Report to

THE INTERNATIONAL JOINT COMMISSION

on

THE DIVISION OF THE WATERS OF

THE ST. MARY AND MILK RIVERS

1990

This report is dedicated to the memory of Donald Lyle Turgeon who passed away at his home July 6, 1990 shortly after returning from a field trip. Since 1983, Don had served as a Hydrometric Supervisor directing Canadian field operations in the Lodge Creek, Battle Creek and Frenchman River basins. Don contributed greatly to enhancing the cooperative spirit between the Water Resources Branch, United States Geological Survey, and other federal and provincial water management agencies. Don will be remembered for his professional attitude, the precision of his technical work, and for his affable nature and wry wit.

Cover photo:

St. Mary River near the crossing of the St. Mary Canal in Montana.
Photo by Don Bischoff, USGS, Helena, Montana.

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1990

by

Philip Cohen
representing the United States

and

R.A. Halliday
representing Canada

March 1991

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

Gentlemen:

In compliance with the provisions of Article VI of the Boundary Waters Treaty of 1909 and Clause VIII (c) of your order of October 4, 1921, directing the division of the waters of the 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, 1990.

Respectfully submitted,

Philip Cohen
Accredited Officer of the United States

R.A. Halliday
Accredited Officer of Her Majesty

SYNOPSIS

During the 1990 irrigation season, the natural flow of the St. Mary and Milk rivers was 103 percent and 87 percent, respectively, of the long-term average.

The natural flow of the St. Mary River at the International Boundary during the irrigation season, April 1 to October 31, 1990, was 738 000 cubic decametres (dam^3) (598,000 acre-feet). Under the terms of the Boundary Waters Treaty, the Canadian share was 448 000 dam^3 (363,000 acre-feet). The total flow recorded at the International Boundary during the irrigation season was 113 percent of the Canadian allotment.

The natural flow of the Milk River at the Eastern Crossing of the International Boundary from March 1 to October 31, 1990, was 121 000 dam^3 (98,100 acre-feet). Under the terms of the Treaty, the United States' allotment was 82 200 dam^3 (66,600 acre-feet). The United States received 147 percent of its allotment at Eastern Crossing, in addition to its share of St. Mary River water diverted into the Milk River by the St. Mary Canal.

During 1990, the four member ad hoc task force, formed to investigate the sharing of the waters of the southern tributaries of the Milk River, discontinued meetings with ranchers and farmers as past meetings were of limited value. Other activities included: continuation of ground water studies, a new station was installed on Breed Creek, a tour of the basin was conducted, a seepage loss program commenced, and an Alberta stock-water requirement study was completed. In addition, Montana initiated a moratorium on future water development in the basin.

The March to October natural flows of the three apportioned eastern tributaries of the Milk River: Lodge Creek, Battle Creek and Frenchman River; were 88, 61, and 42 percent, respectively, of the long-term averages. Minor deficits remained on each tributary at the end of the season.

The annual conference of the Field Representatives was held in Helena, Montana on February 6, 1991. Past operational problems were reviewed and resolved, program and study plans for 1991 were formulated, and streamflow and water level records collected by the United States and Canada were reviewed and approved.

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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. The terms of the Treaty were further clarified by the 1921 Order of the International Joint Commission. Copies of Article VI and the 1921 Order are contained in Annex A of this report.

To comply with this Treaty, Field Representatives of the United States and Canada collected and compiled hydrometric data at 42 international gauging stations on a co-operative basis. An additional 29 gauging stations were operated independently by the United States or Canada to obtain data on diversions, reservoir contents, return flows and index runoff. Most of this additional information was used to improve the accuracy of natural flow computations.

This report summarizes the 1990 natural flow computations, apportionment of the natural flow, unusual occurrences during the year, and procedural modifications designed to increase the accuracy of the natural flow computations. Summary natural flow tables are included. Detailed natural flow computations are included in Appendix A. Daily discharge and other related data are included in Appendix B. Appendices A and B are submitted with this report under separate cover.

In accordance with the International System of Units (SI) conversion schedule established by the International Joint Commission, this report uses SI units first, followed by inch-pound units in parentheses. Data in tables are shown in SI units first, followed by the respective inch-pound units (for example, Tables 1 and 1A). The format for Appendices A and B of the report is SI units only. All Canadian data are collected, computed and published in SI units. The United States' data, which are collected and computed in inch-pound units, were converted to SI units using the appropriate conversions. A summary of the conversion factors is contained in Annex B.

Mr. Philip Cohen, Chief Hydrologist, United States Geological Survey, as Accredited Officer of the United States, was represented in the field by Mr. J.A. Moreland, District Chief, United States Geological Survey, Helena, Montana. Mr. R.A. Halliday, as Accredited Officer of Her Majesty, was represented in the field by Mr. G.H. Morton, Chief,

Water Resources Branch, Calgary, Alberta and Mr. R.G. Boals, Chief, Water Resources Branch, Regina, Saskatchewan. This report was prepared jointly by personnel of the United States Geological Survey and Environment Canada, Water Resources Branch, under the supervision of Messrs. Moreland, Morton and Boals.

The annual conference of the Field Representatives was held in Helena, Montana on February 6, 1991. Streamflow records collected jointly by the United States and Canada were reviewed and approved. Mutual problems, future plans, and changes in computational procedures were discussed and a schedule of field operations for 1991 was adopted.

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, as stipulated by the 1921 Order, is three-fourths of the natural flow when that flow is 666 cubic feet per second (18.86 cubic metres per second) or less. Flow in excess of that quantity is divided equally between Canada and the United States. During the non-irrigation season, November 1 to March 31, the flow is divided equally between the two countries.

To comply with the above Order, representatives of both countries make twice-monthly computations of the daily natural flow of the St. Mary River during the irrigation season. If use by the United States is in excess of its share, then a delivery of an equivalent quantity of water is normally made to Canada at the earliest opportunity. Regular interim reports of these computations are sent to all agencies involved in the water use and management of the flow of the St. Mary River. The interim reports keep these agencies informed as to the quantity of water that is available and the status of apportionment.

Tentative computations and interim reports are not made during the non-irrigation season when use by the United States is limited to storage in Lake Sherburne. The flow into Lake Sherburne is considerably less than 50 percent of the natural flow at the International Boundary. Occasionally, water is diverted into the St. Mary Canal during the non-irrigation season, necessitating additional tentative computations.

Lake Sherburne, the only storage reservoir within the St. Mary River Basin in the United States, is used to store part of the United States' share of flow for later diversion to the Milk River. This water, which passes through Canada, is used by the United States for irrigation in the eastern portion of the Milk River basin.

Storage in Lake Sherburne (station 05AE036) was 8 320 dam^3 (6,750 acre-feet) on October 31, 1989 and increased to 50 100 dam^3 (40,600 acre-feet) on March 13, 1990 when releases began. It subsequently increased to 50 300 dam^3 (40,800 acre-feet) on March 31, 1990, just prior to the commencement of the irrigation season. Maximum storage was 84 300 dam^3 (68,300 acre-feet) on July 3, 1990 and storage decreased to 27 100 dam^3 (22,000 acre-feet) by the end of the irrigation season on October 31, 1990.

Water was diverted from the St. Mary River into the Milk River via the St. Mary Canal from April 2 to October 15, 1990. The total flow recorded at the gauging station on the St. Mary Canal at St. Mary Crossing (station 05AE029) was 255 000 dam^3 (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 computed natural flow of the St. Mary River at the International Boundary from November 1, 1989 to October 31, 1990 was 935 000 dam^3 (758,000 acre-feet) of which 738 000 dam^3 (598,000 acre-feet) occurred during the irrigation season, April 1 to October 31, 1990. For the irrigation season, Canada's and the United States' shares were 448 000 dam^3 (363,000 acre-feet) and 290 000 dam^3 (235,000 acre-feet) respectively. A total discharge of 507 000 dam^3 (411,000 acre-feet) was recorded at the International Boundary, which was 113 percent of the Canadian share. The computed natural flow during the irrigation season was 103 percent of the average of the previous 88 years of record.

Deficit deliveries were recorded in 4 of the 14 division periods during the 1990 irrigation season. All four deficit deliveries, which occurred in August and September, were refunded in the first division period in October. Canada requested that a portion of its share of the St. Mary River be diverted to the Milk River to permit continued irrigation by Canadian Milk River users. In all, 5 810 dam^3 (4,710 acre-feet) of the Canadian share was diverted to the Milk River system. This cooperative effort by both countries allowed irrigators on both sides of the International Boundary to make the best use of available water supplies.

The division of St. Mary River natural flow is summarized in Tables 1 and 1A and Figure 1 which follow. These tables detail the portion of the Canadian share of the St. Mary River delivered to the Milk River. The column "BELOW SHARE, ACTUAL" includes the adjustments to the column "BELOW SHARE, APPARENT" for the Canadian share of the St. Mary River delivered to the Milk River. The detailed computation of the natural flow is given in Table 6 and the historical summary in Table 7 of Appendix A.

TABLE 1
SUMMARY OF ST. MARY RIVER DIVISION FOR 1990 [1]
QUANTITIES IN CUBIC DECAMETRES

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	CANADA'S SHARE	RECEIVED BY CANADA	RECEIVED BY CANADA		
				ABOVE SHARE	BELOW SHARE APPARENT	BELOW SHARE ACTUAL
APR 1 - APR 15	22 927	17 068	18 170	1 102		
APR 16 - APR 30	54 122	33 170	35 693	2 523		
MAY 1 - MAY 15	60 658	36 436	41 905	5 469		
MAY 16 - MAY 31	82 045	47 540	48 373	833		
JUN 1 - JUN 15	101 742	56 980	72 787	15 807		
JUN 16 - JUN 30	110 874	61 546	82 865	21 319		
JUL 1 - JUL 15	92 995	52 607	67 183	14 576		
JUL 16 - JUL 31	61 315	37 172	36 204		968	(11)*
AUG 1 - AUG 15	37 454	24 835	23 709		1 126	209
AUG 16 - AUG 31	28 247	20 493	19 649		844	135
SEP 1 - SEP 15	17 482	13 114	11 954		1 160	243
SEP 16 - SEP 30	10 439	7 829	6 988		841	167
OCT 1 - OCT 15	34 681	22 396	23 713	1 317		
OCT 16 - OCT 31	23 326	17 283	17 988	705		
TOTAL	738 307	448 469	507 181			

[1] This is a summary of data from Table 6, Appendix A.

* Above Share

TABLE 1A
SUMMARY OF ST. MARY RIVER DIVISION FOR 1990 [1]
QUANTITIES IN ACRE-FEET

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	CANADA'S SHARE	RECEIVED BY CANADA	RECEIVED BY CANADA		
				ABOVE SHARE	BELOW SHARE APPARENT	BELOW SHARE ACTUAL
APR 1 - APR 15	18,587	13,837	14,730	893		
APR 16 - APR 30	43,877	26,891	28,936	2,045		
MAY 1 - MAY 15	49,175	29,539	33,972	4,434		
MAY 16 - MAY 31	66,514	38,541	39,216	675		
JUN 1 - JUN 15	82,482	46,194	59,008	12,815		
JUN 16 - JUN 30	89,886	49,895	67,179	17,283		
JUL 1 - JUL 15	75,391	42,648	54,465	11,817		
JUL 16 - JUL 31	49,708	30,135	29,351		785	(9)*
AUG 1 - AUG 15	30,364	20,134	19,221		913	169
AUG 16 - AUG 31	22,900	16,614	15,929		684	109
SEP 1 - SEP 15	14,173	10,632	9,691		940	197
SEP 16 - SEP 30	8,463	6,347	5,665		682	135
OCT 1 - OCT 15	28,116	18,156	19,224	1,068		
OCT 16 - OCT 31	18,910	14,011	14,583	572		
TOTAL	598,546	363,574	411,172			

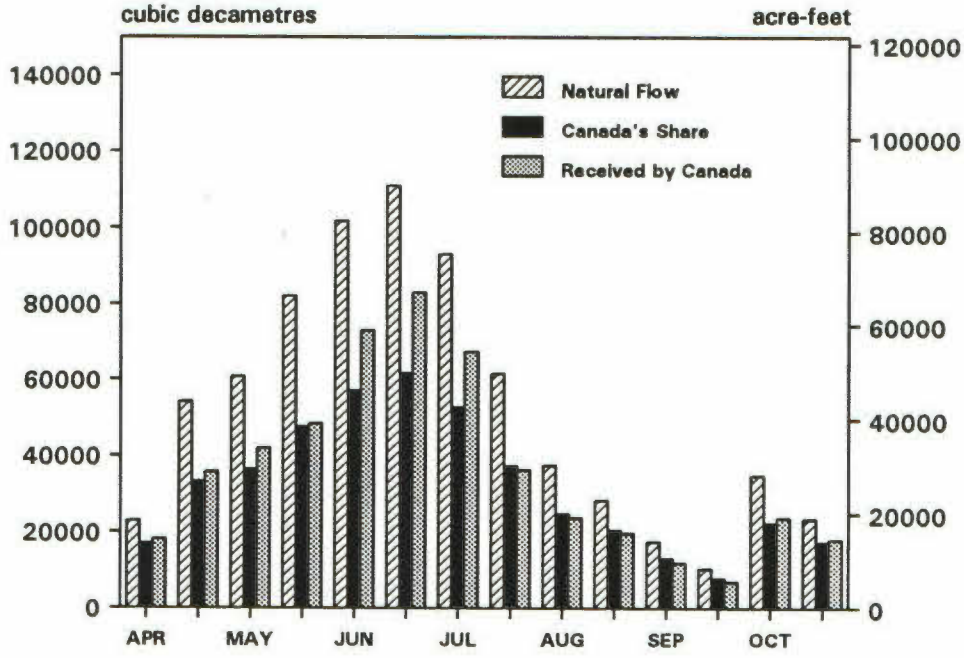
[1] All values are conversions of data from Table 1. Totals and shares may not add or subtract exactly as a result of rounding.

* Above Share

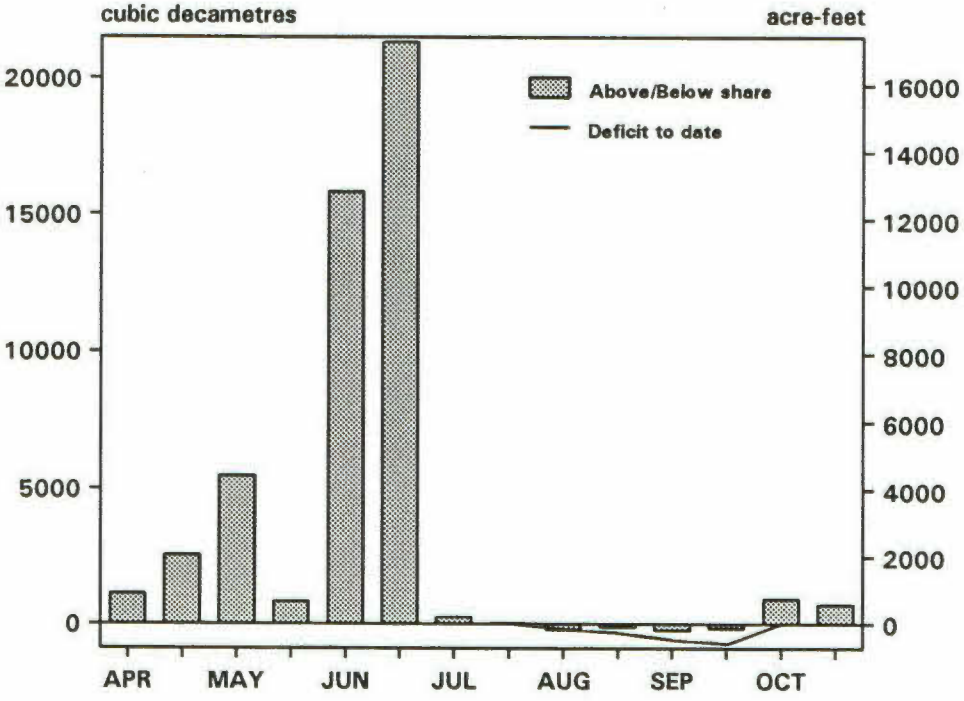
FIGURE 1

ST. MARY RIVER DIVISION 1990

Period Values



Delivery to Canada



MILK RIVER

During the irrigation season, April 1 to October 31, the United States' share of the natural flow of the Milk River at the eastern crossing of the International Boundary, as stipulated by the 1921 Order, is three-fourths of the natural flow when that flow is 666 cubic feet per second (18.86 cubic metres per second) or less. Flows in excess of that quantity are divided equally between the United States and Canada. During the non-irrigation season, November 1 to March 31, the entire flow is divided equally between the two countries.

Prior to the mid-seventies, uses of the natural flow of the Milk River by Canada and the United States were assumed to be less than their respective shares and no formal apportionment was made. By 1977, it became apparent that the increasing numbers of sprinkler irrigation systems were capable of using all of the natural flow for long periods of time. Consequently, a more comprehensive natural flow computation and water division procedure was developed and has been used since 1985. The revised computation procedure includes an approximate accounting of irrigation consumptive uses in both countries, and the interbasin transfer of water in Canada. An additional refinement was made in 1988 when F.I. Morton's evapotranspiration model replaced the adjusted pan evaporation method in the natural flow computations.

During 1990, the United States' and Canada's estimated agricultural consumptive uses in the basin were 5 050 dam^3 (4,090 acre-feet) and 5 160 dam^3 (4,180 acre-feet), respectively. An interbasin transfer of 3 390 dam^3 (2,750 acre-feet) from Verdigris Coulee near the Mouth (station 11AA038) was credited to the Canadian consumptive use.

To comply with the 1921 Order, tentative twice-monthly computations of the natural flow of the Milk River are now made during the irrigation season. When Canada uses more than its share of the natural flow for an extended period of time, the Accredited Officers, after Field Representatives' consultation with the appropriate water management agencies, may agree to allow Canada to divert a portion of its share of the St. Mary River to the Milk River. This allows Canadian irrigators to continue pumping water from the Milk River channel during dry summer months. These arrangements are made on an ad hoc basis as the situations arise, and during 1990, this diversion was made from July 12 to October 15.

The computed natural flow of the Milk River at the Eastern Crossing of the International Boundary from March 1 to October 31, 1990 was 121 000 dam^3 (98,100 acre-feet) or 87 percent of the average computed natural flow of the previous 78 years of record. It is important to note, however, that natural flow computations prior to 1985 did not account for consumptive use. Consequently, natural flow values after 1985 are not directly comparable with natural flows of previous years. The respective shares of the United States and Canada were 82 200 dam^3 (66,600 acre-feet) and 38 700 dam^3 (31,400 acre-feet).

The division of Milk River natural flow is summarized in Tables 2 and 2A and Figure 2 which follow. The detailed computation of natural flow is given in Table 8 and the historical summary in Table 9 of Appendix A.

TABLE 2
SUMMARY OF MILK RIVER DIVISION FOR 1990 [1]
QUANTITIES IN CUBIC DECAMETRES

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 15	11 374	5 687	11 429	5 742	
MAR 16 - MAR 31	12 805	6 403	13 342	6 939	
APR 1 - APR 15	14 598	10 949	14 835	3 886	
APR 16 - APR 30	12 416	9 302	12 494	3 192	
MAY 1 - MAY 15	10 039	7 529	10 295	2 766	
MAY 16 - MAY 31	25 690	17 586	25 122	7 536	
JUN 1 - JUN 15	17 097	12 074	16 527	4 453	
JUN 16 - JUN 30	6 530	4 898	6 394	1 496	
JUL 1 - JUL 15	812	609	194		415
JUL 16 - JUL 31	1 676	1 257	987		270
AUG 1 - AUG 15	646	484	148		336
AUG 16 - AUG 31	2 921	2 191	2 497	306	
SEP 1 - SET 15	618	463	418		45
SEP 16 - SEP 30	124	93	247	154	
OCT 1 - OCT 15	308	231	593	362	
OCT 16 - OCT 31	3 324	2 493	3 674	1 181	
TOTAL	120 978	82 249	119 196		

[1] This is a summary of data from Table 8, Appendix A.

TABLE 2A
SUMMARY OF MILK RIVER DIVISION FOR 1990 [1]
QUANTITIES IN ACRE-FEET

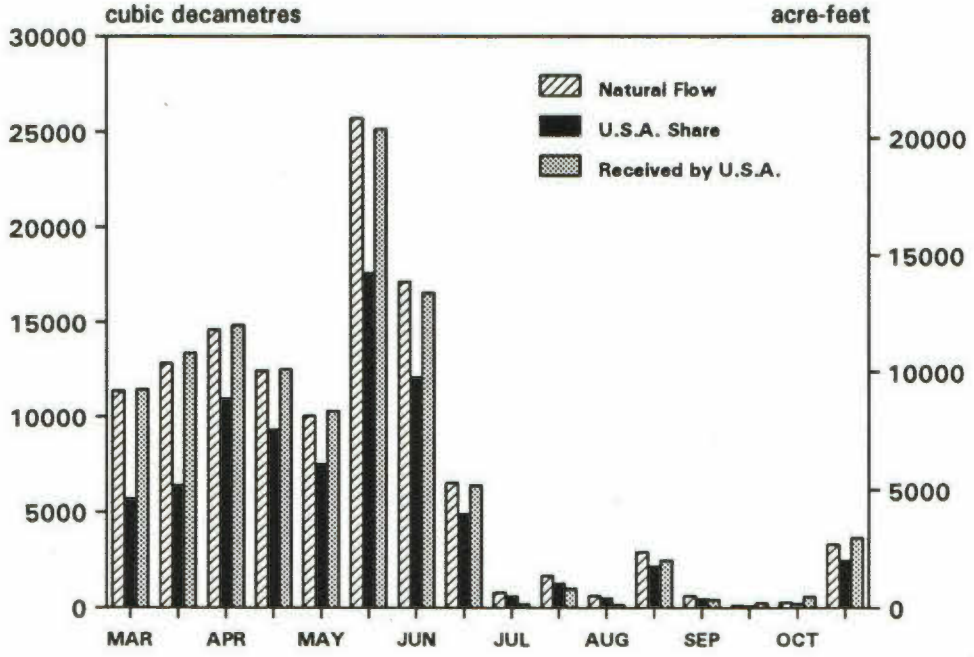
DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 15	9,221	4,610	9,266	4,655	
MAR 16 - MAR 31	10,381	5,191	10,816	5,625	
APR 1 - APR 15	11,835	8,876	12,027	3,150	
APR 16 - APR 30	10,066	7,541	10,129	2,588	
MAY 1 - MAY 15	8,139	6,104	8,346	2,242	
MAY 16 - MAY 31	20,827	14,257	20,366	6,109	
JUN 1 - JUN 15	13,861	9,788	13,398	3,610	
JUN 16 - JUN 30	5,294	3,971	5,184	1,213	
JUL 1 - JUL 15	658	494	157		336
JUL 16 - JUL 31	1,359	1,019	800		219
AUG 1 - AUG 15	524	392	120		272
AUG 16 - AUG 31	2,368	1,776	2,024	248	
SEP 1 - SET 15	501	375	339		36
SEP 16 - SEP 30	101	75	200	125	
OCT 1 - OCT 15	250	187	481	293	
OCT 16 - OCT 31	2,695	2,021	2,979	957	
TOTAL	98,077	66,679	96,632		

[1] All values are conversions of data from Table 2. Totals and shares may not add or subtract exactly as a result of rounding.

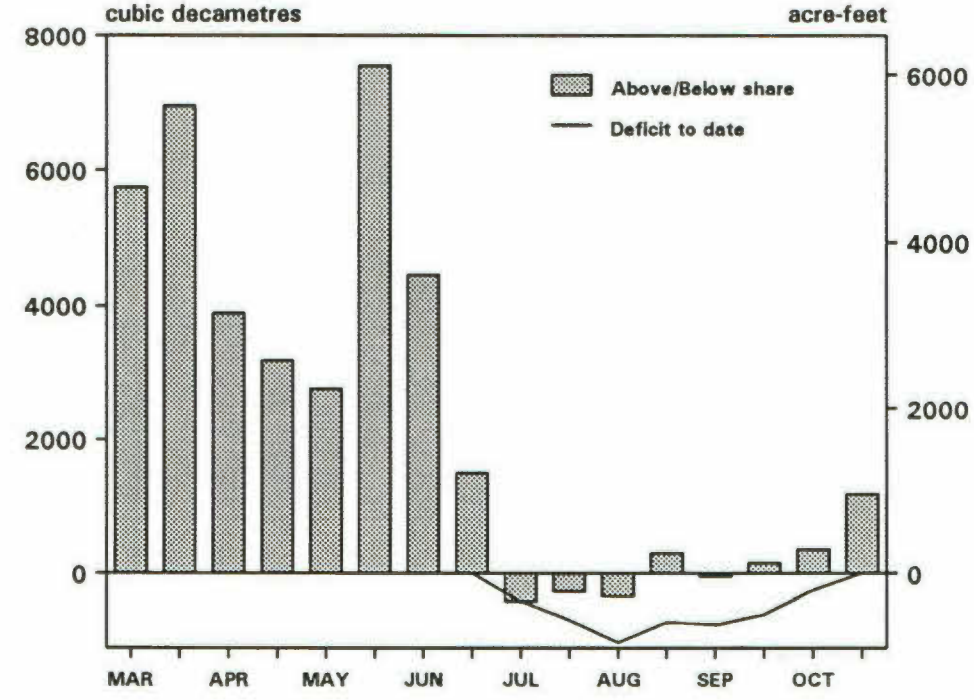
FIGURE 2

MILK RIVER DIVISION 1990

Period Values



Delivery to the United States



SOUTHERN TRIBUTARIES OF THE MILK RIVER

Division of the waters of the southern tributaries of the Milk River is not clearly defined in the Order of the International Joint Commission, dated October 4, 1921. At its executive session on December 8, 1986, the Commission agreed, in principle, that the issue of the utilization of the southern tributaries should be addressed in an informal, pragmatic manner. Accordingly, the Commission instructed the Accredited Officers to proceed with discussions with the goal of determining an early solution. To assist them in implementing the Commission's instructions, the Accredited Officers established a four-member ad hoc task force comprised of officials from the State of Montana and the Province of Alberta water management agencies, and United States and Canadian Field Representatives for the St. Mary-Milk River Treaty.

The task force commenced activities in the fall of 1987 with a tour of the basin and a meeting with a local member of the Montana State Legislature. In the spring of 1988, a meeting was held to inform ranchers of both countries of the formation and activities of the task force. During April, 1988 a meeting was held in Washington, D.C. between some members of the task force and Commissioners Fulton and Totten and IJC engineering and legal advisors. During March, 1989, another public information meeting was held in Canada to further update ranchers on the progress and future activities of the task force. Commissioners Fulton and Totten, Canadian IJC engineering staff, and the task force members visited various ranchers at the end of August, 1989. The task force members decided to discontinue meetings with ranchers during 1990 as it was felt that these meetings would be of limited value.

During 1990, task force activities included:

- an April tour of the basin and subsequent task force meeting.
- installation of a hydrometric station on Breed Creek at the International Boundary.
- continuation of the ground water monitoring program.
- a seepage loss program.
- completion of an Alberta study to determine stock-water requirements.
- initiation by Montana to place a moratorium on future water development.

Lack of delivery of sufficient water to meet the needs of Canadian ranchers was a problem which existed throughout the 1980s. Fortunately, during 1990, nature solved the problem. Runoff commenced in late February and continued to mid-July with the flows on Miners Coulee and Bear Creek being the largest since 1979. Deliveries to Canada of 2 710 dam^3 (2,200 acre-feet) on Miners Coulee, 3 550 dam^3 (2,880 acre-feet) on Bear Creek, and equally significant deliveries on Breed Creek more than satisfied the irrigation requirements of Canadian ranchers. Unfortunately, the lack of storage facilities in Canada, and the reluctance of ranchers to construct these facilities, did not allow for the storage of excess water to be used in future years.

EASTERN TRIBUTARIES OF THE MILK RIVER

The waters of the eastern tributaries of the Milk River are 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; however, the physical limitation due to transit time in the flow system was recognized. Further analysis showed that the minimum practical time frame for compilation of the natural flows at the International Boundary was every 10 days.

Prior to 1937, Canadian use along the eastern tributaries consisted of domestic projects, and the Canadian share of the natural flow was not fully used. In the late 1930s, the Government of Canada constructed three dams on the Frenchman River creating: Eastend Reservoir (station 11AC055), Huff Lake (station 11AC063), and Newton Lake (station 11AC056) and subsequently an operational division of flow on this tributary became necessary by 1937. In 1938, dams were constructed at both ends of Cypress Lake (station 11AC037) near the Battle Creek-Frenchman River divide to allow interbasin storage and transfers of water. In the early 1950s the redevelopment of several private irrigation projects and the construction of the Vidora Irrigation Project resulted in increased use of Battle Creek water in Canada and made an operational division of flow on this tributary necessary by 1957. In 1960, construction of Altawan Reservoir (station 11AB089) and the Spangler Irrigation Project on Lodge Creek made an operational division of flow on this tributary necessary by 1961.

During the period March 1 to October 31, ten-day computations of the natural flow of Lodge Creek, Battle Creek and the Frenchman River are made to determine each country's share. If use by Canada is in excess of its share, then a delivery of an equivalent quantity of water is made to the United States at the earliest opportunity. During some years, the United States may request that delivery of deficit water be delayed to allow more efficient use by United States' irrigators. Canada may honour this request if no flow regulation problems are anticipated by delaying the delivery of water to refund the deficit.

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 are distributed to interested agencies during the irrigation season. Generally, no division of flow is made during the winter as flow and use are low and streamflow records are impractical to obtain.

Lyons Creek is monitored but does not have sufficient use in Canada at this time to warrant an operational division of flow. A total flow of 969 dam^3 (786 acre-feet) was recorded on this tributary from March 1 to October 31, 1990.

Volumes for unmeasured diversions to private irrigation projects in the Lodge Creek, Battle Creek, and Frenchman River basins in Saskatchewan were based on year-end reports provided by the Saskatchewan Water Corporation, and for the Lodge Creek and Battle Creek basins in Alberta, by Alberta Environment. These reports are compiled from reports received from operators of irrigation projects and from on-site inspections. An additional adjustment is made for domestic projects in the Battle Creek and Frenchman River basins based on the results of studies conducted by Canada on domestic use.

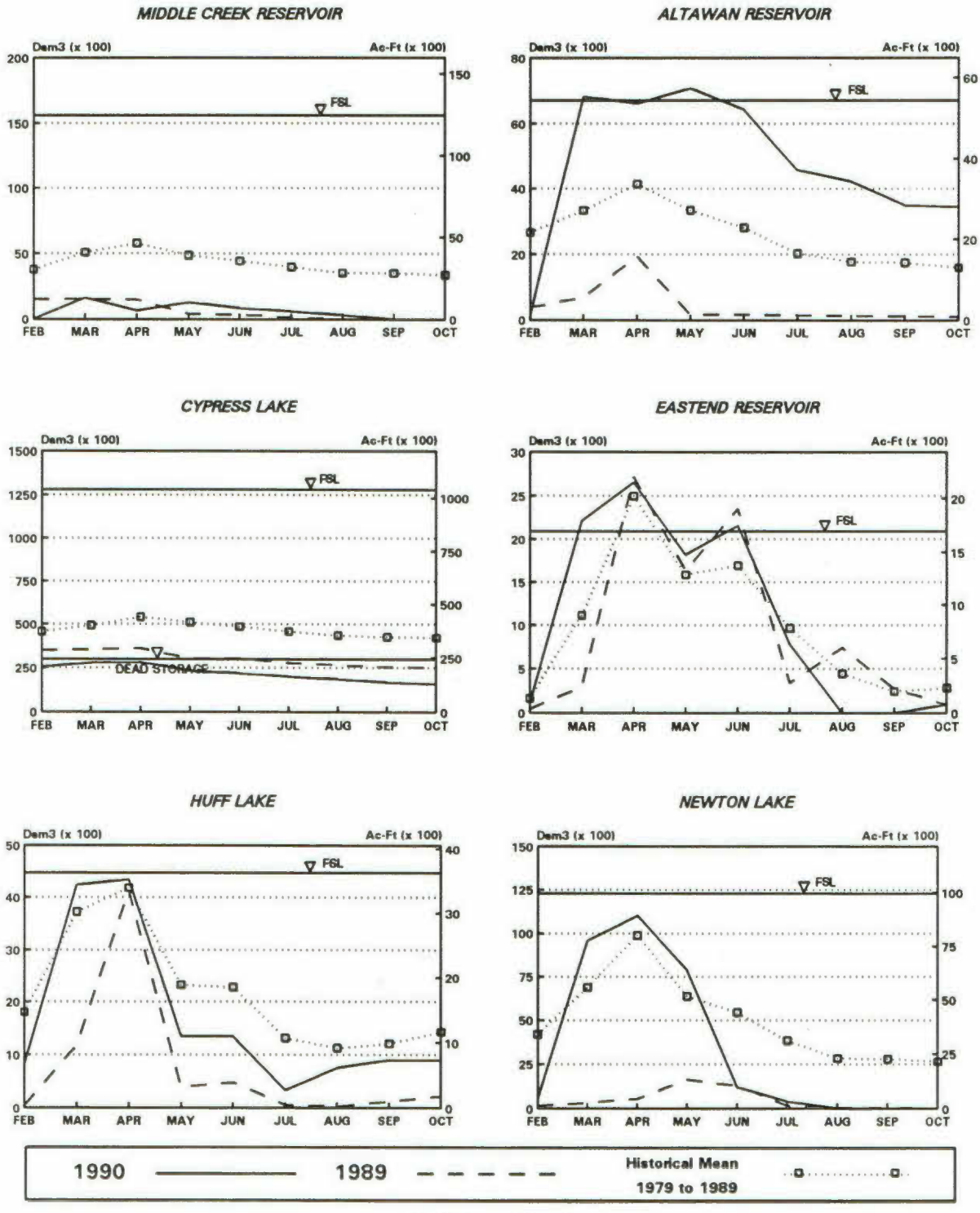
For the interim reports prepared at the end of division periods, estimates of minor diversion use were made based on a correlation between annual natural flows and reported use for previous years. The total natural flow for the current year was derived from computed natural flow to date, plus an estimate of runoff volume for the rest of the year, dependent on runoff conditions. At mid-year and at year-end, estimates of minor diversions were updated based on usage reports received from Alberta Environment and the Saskatchewan Water Corporation. Consequently, some discrepancy exists between interim and final division computations. Lists of reported diversions are contained in Appendix B.

The extremely below normal flows of 1988 and 1989 and below normal flow of 1990 have particularly affected storage levels in Cypress Lake. In 1990 the lake never exceeded the dead storage level and all irrigation from the lake required pumping. At the end of October the lake contained 15 700 dam^3 (12,700 acre-feet) which is 14 300 dam^3 (11,600 acre-feet) below the dead storage level. If a similar net depletion of Cypress Lake occurs during the 1991 season the lake could be dry by the fall of 1991.

At the end of February, the combined usable storage of Middle Creek Reservoir, Altawan Reservoir, Eastend Reservoir, Huff Lake and Newton Lake was 1 550 dam^3 (1,260 acre-feet), or 4 percent of the total live storage of 41 100 dam^3 (33,300 acre-feet). By the end of April, spring flows had increased the combined usable storage to 25 200 dam^3 (20,400 acre-feet) or 61 percent of the total. By the end of October, irrigation usage, evaporation, and releases from the reservoirs depleted the combined usable storage to 4 430 dam^3 (3,590 acre-feet) or 11 percent of the total. Further details on storage in the major Canadian reservoirs are provided in Figure 3, and in Table 16, Appendix B.

FIGURE 3

RESERVOIRS IN LODGE, BATTLE AND FRENCHMAN BASINS
MONTH-END CONTENTS



FSL: Full Supply Level

LODGE CREEK

The computed natural flow of Lodge Creek at the International Boundary from March 1 to October 31, 1990, was 29 800 dam^3 (24,100 acre-feet) or 88 percent of the average natural flow of the previous 40 years of record. Each country is entitled to 50 percent of the natural flow or 14 900 dam^3 (12,100 acre-feet). A total flow of 16 000 dam^3 (13,000 acre-feet) was recorded at Lodge Creek below McRae Creek at International Boundary (station 11AB083) from March 1 to October 31.

Deficit deliveries were recorded in 4 of the 24 division periods during the season. A deficit of 61 dam^3 (49 acre-feet) remained at the end of October.

The division of the Lodge Creek natural flow is summarized in Tables 3 and 3A and Figure 4 which follow. 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 FOR 1990 [1]
QUANTITIES IN CUBIC DECAMETRES

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 10	12 816	6 408	6 424	16	
MAR 11 - MAR 20	6 676	3 338	4 535	1 197	
MAR 21 - MAR 31	2 832	1 416	991		425
APR 1 - APR 10	1 583	792	586		206
APR 11 - APR 20	291	145	396	251	
APR 21 - APR 30	97	49	137	88	
MAY 1 - MAY 10	154	77	266	189	
MAY 11 - MAY 20	146	73	120	47	
MAY 21 - MAY 31	4 429	2 214	1 609		605
JUN 1 - JUN 10	379	190	582	392	
JUN 11 - JUN 20	267	133	328	195	
JUN 21 - JUN 30	78	39	35		4
JUL 1 - JUL 10	3	2	17	15	
JUL 11 - JUL 20	0	0	2	2	
JUL 21 - JUL 31	0	0	0	0	
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	0	0	
SEP 21 - SEP 30	0	0	0	0	
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	29 752	14 876	16 028		

[1] This is a summary of data from Table 10, Appendix A.

TABLE 3A
SUMMARY OF LODGE CREEK DIVISION FOR 1990 [1]
QUANTITIES IN ACRE-FEET

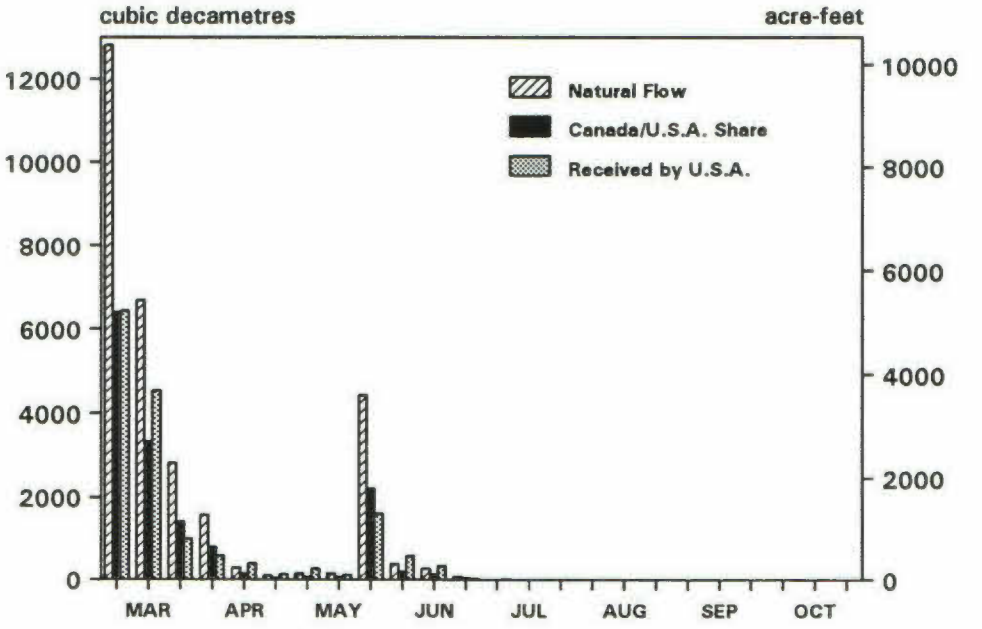
DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 10	10,390	5,195	5,208	13	
MAR 11 - MAR 20	5,412	2,706	3,677	970	
MAR 21 - MAR 31	2,296	1,148	803		345
APR 1 - APR 10	1,283	642	475		167
APR 11 - APR 20	236	118	321	203	
APR 21 - APR 30	79	40	111	71	
MAY 1 - MAY 10	125	62	216	153	
MAY 11 - MAY 20	118	59	97	38	
MAY 21 - MAY 31	3,591	1,795	1,304		490
JUN 1 - JUN 10	307	154	472	318	
JUN 11 - JUN 20	216	108	266	158	
JUN 21 - JUN 30	63	32	28		3
JUL 1 - JUL 10	2	2	14	12	
JUL 11 - JUL 20	0	0	2	2	
JUL 21 - JUL 31	0	0	0	0	
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	0	0	
SEP 21 - SEP 30	0	0	0	0	
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	24,120	12,060	12,994		

[1] All values are conversions of data from Table 3. Totals and shares may not add or subtract exactly as a result of rounding.

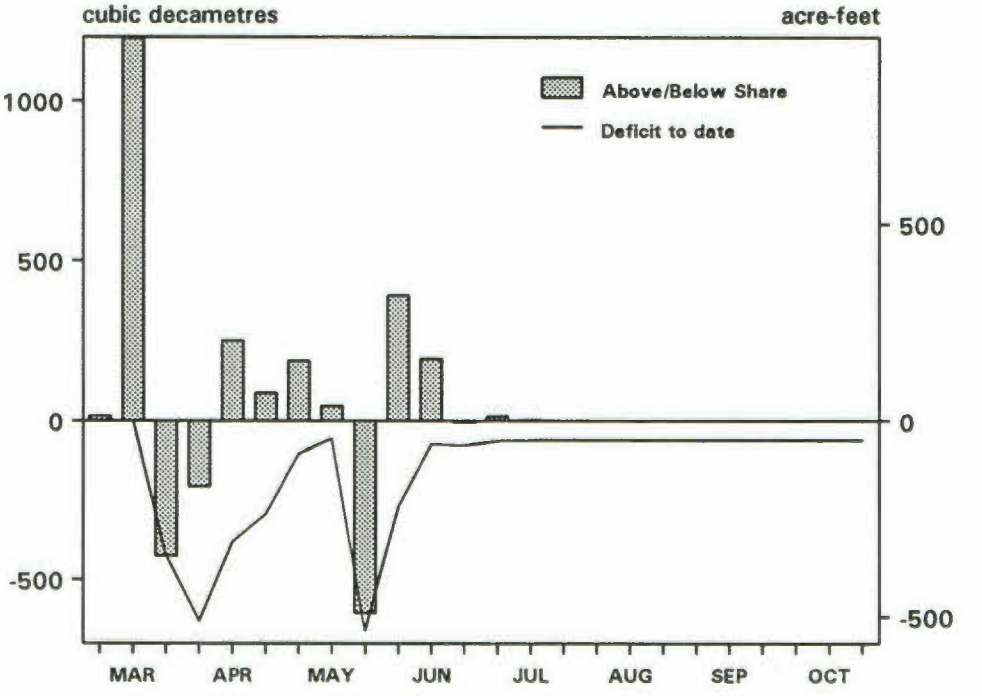
FIGURE 4

LODGE CREEK DIVISION 1990

Period Values



Delivery to U.S.A.



BATTLE CREEK

The computed natural flow of Battle Creek at the International Boundary from March 1 to October 31, 1990, was 19 400 dam^3 (15,700 acre-feet) or 61 percent of the average natural flow of the previous 50 years of record. Each country is entitled to 50 percent of the natural flow or 9 690 dam^3 (7,850 acre-feet). A total flow of 10 700 dam^3 (8,690 acre-feet) was recorded at Battle Creek at International Boundary (station 11AB027) from March 1 to October 31.

Deficit deliveries were recorded in 11 of the 24 division periods during the season. A deficit of 6 dam^3 (5 acre-feet) remained at the end of October.

The accumulated affect of several years of below normal spring runoff resulted in extremely low levels in Cypress Lake. In 1990, all water for irrigation on Battle Creek required pumping out of Cypress Lake.

During the irrigation period, the return flow was computed to be 29 percent for Vidora, Richardson, and McKinnon ditches. Return flow computations for Nashlyn Canal were rendered invalid by local rainfall. Consequently, the normal return flow value of 25 percent was used. Usage on Shepherd Ditch, which is a minor irrigation diversion, was reduced by a return flow factor of 25 percent based on reports from the Saskatchewan Water Corporation. A return flow of 35 percent of diversion, based on a 1972-76 study, was used for the Gaff Ditch diversion from Battle Creek.

The division of the Battle Creek natural flow is summarized in Tables 4 and 4A and Figure 5 which follow. 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 FOR 1990 [1]
QUANTITIES IN CUBIC DECAMETRES

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 14	7 054	3 527	4 490	963	
MAR 15 - MAR 25	1 473	737	401		336
MAR 26 - APR 4	1 818	909	713		196
APR 5 - APR 14	2 870	1 435	803		632
APR 15 - APR 24	1 027	514	418		96
APR 25 - MAY 4	1 002	501	556	55	
MAY 5 - MAY 14	1 046	523	596	73	
MAY 15 - MAY 25	765	383	896	513	
MAY 26 - JUN 4	534	267	602	335	
JUN 5 - JUN 14	813	407	668	261	
JUN 15 - JUN 24	561	281	213		68
JUN 25 - JUL 4	76	38	65	27	
JUL 5 - JUL 14	20	10	16	6	
JUL 15 - JUL 25	52	26	48	22	
JUL 26 - AUG 4	96	48	93	45	
AUG 5 - AUG 14	122	61	121	60	
AUG 15 - AUG 25	19	10	18	8	
AUG 26 - SEP 4	3	2	2	0	
SEP 5 - SEP 14	1	1	0		1
SEP 15 - SEP 24	1	1	0		1
SEP 25 - OCT 4	1	1	0		1
OCT 5 - OCT 14	1	1	0		1
OCT 15 - OCT 25	1	1	0		1
OCT 26 - OCT 31	1	1	0		1
TOTAL	19 357	9 685	10 719		

[1] This is a summary of data from Table 12, Appendix A.

TABLE 4A
SUMMARY OF BATTLE CREEK DIVISION FOR 1990 [1]
QUANTITIES IN ACRE-FEET

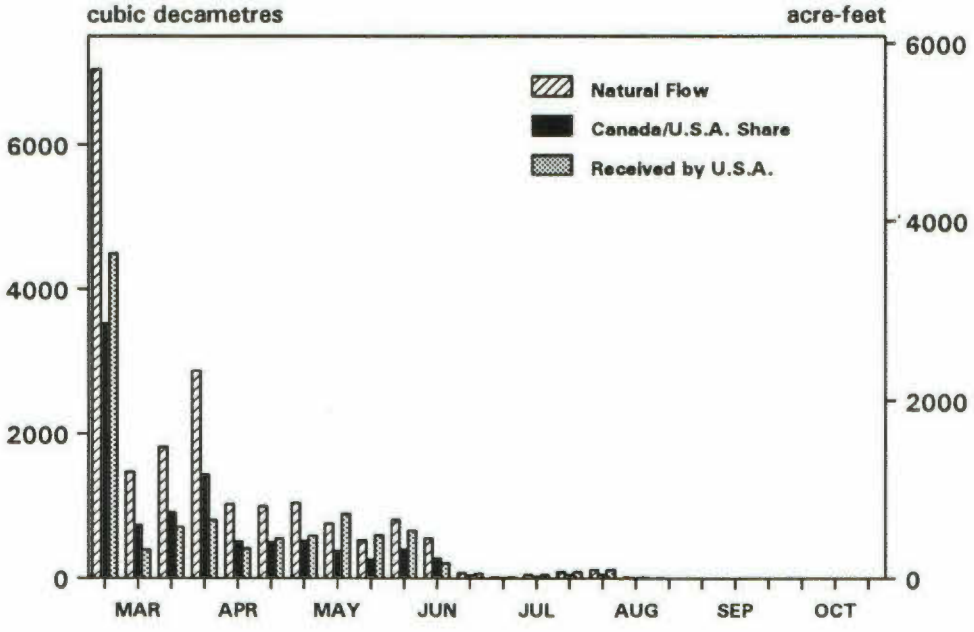
DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 14	5,719	2,859	3,640	781	
MAR 15 - MAR 25	1,194	597	325		272
MAR 26 - APR 4	1,474	737	578		159
APR 5 - APR 14	2,327	1,163	651		512
APR 15 - APR 24	833	417	339		78
APR 25 - MAY 4	812	406	451	45	
MAY 5 - MAY 14	848	424	483	59	
MAY 15 - MAY 25	620	310	726	416	
MAY 26 - JUN 4	433	216	488	272	
JUN 5 - JUN 14	659	330	542	212	
JUN 15 - JUN 24	455	228	173		55
JUN 25 - JUL 4	62	31	53	22	
JUL 5 - JUL 14	16	8	13	5	
JUL 15 - JUL 25	42	21	39	18	
JUL 26 - AUG 4	78	39	75	36	
AUG 5 - AUG 14	99	49	98	49	
AUG 15 - AUG 25	15	8	15	6	
AUG 26 - SEP 4	2	2	2	0	
SEP 5 - SEP 14	1	1	0		1
SEP 15 - SEP 24	1	1	0		1
SEP 25 - OCT 4	1	1	0		1
OCT 5 - OCT 14	1	1	0		1
OCT 15 - OCT 25	1	1	0		1
OCT 26 - OCT 31	1	1	0		1
TOTAL	15,693	7,852	8,690		

[1] All values are conversions of data from Table 4. Totals and shares may not add or subtract exactly as a result of rounding.

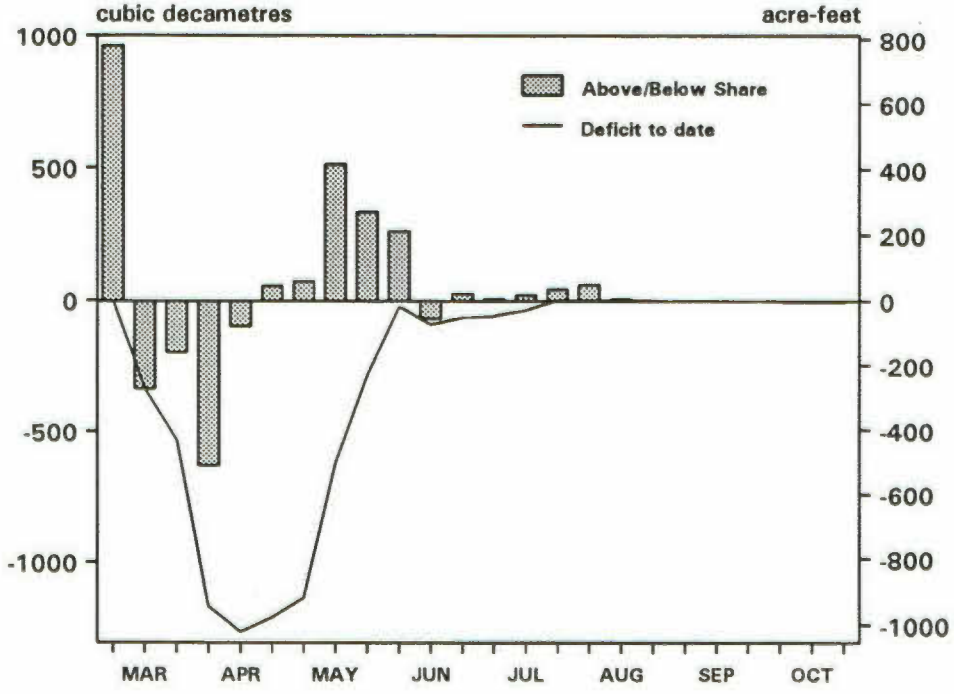
FIGURE 5

BATTLE CREEK DIVISION 1990

Period Values



Delivery to U.S.A.



FRENCHMAN RIVER

The computed natural flow of the Frenchman River at the International Boundary from March 1 to October 31, 1990, was 34 400 dam^3 (27,900 acre-feet) or 42 percent of the average natural flow of the previous 50 years of record. Each country is entitled to 50 percent of the natural flow or 17 200 dam^3 (13,900 acre-feet). A total flow of 19 900 dam^3 (16,200 acre-feet) was recorded at Frenchman River at International Boundary (station 11AC041) from March 1 to October 31.

Deficit deliveries were recorded in 6 of the 24 division periods during the season. A deficit of 28 dam^3 (23 acre-feet) remained at the end of October.

The two periods from August 21 to September 10 were combined into one period. This was done to eliminate discrepancies in the natural flow calculations that would have occurred as a result of overlapping periods of release from Eastend Reservoir and storage in Huff Lake.

The division of the Frenchman River natural flow is summarized in Tables 5 and 5A and Figure 6 which follow. 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 FOR 1990 [1]
QUANTITIES IN CUBIC DECAMETRES

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 10	4 051	2 026	2 646	620	
MAR 11 - MAR 20	7 025	3 512	612		2 900
MAR 21 - MAR 31	5 859	2 930	294		2 636
APR 1 - APR 10	4 955	2 477	2 006		471
APR 11 - APR 20	1 731	866	1 343	477	
APR 21 - APR 30	1 390	695	1 017	322	
MAY 1 - MAY 10	1 199	599	839	240	
MAY 11 - MAY 20	1 246	623	392		231
MAY 21 - MAY 31	1 129	564	1 787	1 223	
JUN 1 - JUN 10	1 471	736	1 766	1 030	
JUN 11 - JUN 20	671	336	2 185	1 849	
JUN 21 - JUN 30	498	249	1 617	1 368	
JUL 1 - JUL 10	885	443	1 233	790	
JUL 11 - JUL 20	4	2	122	120	
JUL 21 - JUL 31	1 981	991	1 943	952	
AUG 1 - AUG 10	223	112	85		27
AUG 11 - AUG 20	0	0	31	31	
AUG 21 - AUG 31 Periods combined SEP 1 - SEP 10	110	55	27		28
SEP 11 - SEP 20	1	1	1	0	
SEP 21 - SEP 30	0	0	0	0	
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	34 430	17 217	19 946		

[1] This is a summary of data from Table 10, Appendix A.

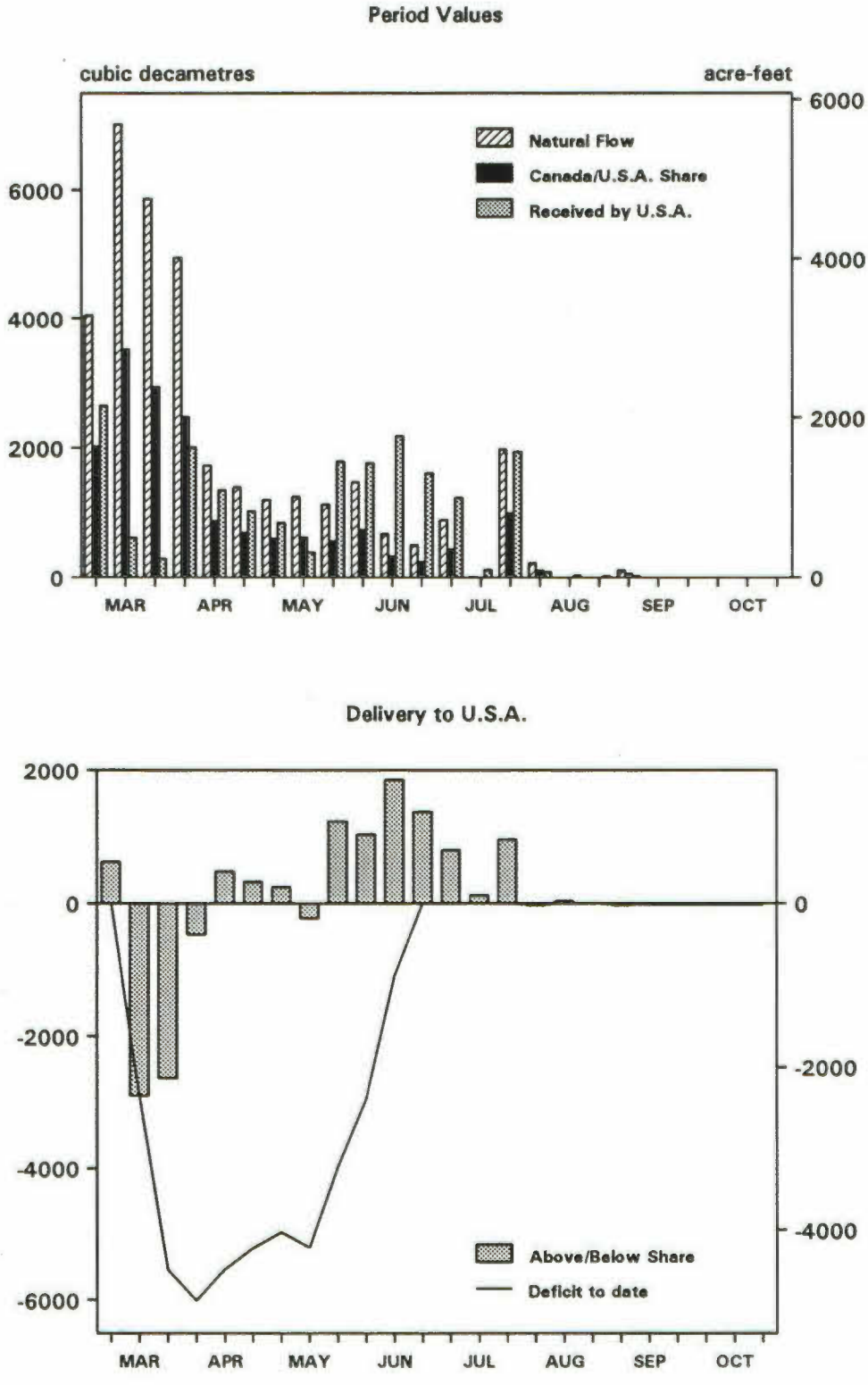
TABLE 5A
SUMMARY OF FRENCHMAN RIVER DIVISION FOR 1990 [1]
QUANTITIES IN ACRE-FEET

DIVISION PERIOD AT INTERNATIONAL BOUNDARY	COMPUTED NATURAL FLOW	U.S.A. SHARE	RECEIVED BY U.S.A.	RECEIVED BY U.S.A.	
				ABOVE SHARE	BELOW SHARE
MAR 1 - MAR 10	3,284	1,642	2,145	503	
MAR 11 - MAR 20	5,695	2,847	496		2,351
MAR 21 - MAR 31	4,750	2,375	238		2,137
APR 1 - APR 10	4,017	2,008	1,626		382
APR 11 - APR 20	1,403	702	1,089	387	
APR 21 - APR 30	1,127	563	824	261	
MAY 1 - MAY 10	972	486	680	195	
MAY 11 - MAY 20	1,010	505	318		187
MAY 21 - MAY 31	915	457	1,449	991	
JUN 1 - JUN 10	1,193	597	1,432	835	
JUN 11 - JUN 20	544	272	1,771	1,499	
JUN 21 - JUN 30	404	202	1,311	1,109	
JUL 1 - JUL 10	717	359	1,000	640	
JUL 11 - JUL 20	3	2	99	97	
JUL 21 - JUL 31	1,606	803	1,575	772	
AUG 1 - AUG 10	181	91	69		22
AUG 11 - AUG 20	0	0	25	25	
AUG 21 - AUG 31 Periods combined SEP 1 - SEP 10	89	45	22		23
SEP 11 - SEP 20	1	1	1	0	
SEP 21 - SEP 30	0	0	0	0	
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	27,912	13,958	16,170		

[1] All values are conversions of data from Table 5. Totals and shares may not add or subtract exactly as a result of rounding.

FIGURE 6

FRENCHMAN RIVER DIVISION 1990



ANNEX A

TREATY BETWEEN THE UNITED STATES AND GREAT BRITAIN RELATING TO BOUNDARY WATERS, AND QUESTIONS ARISING BETWEEN THE UNITED STATES AND CANADA - ARTICLE VI

INTERNATIONAL JOINT COMMISSION
1921 Order

TREATY
BETWEEN THE UNITED STATES AND GREAT BRITAIN RELATING TO BOUNDARY WATERS, AND QUESTIONS ARISING BETWEEN THE UNITED STATES AND CANADA

ARTICLE VI

The High Contracting Parties agree that the St. Mary and Milk rivers and their tributaries (in the State of Montana and the Provinces of Alberta and Saskatchewan) are to be treated as one stream for the purposes of irrigation and power, and the waters thereof shall be apportioned equally between the two countries, but in making such equal apportionment more than half may be taken from one river and less than half from the other by either country so as to afford a more beneficial use to each. It is further agreed that in the division of such waters during the irrigation season, between the 1st of April and 31st of October, inclusive, annually, the United States is entitled to a prior appropriation of 500 cubic feet per second of the waters of the Milk River, or so much of such amount as constitutes three-fourths of its natural flow, and that Canada is entitled to a prior appropriation of 500 cubic feet per second of the flow of St. Mary River, or so much of such amount as constitutes three-fourths of its natural flow.

The Channel of the Milk River in Canada may be used at the convenience of the United States for the conveyance, while passing through Canadian territory, of waters diverted from the St. Mary River. The provisions of Article II of this treaty shall apply to any injury resulting to property in Canada from the conveyance of such waters through the Milk River.

The measurement and apportionment of the water to be used by each country shall from time to time be made jointly by the properly constituted reclamation officers of the United States and the properly constituted irrigation officers of His Majesty under the direction of the International Joint Commission.

INTERNATIONAL JOINT COMMISSION

ORDER

IN THE MATTER OF THE MEASUREMENT AND APPORTIONMENT OF THE WATERS OF THE ST. MARY AND MILK RIVERS AND THEIR TRIBUTARIES IN THE STATE OF MONTANA AND THE PROVINCES OF ALBERTA AND SASKATCHEWAN.

Whereas by Article VI of the Treaty entered into between the United States of America and His Majesty, the King of the United Kingdom Great Britain and Ireland and of the British Dominions beyond the Seas, Emperor of India, signed at Washington on the 11th of January, 1909;

And whereas, the said Reclamation and Irrigation Officers have been unable to agree as to the manner in which the waters mentioned in the said Article VI should be measured and apportioned;

And whereas, before giving directions as to the measurement and apportionment of the said waters, the International Joint Commission deemed it proper to hear such representations and suggestions thereon as the Governments of the United States and Canada, the Provinces of Alberta and Saskatchewan, and the State of Montana, and as corporations and persons interested might see fit to make, and for such purposes sittings of the Commission were held at the following times and places: At the city of St. Paul, in the State of Minnesota, on the 24th, 25th, 26th, 27th, and 28th days of May, 1915; at the city of Detroit, in the State of Michigan, on the 15th, 16th, and 17th days of May, 1917; at the city of Ottawa, in the Province of Ontario, on the 3rd, 4th, and 5th days of May, 1920; at the village of Chinook, in the State of Montana, on the 15th day of September, 1921; and at the city of Lethbridge, in the Province of Alberta, on the 17th day of September, 1921, when counsel and representatives of the said Governments, corporations, and persons appeared and presented their views;

And whereas, pending final decision as to the proper method of measuring and apportioning said waters, interim orders with reference thereto have been made by the

International Joint Commission from time to time, the last of such orders bearing the date of 5th day of April, 1921;

And whereas the members of the International Joint Commission have unanimously determined that the said Reclamation and Irrigation Officers should be guided in the measurement and apportionment of said waters by the directions and instructions hereinafter set forth;

IT IS THEREFORE ORDERED AND DIRECTED by the Commission in pursuance of the powers conferred by the said Article VI of the said Treaty that the Reclamation and Irrigation Officers of the United States and Canada shall, until this order is varied, modified, or withdrawn by the Commission, make jointly the measurement and apportionment of the water to be used by the United States and Canada in accordance with the following rules:

St. Mary River

I. (a) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is six hundred and sixty-six (666) cubic feet per second or less Canada shall be entitled to three-fourths and the United States to one-fourth of such flow.

(b) During the irrigation season when the natural flow of the St. Mary River at the point where it crosses the international boundary is more then six hundred and sixty-six (666) cubic feet per second Canada shall be entitled to a prior appropriation of five hundred (500) cubic feet per second, and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the St. Mary River at the point where it crosses the international boundary shall be divided equally between the two countries.

Milk River

II. (a) During the irrigation season when the natural flow of the Milk River at the point where it crosses the international boundary for the last time (commonly and hereafter called the Eastern Crossing) is six hundred and sixty-six (666) cubic feet per second or less, the United States shall be entitled to three-fourths and Canada to one-fourth of such natural flow.

(b) During the irrigation season when the natural flow of the Milk River at the Eastern Crossing is more then six hundred and sixty-six (666) cubic feet per second the United States shall be entitled to a prior appropriation of five hundred (500) cubic feet per second and the excess over six hundred and sixty-six (666) cubic feet per second shall be divided equally between the two countries.

(c) During the non-irrigation season the natural flow of the Milk River at the Eastern Crossing shall be divided equally between the two countries.

Eastern Tributaries of Milk River

III. 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.

Waters not naturally crossing the boundary

IV. Each country shall be apportioned such waters of the said rivers and of any tributaries therof as rise in that country but do not naturally flow across the international boundary.

V. For the purpose of carrying out the apportionment directed in Paragraphs I, II, and III hereof the said Reclamation and Irrigation Officers shall jointly take steps:

(a) To ascertain and keep daily record of the natural flow of the St. Mary River at the international boundary, of the Milk River at the Eastern Crossing, and of the eastern tributaries of the Milk River at the international boundary by measurement in each case:

(1) At the gauging station at the international boundary;

(2) At all places where any of the waters which would naturally flow across the international boundary at that particular point are diverted in either country prior to such crossing;

(3) At all places where any of the waters which would naturally flow across the international boundary at that particular point are stored, or the natural flow thereof increased or decreased prior to such crossing.

(b) To fix the amount of water to which each country is entitled in each case by applying the directions contained in paragraphs 1, 2, and 3 hereof to the total amount of the natural flow so ascertained in each case.

(c) To communicate the amount so fixed to all parties interested, so that the apportionment of the said waters may be fully carried out by both countries in accordance with the said directions.

VI. Each country may receive its share of the said waters as so fixed at such point or points as it may desire. A gauging station shall be established and maintained by the Reclamation or Irrigation Officers of the country in which any diversion, storage, increase or decrease of the natural flow shall be made at every point where such diversion, storage, increase, or decrease takes place.

VII. International gauging stations shall be maintained at the following points:

St. Mary River near international boundary; the north branch of Milk River near international boundary; the south branch of Milk River near international boundary; Milk River at Eastern Crossing; Lodge Creek, Battle Creek, and Frenchman River, near international boundary; and gauging stations shall be established and maintained at such other points as the Commission may from time to time approve.

VIII. The said Reclamation and Irrigation Officers are hereby further authorized and directed:

(a) To make such additional measurements and to take such further and other steps as may be necessary or advisable in order to insure the apportionment of the said waters in accordance with the directions herein set forth.

(b) To operate the irrigation works of either country in such a manner as to facilitate the use by the other country of its share of the said waters and subject hereto to secure to the two countries the greatest beneficial use thereof.

(c) To report to the Commission the measurements made at all international and other gauging stations established pursuant to this order.

IX. In the event of any disagreement in respect to any matter or thing to be done under this order the said Reclamation and Irrigation Officers shall report to the Commission, setting forth fully the points of difference and the facts relating thereto.

X. The said order of the Commission, dated the 6th day of April 1921, is hereby withdrawn, except with respect to the report to be furnished to the Commission thereunder.

Dated at Ottawa, Canada, this 4th day of October, 1921.

O. GARDNER,
C.A. MACGRATH,
C.D. CLARK,
HENRY A. POWELL,
W.H. HEARST,
MARK A. SMITH.

ANNEX B

International System of Units

(SI) Conversions

WRB - USGS

INCH-POUND TO INTERNATIONAL SYSTEM OF UNITS (SI) CONVERSION

Since 1975, the Report to the International Joint Commission on the Division of the Waters of the St. Mary and Milk rivers has used dual units (SI and inch-pound).

The two inch-pound units that were used in previous reports were cfs-days and acre-feet.

1 cfs-day = 86,400 cubic feet
1 acre-foot = 43,560 cubic feet
1 cfs-day = 1.9835 acre-feet

The SI unit replacing the inch-pound units is the cubic decametre(dam^3).

1 dam^3 = 1 000 cubic metres
1 cubic metre = 35.315 cubic feet
1 dam^3 = 35,315 cubic feet
1 acre-foot = 1.2335 dam^3
1 cfs-day = 2.4466 dam^3
1 dam^3 = 0.8107 acre-foot

ANNEX C

List of Gauging Stations

INTERNATIONAL GAUGING STATIONS OPERATED JOINTLY BY THE UNITED STATES AND CANADA ST. MARY AND MILK RIVER DRAINAGE BASINS 1990

Map Index	Station Name
	ST. MARY RIVER BASIN
05AE027	St. Mary River at International Boundary
05AE029	St. Mary Canal at St. Mary Crossing near Babb, Montana
05AE033	Swiftcurrent Creek at Sherburne, Montana
05AE036	Lake Sherburne at Sherburne, Montana
	MILK RIVER BASIN
11AA001	North Milk River near International Boundary
11AA005	Milk River at Milk River
11AA025	Milk River at Western Crossing of International Boundary
11AA031	Milk River at Eastern Crossing of International Boundary
11AA032	North Fork Milk River above St. Mary Canal near Browning, Montana.
11AA033	South Fork Milk River near Babb, Montana
11AA038	Verdigris Coulee near the Mouth
	LODGE CREEK TRIBUTARY BASIN
11AB008	Middle Creek above Lodge Creek
11AB001	Middle Creek below Middle Creek Reservoir
11AB108	Middle Creek near Govenlock
11AB009	Middle Creek near Saskatchewan Boundary
11AB060	Spangler Ditch near Govenlock
11AB080	Middle Creek Reservoir
11AB083	Lodge Creek below McRae Creek at International Boundary
11AB089	Altawan Reservoir near Govenlock

BATTLE CREEK TRIBUTARY BASIN

11AB018	Nashlyn Canal near Consul
11AB027	Battle Creek at International Boundary
11AB044	McKinnon Ditch near Consul
11AB058	Richardson Ditch near Consul
11AB075	Lyons Creek at International Boundary
11AB077	Cypress Lake West Outflow Canal
11AB078	Cypress Lake West Inflow Canal
11AB084	Vidora Ditch near Consul
11AB085	Cypress Lake West Inflow Canal Drain
11AB102	Gaff Ditch near Merryflat

FRENCHMAN RIVER TRIBUTARY BASIN

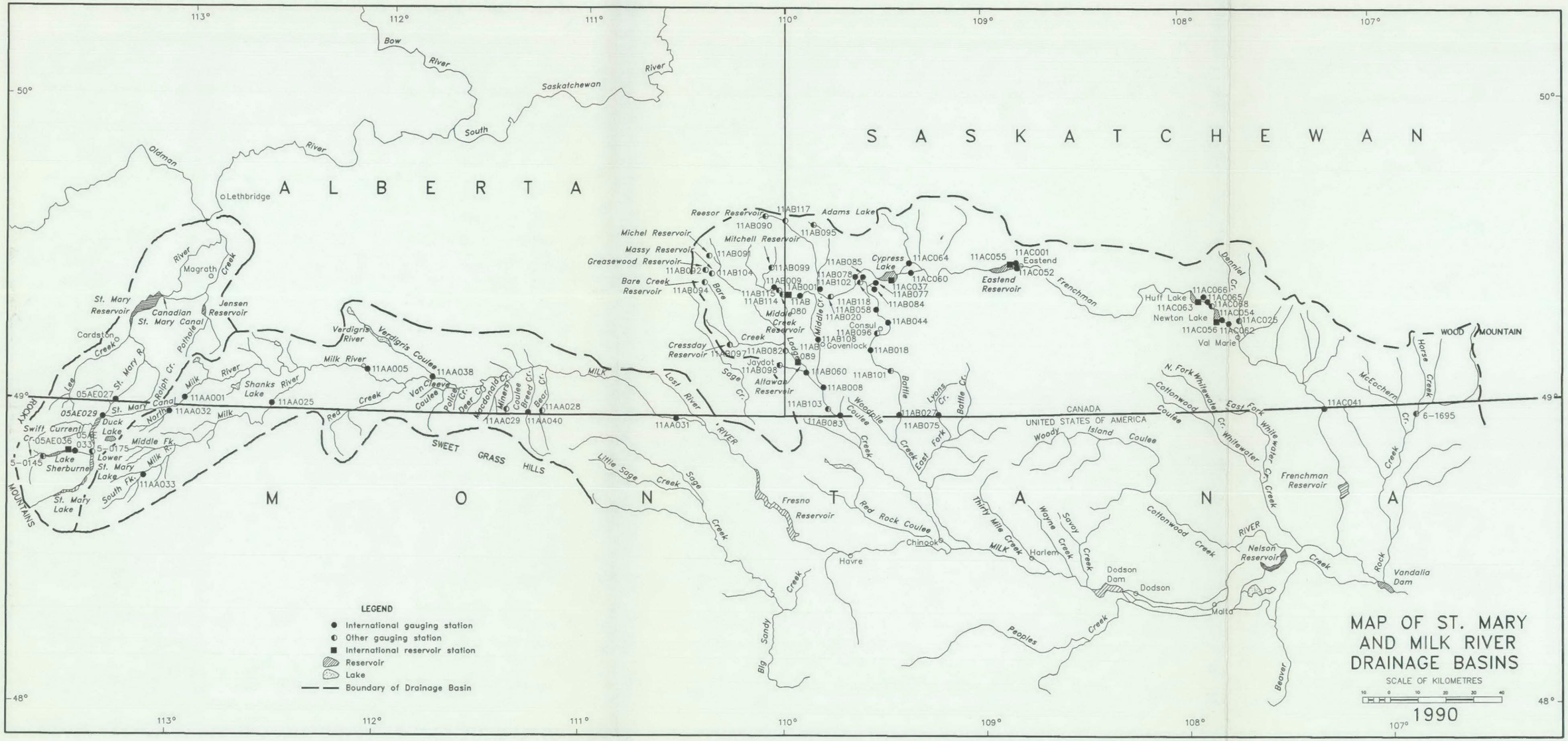
11AC001	Frenchman River below Eastend Reservoir
11AC037	Cypress Lake
11AC041	Frenchman River at International Boundary
11AC052	Eastend Canal near Eastend
11AC054	Newton Lake Main Canal
11AC055	Eastend Reservoir
11AC056	Newton Lake
11AC060	Cypress Lake East Outflow Canal
11AC062	Frenchman River below Newton Lake
11AC063	Huff Lake
11AC064	Belanger Creek Diversion to Cypress Lake
11AC065	Huff Lake Gravity Canal
11AC066	Huff Lake Pumping Canal

GAUGING STATIONS OPERATED INDEPENDENTLY BY EITHER THE UNITED STATES OR CANADA IN THE ST. MARY AND MILK RIVER DRAINAGE BASINS 1990

* Data of these stations are not included in this report or appendices

Map Index	Station Name	Operated by
	ST. MARY RIVER BASIN	
5-0145*	Swiftcurrent Creek at Many Glacier, Montana	U.S.A.
5-0175*	St. Mary River near Babb, Montana	U.S.A.
	MILK RIVER BASIN	
11AA028*	Bear Creek near International Boundary	Canada
11AA029*	Miners Coulee near International Boundary	Canada
11AA040*	Breed Creek near International Boundary	Canada
	LODGE CREEK TRIBUTARY BASIN	
11AB082*	Lodge Creek at Alberta Boundary	Canada
11AB091	Michel Reservoir near Elkwater	Canada
11AB092	Greasewood 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
11AB103	Squaw Coulee near Willow Creek	Canada
11AB104	Massy Reservoir near Elkwater	Canada
11AB114	Middle Creek Reservoir Bedford Outlet	Canada
11AB115	Middle Creek Reservoir Flood Spillway	Canada

	BATTLE CREEK TRIBUTARY BASIN	
11AB020*	Shepherd Ditch near Consul	Canada
11AB090	Reesor Reservoir near Elkwater	Canada
11AB095*	Adams Lake	Canada
11AB096*	Battle Creek near Consul	Canada
11AB101*	Battle Creek below Nashlyn Project	Canada
11AB117*	Battle Creek at Alberta Boundary	Canada
11AB118*	Battle Creek below Wilson's Weir	Canada
	FRENCHMAN RIVER TRIBUTARY BASIN	
11AC023*	Frenchman River at 50-Mile	Canada
11AC025*	Denniel Creek near Val Marie	Canada
11AC051*	Frenchman River below Val Marie	Canada
11AC068*	Val Marie Pump No. 1	Canada
11AC073*	Denniel Creek East Tributary	Canada
	ROCK CREEK TRIBUTARY BASIN	
6-1695*	Rock Creek below Horse Creek near International Boundary	U.S.A.


MAP OF ST. MARY AND MILK RIVER DRAINAGE BASINS
SCALE OF KILOMETRES
1990
LEGEND
International gauging station
Other gauging station
International reservoir station
Reservoir
Lake
Boundary of Drainage Basin
ALBERTA
SASKATCHEWAN
MONTANA
CANADA
UNITED STATES OF AMERICA
Lethbridge
Bow River
Saskatchewan River
South Saskatchewan River
Oldman River
St. Mary Reservoir
Canadian St. Mary Canal
Jensen Reservoir
Magrath
Cardston
Milk River
St. Mary River
Lee Creek
Ralph Cr.
Pothole Creek
Verdigris River
Verdigris Coulee
Shanks Lake
Van Cleeve Coulee
Police Cr.
Deer Cr.
Macdonald Cr.
Miners Coulee
Breed Cr.
Beaver Cr.
Red Creek
Lost River
SWEET GRASS HILLS
ROCKY MOUNTAINS
Swift Current Cr.
Duck Lake
Lake Sherburne
Lower St. Mary Lake
St. Mary Lake
North Fk.
Middle Fk.
South Fk.
Milk R.
Reesor Reservoir
Michel Reservoir
Massy Reservoir
Greasewood Reservoir
Bare Creek Reservoir
Bare Creek
Mitchell Reservoir
Adams Lake
Cypress Lake
Middle Creek Reservoir
Middle Cr.
Cressday Reservoir
Lodge Creek
Sage Cr.
Jaydot
Govenlock
Consul
Battle Cr.
Lyons Cr.
Battle Creek
Altawan Reservoir
Woodpile Coulee
Lost Fork Creek
Eastend
Eastend Reservoir
Frenchman
Denniel Cr.
Huff Lake
Newton Lake
Val Marie
WOOD MOUNTAIN
Horse Creek
McEachern Cr.
N. Fork Whitewater Cr.
Cottonwood Coulee
East Fork Whitewater Cr.
Whitewater Cr.
Woody Island Coulee
Frenchman Reservoir
Little Sage Creek
Sage Creek
Fresno Reservoir
Red Rock Coulee
Thirty Mile Creek
Wayne Creek
Savoy Creek
Cottonwood Creek
Chinook
Havre
Harlem
Dodson
Dodson Dam
Malta
Nelson Reservoir
Vandalia Dam
Rock Creek
Big Sandy Creek
Peoples Creek
Beaver Creek
11AA001
11AA005
11AA025
11AA028
11AA029
11AA031
11AA032
11AA033
11AA038
11AA040
11AB001
11AB008
11AB009
11AB018
11AB020
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11AC068
11AC041
05AE027
05AE029
05AE030
05AE031
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5-0145
5-0175

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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...