,601
May	143,471	198,968	86,836	112,133	31,340	11,495	75,341	44,003	61,117
June	98,319	160,496	68,004	92,490	5,828	10,656	57,348	51,522	64,120
July	92,833	152,025	63,374	88,652	4,182	6,647	56,726	52,545	60,508
August	61,406	90,211	32,455	57,756	3,650	-23,598	56,053	52,403	57,888
Sept.	35,669	39,246	10,284	28,964	6,707	-42,733	53,017	46,311	44,199
Oct.	23,071	22,208	5,547	16,662	6,410	- 4,823	10,370	3,958	15,150
Total Irrig. Season	495,506	716,550	282,586	433,965	61,544	-34,574	317,160	255,617	331,583
Period Nov. to Oct.	608,495	865,100	356,861	508,240					

*Milk River at Eastern Crossing is the natural flow of the Milk River plus the diversion from the St. Mary River basin, less unaccounted canal losses.

Quantities for 15-Day Periods in Cubic Decametres

Division Period at International Boundary	Natural Flow	Canada's Share	Received by Canada	Received by Canada	
				Above Share	Below Share
Apr. 1 - Apr. 15	21,618	15,303	15,489	186	
Apr. 16 - Apr. 30	31,776	22,005	25,246	3,242	
May 1 - May 15	91,471	51,856	67,673	15,817	
May 16 - May 31	107,494	60,274	75,796	15,521	
June 1 - June 15	79,287	45,766	50,473	4,707	
June 16 - June 30	81,205	46,723	47,843	1,121	
July 1 - July 15	85,088	48,663	51,428	2,765	
July 16 - July 31	66,934	39,987	41,404	1,417	
Aug. 1 - Aug. 15	46,077	29,161	29,332	171	
Aug. 16 - Aug. 31	44,132	28,593	32,072	3,479	
Sep. 1 - Sep. 15	24,442	17,855	20,483	2,628	
Sep. 16 - Sep. 30	14,804	11,108	15,186	4,078	
Oct. 1 - Oct. 15	13,689	10,268	16,505	6,236	
Oct. 16 - Oct. 31	8,519	6,393	6,567	174	

TABLE 1-A

SUMMARY OF DIVISION OF ST. MARY RIVER AND DIVERSION TO MILK RIVER

1976

Quantities in Acre-Feet

MONTH	St. Mary River at International Boundary				Excess Rec'd by Canada	Storage Lake Sherburne	Total Available for Diversion	St. Mary Canal at St. Mary Crossing	Milk * River at Eastern Crossing
	Recorded Flow	Natural Flow	U.S. Share	Canada Share					
April	33,025	43,288	13,042	30,246	2,779	6,309	6,733	3,953	23,187
May	116,312	161,304	70,398	90,906	25,407	9,319	61,079	35,673	49,548
June	79,707	130,114	55,131	74,982	4,725	8,639	46,492	41,769	51,982
July	75,260	123,247	51,377	71,870	3,390	5,389	45,988	42,598	49,054
August	49,782	73,134	26,311	46,823	2,959	-19,131	45,442	42,483	46,930
Sept.	28,917	31,817	8,337	23,481	5,437	-34,644	42,981	37,544	35,832
Oct.	18,704	18,004	4,497	13,508	5,197	- 3,910	8,407	3,209	12,282
Total Irrig. Season	401,707	580,908	229,093	351,816	49,894	-28,029	257,122	207,229	268,815
Period Nov. to Oct.	493,308	701,338	289,308	412,031					

*Milk River at Eastern Crossing is the natural flow of the Milk River plus the diversion from the St. Mary River basin, less unaccounted canal losses.

Quantities for 15-Day Periods in CFS-Days

Division Period at International Boundary	Natural Flow	Canada's Share	Received by Canada	Received by Canada	
				Above Share	Below Share
Apr. 1 - Apr. 15	8,836	6,255	6,331	76	
Apr. 16 - Apr. 30	12,988	8,994	10,319	1,325	
May 1 - May 15	37,387	21,195	27,660	6,465	
May 16 - May 31	43,936	24,636	30,980	6,344	
June 1 - June 15	32,407	18,706	20,630	1,924	
June 16 - June 30	33,191	19,097	19,555	458	
July 1 - July 15	34,778	19,890	21,020	1,130	
July 16 - July 31	27,358	16,344	16,923	579	
Aug. 1 - Aug. 15	18,833	11,919	11,989	70	
Aug. 16 - Aug. 31	18,038	11,687	13,109	1,422	
Sep. 1 - Sep. 15	9,990	7,298	8,372	1,074	
Sep. 16 - Sep. 30	6,051	4,540	6,207	1,667	
Oct. 1 - Oct. 15	5,595	4,197	6,746	2,549	
Oct. 16 - Oct. 31	3,482	2,613	2,684	71	

MILK RIVER

The 1921 Order on the division of flow of the Milk River is the converse to that of the St. Mary River. That is, the United States is entitled to three-quarters of the flow up to a total discharge of 666 cfs[1], with any amount above this total to be divided equally between the two countries. During the non-irrigation season (November 1, to March 31), the entire flow is to be divided equally.

No actual apportionment of the Milk River at Eastern Crossing is made as Canadian usage is assumed to be less than her share of the natural flow. Alberta is processing more and more license requests for water usage in the basin, which may require a change in natural flow computation procedures and a more formal approach to apportionment. Water Survey of Canada staff toured the major licensed projects during 1976 to compare use with water right allocation and further discussion with the Alberta Water Rights personnel will be carried out to review the findings.

The computed natural flow of the Milk River at its eastern crossing of the International Boundary during the period March 1 to October 31, 1976 was 118,000 cubic decametres (95,500 acre-feet). This is 80 percent of the average natural flow of the previous sixty-four years of records. The United States and Canadian shares were 80,400 cubic decametres (65,100 acre-feet) and 37,400 cubic decametres (30,300 acre-feet), respectively. The natural flow computations of the Milk River at its eastern crossing are given in Table 8 in Appendix A.

An international gauging station was again operated in 1976 on the South Fork Milk River near Babb, Montana, for the purpose of studying the utilization of water in the Milk River basin within the Blackfoot Indian Reservation. A substantial flow was recorded all summer downstream at the gauging station, Milk River at the Western Crossing of the International Boundary, and consequently, there were no complaints by Canadian ranchers about water shortages.

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[1]666 cfs converts to 18.9 cubic metres/second

The Milk River miscellaneous suspended sediment program which was initiated in 1974 was continued during the 1976 irrigation season. The laboratory analyses of the 1976 samples have not been completed. On completion of analysis, a review of data collected from 1974 to 1976 will be made and the findings with respect to changes in sediment transport characteristics due to the changed flow regime, will be published.

EASTERN TRIBUTARIES OF MILK RIVER

The waters of the eastern tributaries of the Milk River were divided in accordance with the Order of the International Joint Commission dated October 4, 1921, which stipulates under Rule III that "The natural flow of the eastern (otherwise known as the Saskatchewan or northern) tributaries of the Milk River at the points where they cross the International Boundary shall be divided equally between the two countries". This order might well be interpreted as requiring that the division of water be made on a continuing basis. It was recognized that there is a physical limitation because of the transit time in the flow system so compilation of the natural flows at the International Boundary are done by ten-day periods, the smallest practical time increment.

Prior to 1937, Canadian usage on the eastern tributaries consisted of private irrigators and the Canadian share of the natural flow was not fully utilized. The construction of three major reservoirs by the government of Canada on the Frenchman River during the late 1930's made an operational division of flow necessary on this tributary in 1937.

The re-development by the government of several private irrigation projects and the construction of the Vidora project during the early 1950's resulted in increased utilization in Canada of Battle Creek water and made an operational division of flow on this tributary necessary in 1957.

Construction of a major government reservoir and irrigation project on Lodge Creek in 1960 made an operational division of flow on this tributary necessary in 1961.

The remaining tributaries, Woodpile, East Fork Battle, Lyons, Whitewater, Rock and McEachern Creeks, are monitored but do not have sufficient usage in Canada at this time to warrant an operational division of flow.

During the runoff season March 1 to October 31, field engineers of both countries make ten-day computations of the natural flows of Lodge Creek, Battle Creek and Frenchman River to determine each country's share, so that any usage by Canada in excess of her share can be adjusted at the earliest opportunity by a subsequent delivery to the United States of an equivalent amount. Regular interim reports on the progress of the division of the natural flows of Lodge Creek, Battle Creek and Frenchman River at the International Boundary were made to interested agencies throughout the runoff season. No division of flow is made during the winter period as there is usually very little flow or use and it is impracticable to obtain streamflow records during this period.

Deficit deliveries in the 10-day division periods during May in the Battle Creek and Frenchman River did not create a significant problem this year since runoff was above average. Makeup deliveries appear to have been well planned to the benefit of downstream users in the United States.

The total quantity of water delivered to the United States by the eastern tributaries of the Milk River during the period March 1 to October 31, 1976 was 182,000 cubic decametres (148,000 acre-feet) or 111 percent of the average of the previous forty-nine years. The quantities delivered to the United States by the various tributaries are listed in Table 2 on Page 12 of this report. This historical summary is listed in Table 16 in Appendix A.

TABLE 2

RECORDED RUNOFF OF EASTERN TRIBUTARIES

OF MILK RIVER AT INTERNATIONAL BOUNDARY

FOR PERIOD MARCH TO OCTOBER 1976

(quantities in cubic decametres)

Month	Lodge Creek	Battle Creek	Wood-pile Coulee	East Fork Battle Creek	Lyons Creek	White-water Creek	French-man River	Rock Creek below Horse Creek	Mc-Eachern Creek
Mar	15,381	10,312	2,810	2,335	1,605	2,382	44,017	28,023	18,498
Apr	5,984	4,381	15	1	43	43	21,435	4,358	1,816
May	501	1,752	0	0	0	7	1,993	430	22
Jun	32	2,946	0	0	0	6	2,674	593	31
Jul	187	582	0	0	0	2	2,312	1,095	63
Aug	0	767	0	0	0	1	1,352	353	2
Sep	237	22	0	0	0	2	19	48	0
Oct	0	438	0	0	0	5	180	121	0
TOTAL	22,322	21,200	2,825	2,336	1,648	2,448	73,982	35,021	20,432

Total - Milk River Eastern Tributaries - 182,214 (dam^3)

TABLE 2-A

RECORDED RUNOFF OF EASTERN TRIBUTARIES

OF MILK RIVER AT INTERNATIONAL BOUNDARY

FOR PERIOD MARCH TO OCTOBER 1976

(quantities in acre-feet)

Month	Lodge Creek	Battle Creek	Wood-pile Coulee	East Fork Battle Creek	Lyons Creek	White-water Creek	French-man River	Rock Creek below Horse Creek	Mc-Eachern Creek
Mar	12,469	8,360	2,278	1,893	1,301	1,931	35,685	22,718	14,996
Apr	4,851	3,552	12	1	35	35	17,377	3,533	1,472
May	406	1,420	0	0	0	6	1,616	349	18
Jun	26	2,388	0	0	0	5	2,168	481	25
Jul	152	472	0	0	0	2	1,874	888	51
Aug	0	622	0	0	0	1	1,096	286	2
Sep	192	18	0	0	0	2	15	39	0
Oct	0	355	0	0	0	4	146	98	0
TOTAL	18,096	17,187	2,290	1,894	1,336	1,986	59,977	28,392	16,564

Total - Milk River Eastern Tributaries - 147,722 acre-feet

Estimates of unmeasured diversions to private irrigation projects in the Lodge, Battle and Frenchman basins in Saskatchewan were provided by the Saskatchewan Department of the Environment, and for the Lodge basin in Alberta by the Department of Regional Economic Expansion, PFRA. These estimates are based on reports received from the operators of individual projects and by field inspections. An additional charge is made for domestic projects in the Battle and Frenchman basins based on the results of studies carried out by Canada on domestic project usage.

For the interim reports prepared at the end of apportionment periods an estimate of minor diversion projects usage is made based on a correlation between annual natural flows and reported usages for previous years. The natural flow for the current year is forecast based on computed natural flow to date and an estimate of runoff volume for the remainder of the year dependent on runoff conditions. At the end of the year, the actual flow is known and a final estimate of minor diversions is made based on reported usage, consequently there is some discrepancy between interim and final division computations. A list of reported and estimated diversions for 1976 is contained in Appendix B.

A return flow of 30% of the diversion for the Gaff project and a standard return flow of 25% of the diversion for Vidora, Richardson and McKinnon projects on Battle Creek were used in computation of natural flow. The Squaw Coulee gauging station which records the return flow from the Spangler project on Lodge Creek indicated a return flow of 78 cubic decametres (63 acre-feet) or 4 percent of the 2000 cubic decametres (1620 acre-feet) diverted. In this case the actual values of return flow were used in the computation of natural flow.

A supplementary gauging station was operated during 1976 on Shepherd Ditch, a private diversion on Battle Creek re-constructed during 1972 and located downstream from Gaff Ditch, to record the amount of water being diverted. A total diversion of 805 cubic decametres (653 acre-feet) was recorded at this station during 1976.

Canada installed and tested a Leupold & Stevens Memomark coupled with an LANDSAT data collection platform at Battle Creek at the International Boundary during October 1975. Data from this gauging station was available daily via Telex from the satellite tracking station during the 1976 irrigation season. The system proved to be very successful and will be used again during 1977.

The Atmospheric Environment service continued their study of indirect methods of determining evaporation at Val Marie Reservoir as a possible alternative to use of adjusted evaporation pan values.

LODGE CREEK

The computed natural runoff of Lodge Creek at the International Boundary for the period March 1 to October 31, 1976 was 29,500 cubic decametres (23,900 acre-feet) or 74 percent of the average natural runoff of the previous twenty-six years of record. Each country was entitled to 14,800 cubic decametres (12,000 acre-feet), which is fifty percent of the natural runoff. A total runoff of 22,300 decametres (18,100 acre-feet) was recorded at the International Boundary which is 151 percent of the United States share.

Deficit deliveries to the U.S.A. were recorded in three of the twenty-four division periods during the season. Deficits were minor and were largely refunded within thirty days.

The division of the Lodge Creek natural flow is summarized in Table 3. The detailed computation of the natural flow is given in Table 10 and the historical summary in Table 11, of Appendix A.

TABLE 3

SUMMARY OF LODGE CREEK DIVISION

1976

(quantities in cubic decametres)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 10	181	91	321	230	
Mar 11 - Mar 20	8,617	4,308	5,106	798	
Mar 21 - Mar 31	11,859	5,930	9,955	4,025	
Apr 1 - Apr 10	5,701	2,850	4,064	1,214	
Apr 11 - Apr 20	1,962	981	1,519	538	
Apr 21 - Apr 30	409	204	401	197	
May 1 - May 10	206	103	154	51	
May 11 - May 20	0	0	127	127	
May 21 - May 31	122	61	220	159	
Jun 1 - Jun 10	0	0	20	20	
Jun 11 - Jun 20	100	50	7		43
Jun 21 - Jun 30	252	126	5		121
Jul 1 - Jul 10	69	35	2		33
Jul 11 - Jul 20	0	0	152	152	
Jul 21 - Jul 31	0	0	34	34	
Aug 1 - Aug 10	0	0	0	0	
Aug 11 - Aug 20	0	0	0	0	
Aug 21 - Aug 31	0	0	0	0	
Sep 1 - Sep 10	0	0	0	0	
Sep 11 - Sep 20	0	0	232	232	
Sep 21 - Sep 30	5	3	5	2	
Oct 1 - Oct 10	0	0	0	0	
Oct 11 - Oct 20	0	0	0	0	
Oct 21 - Oct 31	0	0	0	0	
TOTAL - cubic decametres	29,483	14,742	22,324		

TABLE 3-A

SUMMARY OF LODGE CREEK DIVISION

1976

(quantities in cfs days)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 10	74	37	131	94	
Mar 11 - Mar 20	3,522	1,761	2,087	326	
Mar 21 - Mar 31	4,847	2,424	4,069	1,645	
Apr 1 - Apr 10	2,330	1,165	1,661	496	
Apr 11 - Apr 20	802	401	621	220	
Apr 21 - Apr 30	167	84	164	80	
May 1 - May 10	84	42	63	21	
May 11 - May 20	0	0	52	52	
May 21 - May 31	50	25	90	65	
Jun 1 - Jun 10	0	0	8	8	
Jun 11 - Jun 20	41	21	3		18
Jun 21 - Jun 30	103	52	2		50
Jul 1 - Jul 10	28	14	1		13
Jul 11 - Jul 20	0	0	62	62	
Jul 21 - Jul 31	0	0	14	14	
Aug 1 - Aug 10	0	0	0	0	
Aug 11 - Aug 20	0	0	0	0	
Aug 21 - Aug 31	0	0	0	0	
Sep 1 - Sep 10	0	0	0	0	
Sep 11 - Sep 20	0	0	95	95	
Sep 21 - Sep 30	2	1	2	1	
Oct 1 - Oct 10	0	0	0	0	
Oct 11 - Oct 20	0	0	0	0	
Oct 21 - Oct 31	0	0	0	0	
TOTAL - cfs days	12,050	6,027	9,125		
- acre-feet	23,901	11,955	18,099		

BATTLE CREEK

The computed natural runoff of Battle Creek at the International Boundary for the period March 1 to October 31, 1976 was 34,500 cubic decametres (28,000 acre-feet) or 100 percent of the average natural runoff of the previous thirty-six years of record. Each country was entitled to 17,300 cubic decametres (14,000 acre-feet), which is 50 percent of the natural runoff. A total runoff of 21,200 cubic decametres (17,200 acre-feet) was recorded at the International Boundary which is 123 percent of the United States share.

Deficit deliveries were recorded in four division periods during the season of which one deficit period during April totalled 1771 cubic decametres (1,436 acre-feet). In consideration of a request from the Battle Creek Water User's Association in Montana, release of water from Cypress Lake to restore this deficit was delayed until later in the season thereby deriving a more beneficial use to irrigators.

The division of the Battle Creek natural flow is summarized in Table 4. The detailed computation of the natural flow is given in Table 12 and the historical summary in Table 13 of Appendix A.

TABLE 4

SUMMARY OF BATTLE CREEK DIVISION

1976

(quantities in cubic decametres)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 14	744	372	560	188	
Mar 15 - Mar 25	11,487	5,744	7,832	2,088	
Mar 26 - Apr 4	5,493	2,746	2,750	4	
Apr 5 - Apr 14	7,142	3,571	1,801		1,770
Apr 15 - Apr 24	2,427	1,214	1,338	124	
Apr 25 - May 4	1,047	523	643	120	
May 5 - May 14	724	362	404	42	
May 15 - May 25	306	153	352	199	
May 26 - Jun 4	0	0	1,656	1,656	
Jun 5 - Jun 14	1,889	944	1,390	446	
Jun 15 - Jun 24	1,103	552	406		146
Jun 25 - Jul 4	744	372	340		32
Jul 5 - Jul 14	301	150	130		20
Jul 15 - Jul 25	98	49	130	81	
Jul 26 - Aug 4	0	0	453	453	
Aug 5 - Aug 14	188	94	323	229	
Aug 15 - Aug 25	193	97	164	67	
Aug 26 - Sep 4	100	50	86	36	
Sep 5 - Sep 14	12	6	10	4	
Sep 15 - Sep 24	0	0	0	0	
Sep 25 - Oct 4	0	0	0	0	
Oct 5 - Oct 14	73	36	61	25	
Oct 15 - Oct 25	252	126	213	87	
Oct 26 - Oct 31	193	97	164	67	
TOTAL - cubic decametres	34,516	17,258	21,206		

TABLE 4A

SUMMARY OF BATTLE CREEK DIVISION

1976

(quantities in cfs days)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 14	304	152	229	77	
Mar 15 - Mar 25	4,695	2,348	3,201	853	
Mar 26 - Apr 4	2,245	1,122	1,124	2	
Apr 5 - Apr 14	2,919	1,460	736		724
Apr 15 - Apr 24	992	496	547	51	
Apr 25 - May 4	428	214	263	49	
May 5 - May 14	296	148	165	17	
May 15 - May 25	125	62	144	82	
May 26 - Jun 4	0	0	677	677	
Jun 5 - Jun 14	772	386	568	182	
Jun 15 - Jun 24	451	226	166		60
Jun 25 - Jul 4	304	152	139		13
Jul 5 - Jul 14	123	62	53		9
Jul 15 - Jul 25	40	20	53	33	
Jul 26 - Aug 4	0	0	185	185	
Aug 5 - Aug 14	77	38	132	94	
Aug 15 - Aug 25	79	40	67	27	
Aug 26 - Sep 4	41	20	35	15	
Sep 5 - Sep 14	5	2	4	2	
Sep 15 - Sep 24	0	0	0	0	
Sep 25 - Oct 4	0	0	0	0	
Oct 5 - Oct 14	30	15	25	10	
Oct 15 - Oct 25	103	51	87	36	
Oct 26 - Oct 31	79	40	67	27	
TOTAL - cfs days	14,108	7,054	8,667		
- acre-feet	27,983	13,992	17,191		

FRENCHMAN RIVER

The computed natural runoff of the Frenchman River at the International Boundary for the period March 1 to October 31, 1976 was 90,700 cubic decametres (73,500 acre-feet) or 99 percent of the average runoff of the previous thirty-six years of record. Each country was entitled to 45,400 cubic decametres (36,800 acre-feet) which is 50 percent of the natural runoff. A total runoff of 74,000 cubic decametres (60,000 acre-feet) was recorded at the International Boundary which is 163 percent of the United States share.

Deficit deliveries were recorded in eight of the twenty-four division periods during the season. All major deficits were refunded within twenty days.

The division of the Frenchman River natural flow is summarized in Table 5. The detailed computation of the natural flow is given in Table 14 and the historical summary in Table 15 of Appendix A.

TABLE 5

SUMMARY OF FRENCHMAN RIVER DIVISION

1976

(quantities in cubic decametres)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 10	1,713	856	1,522	666	
Mar 11 - Mar 20	5,867	2,933	5,473	2,540	
Mar 21 - Mar 31	45,509	22,755	37,022	14,267	
Apr 1 - Apr 10	14,376	7,188	15,184	7,996	
Apr 11 - Apr 20	7,144	3,572	3,528		44
Apr 21 - Apr 30	2,148	1,074	2,723	1,649	
May 1 - May 10	1,654	827	624		203
May 11 - May 20	954	477	470		7
May 21 - May 31	1,089	545	900	355	
Jun 1 - Jun 10	1,669	834	1,280	446	
Jun 11 - Jun 20	2,498	1,249	604		645
Jun 21 - Jun 30	1,962	981	790		191
Jul 1 - Jul 10	1,108	554	898	344	
Jul 11 - Jul 20	541	271	736	465	
Jul 21 - Jul 31	362	181	678	497	
Aug 1 - Aug 10	991	495	1,003	508	
Aug 11 - Aug 20	724	362	316		46
Aug 21 - Aug 31	108	54	34		20
Sep 1 - Sep 10	32	16	17	1	
Sep 11 - Sep 20	0	0	0	0	
Sep 21 - Sep 30	54	27	0		27
Oct 1 - Oct 10	0	0	0	0	
Oct 11 - Oct 20	0	0	0	0	
Oct 21 - Oct 31	188	94	181	87	
TOTAL - cubic decametres	90,691	45,345	73,983		

TABLE 5-A

SUMMARY OF FRENCHMAN RIVER DIVISION

1976

(quantities in cfs days)

Division Period at International Boundary	Natural Flow	U.S.A. Share	Received by U.S.A.	Received by U.S.A.	
				Above Share	Below Share
Mar 1 - Mar 10	700	350	622	272	
Mar 11 - Mar 20	2,398	1,199	2,237	1,038	
Mar 21 - Mar 31	18,601	9,301	15,132	5,831	
Apr 1 - Apr 10	5,876	2,938	6,206	3,268	
Apr 11 - Apr 20	2,920	1,460	1,442		18
Apr 21 - Apr 30	878	439	1,113	674	
May 1 - May 10	676	338	255		83
May 11 - May 20	390	195	192		3
May 21 - May 31	445	223	368	145	
Jun 1 - Jun 10	682	341	523	182	
Jun 11 - Jun 20	1,021	511	247		264
Jun 21 - Jun 30	802	401	323		78
Jul 1 - Jul 10	453	227	367	140	
Jul 11 - Jul 20	221	111	301	190	
Jul 21 - Jul 31	148	74	277	203	
Aug 1 - Aug 10	405	203	410	207	
Aug 11 - Aug 20	296	148	129		19
Aug 21 - Aug 31	44	22	14		8
Sep 1 - Sep 10	13	7	7	0	
Sep 11 - Sep 20	0	0	0	0	
Sep 21 - Sep 30	22	11	0		11
Oct 1 - Oct 10	0	0	0	0	
Oct 11 - Oct 20	0	0	0	0	
Oct 21 - Oct 31	77	39	74	35	
TOTAL - cfs days	37,068	18,538	30,239		
- acre feet	73,524	36,770	59,979		

APPENDICES

Appendices A and B are submitted with this report under separate cover. Appendix A contains the natural flow computations for the St. Mary River, Milk River, Lodge Creek, Battle Creek and Frenchman River. It also contains historical summaries of the natural flows, recorded runoff, United States shares and Canadian shares of the St. Mary River; historical summaries of natural flows, United States and Canadian shares and recorded runoff of Milk River; historical summaries of natural and recorded runoff of Lodge Creek, Battle Creek and Frenchman River; the historical summary of the March to October runoff of the Eastern Tributaries of the Milk River and the month-end contents of the major reservoirs in the Lodge, Battle and Frenchman basins for 1976.

Appendix B contains the daily discharge data for thirty-nine international gauging stations operated jointly by the United States and Canada, and six stations used in the natural flow computations which are operated by Canada. The details of the minor diversions in Canada are also contained in Appendix B.

INTERNATIONAL GAUGING STATIONS OPERATED JOINTLY

BY

CANADA AND UNITED STATES

ST. MARY AND MILK RIVER DRAINAGE BASINS

1976

Map Index	Stream and Location
	ST. MARY RIVER BASIN
05AE027	St. Mary River at International Boundary
05AE036	Lake Sherburne at Sherburne, Montana
05AE033	Swiftcurrent Creek at Sherburne, Montana
05AE029	St. Mary Canal at St. Mary Crossing near Babb, Montana
	MILK RIVER BASIN
11AA025	Milk River at Western Crossing of International Boundary
11AA005	Milk River at Milk River
11AA031	Milk River at Eastern Crossing of International Boundary
11AA033	South Fork Milk River near Babb, Montana
11AA032	North Fork Milk River above St. Mary Canal near Browning, Montana
11AA001	North Milk River near International Boundary
	LODGE CREEK TRIBUTARY BASIN
11AB089	Altawan Reservoir near Govenlock
11AB083	Lodge Creek below McRae Creek at International Boundary
11AB086	Walburger Coulee below Diversions
11AB060	Spangler Ditch near Govenlock
11AB009	Middle Creek near Alberta Boundary
11AB080	Middle Creek Reservoir
11AB001	Middle Creek below Middle Creek Reservoir
	BATTLE CREEK TRIBUTARY BASIN
11AB027	Battle Creek at International Boundary
11AB102	Gaff Ditch near Merryflat
11AB078	Cypress Lake West Inflow Canal
11AB085	Cypress Lake West Inflow Canal Drain
11AB077	Cypress Lake West Outflow Canal
11AB084	Vidora Ditch near Consul

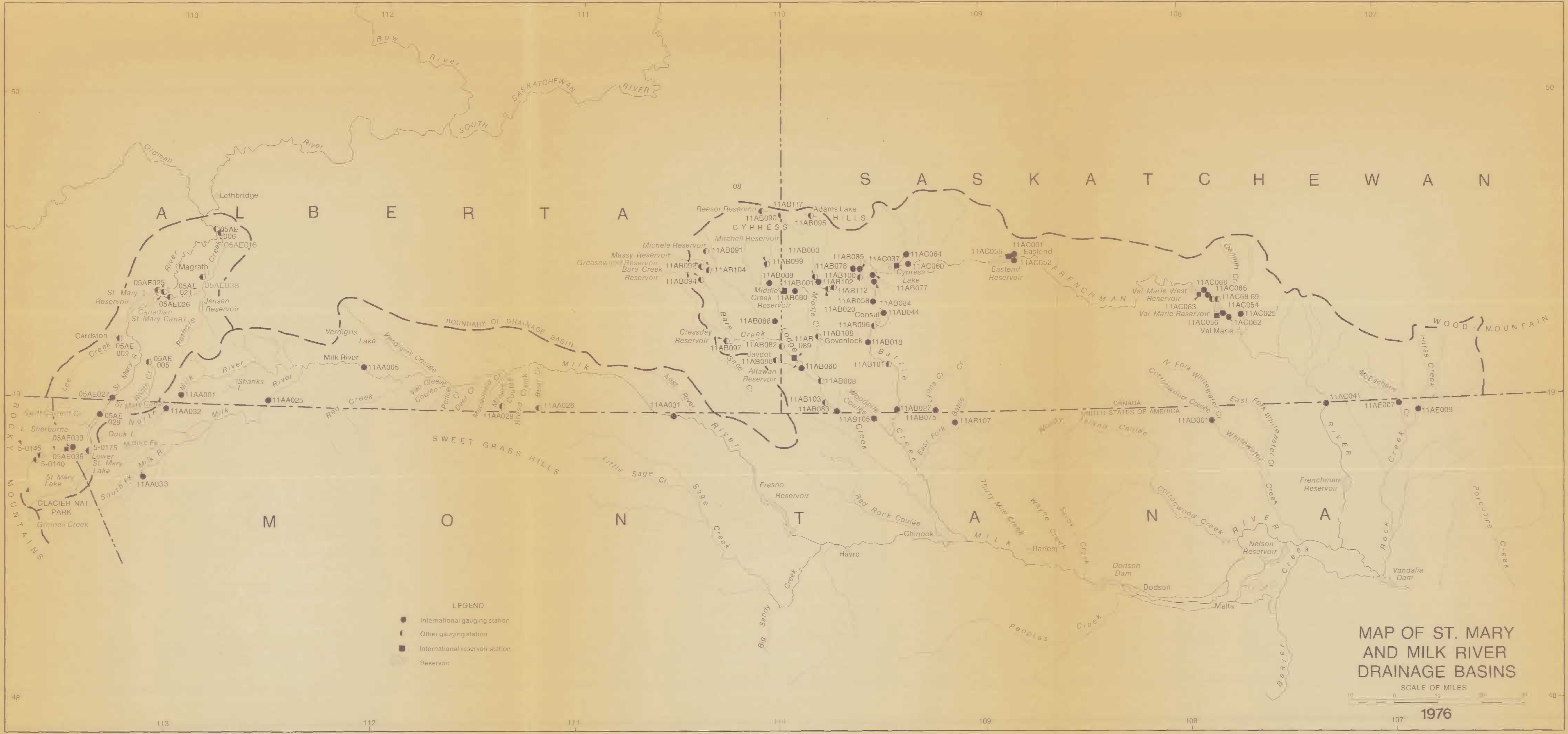
Map Index	Stream and Location
	BATTLE CREEK TRIBUTARY BASIN (continued)
11AB058	Richardson Ditch near Consul
11AB044	McKinnon Ditch near Consul
11AB018	Nashlyn Canal near Consul
11AB105	Woodpile Coulee near International Boundary
11AB107	East Fork Battle Creek near International Boundary
11AB075	Lyons Creek at International Boundary
	FRENCHMAN RIVER TRIBUTARY BASIN
11AC055	Eastend Reservoir
11AC001	Frenchman River below Eastend Reservoir
11AC063	Val Marie West Reservoir
11AC056	Val Marie Reservoir
11AC041	Frenchman River at International Boundary
11AC060	Cypress Lake East Outflow Canal
11AC037	Cypress Lake
11AC064	Belanger Creek Diversion to Cypress Lake
11AC052	Eastend Canal
11AC066	Val Marie West Pumping Canal
11AC065	Val Marie West Gravity Canal
11AC054	Val Marie Main Canal
11AC025	Denniel Creek near Val Marie
11AC062	Frenchman River below Val Marie Reservoir
	WHITEWATER CREEK TRIBUTARY BASIN
11AD001	Whitewater Creek near International Boundary
	ROCK CREEK TRIBUTARY BASIN
11AE009	Rock Creek below Horse Creek near International Boundary
11AE007	McEachern Creek at International Boundary

GAUGING STATIONS OPERATED INDEPENDENTLY BY EITHER CANADA OR UNITED STATES IN THE ST. MARY AND MILK RIVER DRAINAGE BASINS 1976

Map Index	Stream and Location	Operated By
	ST. MARY RIVER BASIN	
5-0175*	St. Mary River near Babb, Montana	U.S.A.
05AE025*	St. Mary Reservoir near Spring Coulee	Canada
05AE006*	St. Mary River near Lethbridge	Canada
5-0140*	Grinnell Creek near Many Glacier, Montana	U.S.A.
5-0145*	Swiftcurrent Creek at Many Glacier, Montana	U.S.A.
05AE005*	Rolph Creek near Kimball	Canada
05AE002*	Lee Creek at Cardston	Canada
05AE026*	Canadian St. Mary Canal near Spring Coulee	Canada
05AE021*	Magrath Irrigation District Canal near Spring Coulee	Canada
05AE016*	Pothole Creek at Russell's Ranch	Canada
05AE038*	Pothole Turnout near Magrath	Canada
	MILK RIVER BASIN - SOUTHERN TRIBUTARIES	
11AA029*	Miners Coulee near International Boundary	Canada
11AA028*	Bear Creek near International Boundary	Canada
	LODGE CREEK TRIBUTARY BASIN	
11AB082*	Lodge Creek at Alberta Boundary	Canada
11AB091	Michele Reservoir near Elkwater	Canada
11AB092	Greasewood Reservoir near Elkwater	Canada
11AB104	Massy Reservoir near Elkwater	Canada
11AB094	Bare Creek Reservoir near Elkwater	Canada
11AB097	Cressday Reservoir near Cressday	Canada
11AB098	Jaydot Reservoir near Jaydot	Canada
11AB099	Mitchell Reservoir near Elkwater	Canada
11AB113	Middle Creek Reservoir Main Outlet	Canada

Map Index	Stream and Location	Operated By
	LODGE CREEK TRIBUTARY BASIN (continued)	
11AB008*	Middle Creek above Lodge Creek	Canada
11AB114	Middle Creek Reservoir Bedford Outlet	Canada
11AB115	Middle Creek Reservoir Flood Spillway	Canada
11AB108*	Middle Creek near Govenlock	Canada
11AB103	Squaw Coulee near Willow Creek	Canada
11AB088*	Lodge Creek below Spangler Project	Canada
	BATTLE CREEK TRIBUTARY BASIN	
11AB117*	Battle Creek at Alberta Boundary	Canada
11AB003*	Battle Creek above Gaff Ditch	Canada
11AB112*	Battle Creek below Gaff Ditch	Canada
11AB100*	Battle Creek above Cypress Lake West Outflow Canal	Canada
11AB096*	Battle Creek near Consul	Canada
11AB101*	Battle Creek below Nashlyn Project	Canada
11AB095	Adams Lake	Canada
11AB090	Reesor Reservoir	Canada
11AB020*	Shepherd Ditch near Consul	Canada
	FRENCHMAN RIVER TRIBUTARY BASIN	
11AC068	Val Marie Electric Pump No. 1	Canada
11AC069	Val Marie Electric Pump No. 2	Canada

* Data not included in this report or appendices



MAP OF ST. MARY AND MILK RIVER DRAINAGE BASINS

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Report to the International Joint Commission on the division and use of the waters of the St. Mary and Milk Rivers...