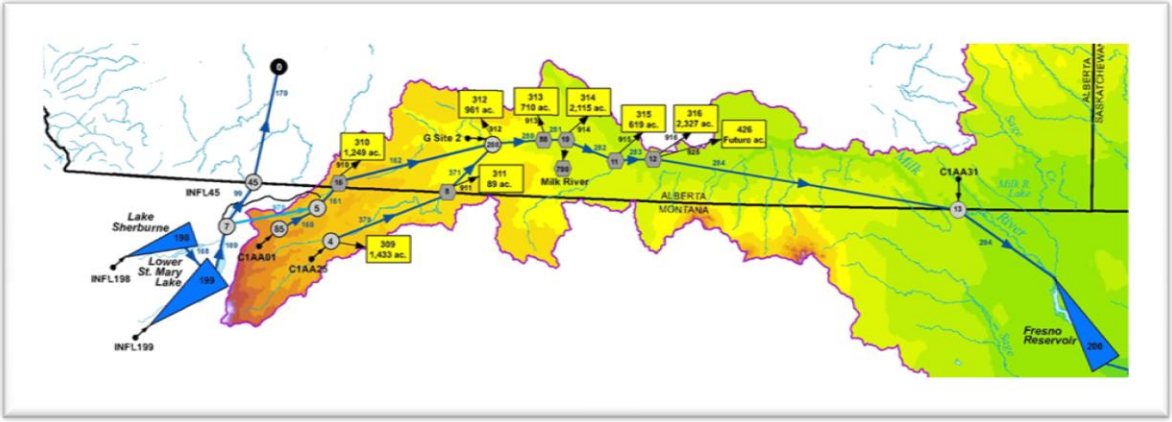

Montana – Alberta

St. Mary and Milk Rivers

Water Management Initiative

Modelling Report

November 2015

Abstract

In 2008 a Joint Water Management team was designated by the State of Montana, United States of America and the Province of Alberta, Canada to explore and evaluate options for improving both Montana's and Alberta's access to the shared water of the St. Mary and Milk Rivers. A key component of the process was hydrologic modelling of potential water management options.

This report describes the development of the water management model, its input data, management options and predicted results. These components are presented in hydrologic terms, such as water flows and volumes, as well as irrigation application depths and water storage levels.

Tables and charts that enable readers to compare options are presented, but without comment, regarding costs or benefits. A separate report, prepared by the full Montana-Alberta Joint Initiative Team, presents findings and recommendations.

Copies of this report may be obtained from the following:

Montana Department of Natural Resources and Conservation
Water Resources Division
dnrc_publicinfo@mt.gov

Alberta Environment and Protected Areas
Transboundary Waters
AEP.TWS@gov.ab.ca

Title Page: Model schematic of the St. Mary and Milk Rivers

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List of Abbreviations and Equivalent Measurements

Imperial Units	Abbr.		Metric Equivalent	Abbr.
acre	ac		0.407 hectares	ha
acre-feet	ac-ft		1233.5 cubic metres	m^3
acre-feet	ac-ft		1.2335 cubic decametres	dam^3
cubic foot/second	cfs (ft^3/sec)		0.0283 cubic metres/sec	m^3/sec
foot	ft		0.305 metres	m
inch	in		25.4 millimetres	mm
inch	in		2.54 centimetres	cm
mile	mi		1.609 kilometres	km
square mile	sq mi		2.59 square kilometres	km^2
Metric Units	**Abbr.**		**Imperial Equivalent**	**Abbr.**
hectare	ha		2.471 acres	ac
cubic metre/sec	m^3/sec		35.31 cubic feet/sec	cfs (ft^3/sec)
cubic decametre (1000 cubic metre)	dam^3(m^3)		0.811 acre-feet	ac-ft
millimetre	mm		0.03937 inches	in
centimetre	cm		0.3937 inches	in
kilometre	km		0.621 miles	mi
square kilometre	km^2		0.386 square mile	sq mi

List of Acronyms and Abbreviations

AEP	Alberta Environment and Parks (previously Alberta Environment and Sustainable Resource Development)
CU	Consumptive Use
GD	Gross Diversion
IRM	Irrigation (District) Requirements Model
JIT	Joint Initiative Team
U.S.	United States
WRMDSS	Water Resources Management Decision Support System

1.0 Introduction

This report on the water management modelling of the St. Mary – Milk River System is one of a series of reports that describes the *Montana - Alberta St. Mary and Milk Rivers Water Management Initiative.*

Reports in this series include:

1. *Montana – Alberta Joint Initiative on the Sharing of the Waters of the St. Mary and Milk Rivers – Background Information Report* (November 2009): establishes a common understanding of the existing water management environment in the two basins to inform the Joint Initiative Team (physical setting, current water management practice, administrative context, operations infrastructure and regulatory/planning processes).
2. *Montana – Alberta St. Mary and Milk Rivers Water Management Initiative Process Report*: describes how the joint initiative was undertaken and provides minutes of meetings.
3. *Montana – Alberta St. Mary and Milk Rivers Water Management Initiative Modelling Report*: describes how the system was modelled (this report).
4. *Montana – Alberta St. Mary and Milk Rivers Water Management Initiative Recommendations Report:* compares water supply and irrigation impact of a range of water-sharing scenarios, and provides recommendations to the Montana Governor and Alberta Premier for improving access to the water supply available including long-term actions for better management of shared waters.

This report provides a short background of the St. Mary and Milk River basins (Section 2.0), including the elements of the basin that have been modelled, for example, storage reservoirs. It also describes the Water Resources Management Decision Support System (WRMDSS) model and defines standard model elements (Section 3.0). Finally, the report describes the two models created for the St. Mary and Milk River basins (Section 4.0), model calibration (5.0), the options modelled (6.0) and how to read results within the results viewer utility (Section 7.0).

2.0 Background

The St. Mary and Milk Rivers have been jointly apportioned and managed by the U.S. and Canada for more than a century. Concerns that neither jurisdiction had been able to capture and use its full share of the water led to the formation of the Montana-Alberta Joint Initiative Team (JIT).

The JIT technical team determined that a principal component of the process was the ability to model (and evaluate the performance of) water management and infrastructure options. Information about current models used within the jurisdictions was gathered. Discussions then occurred about what model to use and what initial options to model.

A number of options were soon specified and it was decided that they would be modelled using the WRMDSS model. This model was created by Alberta Environment and Parks (AEP) and used for many years in Alberta's water planning, as a basis. The model already was capable of simulating the St. Mary River system and Milk River to the Eastern Crossing of the International Boundary. However, it needed to be expanded to include the Milk River watershed from the Eastern Crossing to its confluence with the Missouri River. The actual model runs were to be performed by Alberta Environment and Parks (AEP) modelling staff in Lethbridge, with input from Montana technical staff.

The JIT also gathered background information including basin descriptions, the climate and hydrology of the basins, agreements and compacts, water rights allocations and use, instream and ecosystem flows, and water management infrastructure and irrigation. These topics are described in the *Background Information Report*, a comprehensive description of the relevant technical and administrative elements relating to Alberta and Montana's management and sharing of the waters of the St. Mary and Milk Rivers.

Sections 2.1, 2.2 and 2.3 provide a summary of the St. Mary and Milk River basins, and their water supply, demand, infrastructure and storage. The *Background Information Report* should be referred to for a more detailed description of these topics.

2.1 St. Mary and Milk Rivers

Figure 1 shows the *Milk River and St. Mary Drainage Basins*, together with major storage reservoirs and main diversion canals. This map is also included as Map 2.1 in the *Background Information Report*.

St. Mary River and its major tributary Swift Current Creek both originate in Glacier National Park, Montana. St. Mary River flows through the natural Upper and Lower St. Mary Lakes, whilst Swift Current Creek is regulated by Sherburne Reservoir before entering Lower St. Mary Lake. Downstream of Lower St. Mary Lake, the St. Mary Canal diverts water eastwards to the North Milk River. Below this diversion, the St. Mary River flows into Alberta. There is tributary inflow between the U.S. St. Mary Canal Diversion Dam and the International Boundary. There is no significant consumptive use of St. Mary River water in Montana.

In Alberta, St. Mary River is augmented by Lee Creek tributary before flowing into St. Mary Reservoir. This reservoir provides a major diversion eastwards to the irrigation districts that comprise the St. Mary Project (approximately 520,000 irrigated acres). Downstream of the reservoir, St. Mary River finally enters the Oldman River at Lethbridge.

Milk River originates in the western extremity of the Blackfeet Indian Reservation in Montana, southeast of the town of Saint Mary. It provides water for irrigation of 1,433 acres within the Reservation before flowing into Alberta.

In Alberta, the Milk River supplies water to irrigate:

- 89 acres upstream of the confluence of the North Milk River tributary; and
- 6,732 acres downstream of the confluence of the North Milk River tributary.

In Montana, the Milk River flows into Fresno Reservoir, that is used to manage the water supply downstream to:

- Irrigation Districts (Fort Belknap Canal [Ft. Belknap, Alfalfa Valley and Zurich irrigation districts], Paradise Valley, Harlem, Malta and Glasgow), which comprise a total of about 106,800 acres;
- Non-District contract and private irrigators – about 23,500 acres; and
- Indian Reservation irrigation (Fort Belknap) – about 6,700 acres.

East of Milk River, near Malta, a major canal (the Dodson Canal) diverts water south of the river to irrigated lands for the Malta Irrigation District, the Bowdoin National Wildlife Refuge, centered on Lake Bowdoin, and to Nelson Reservoir. Lake Bowdoin also receives water from the Upper Malta Irrigation District return flow. Nelson Reservoir is used to provide water to the Lower Malta Irrigation District. Water also is released from Nelson Reservoir for the Glasgow Irrigation District, on the Milk River downstream, when Milk River flows are insufficient to meet demands.

Riparian vegetation (phreatophytes) is present along the entire lower Milk River in Montana and represents significant instream water consumption. Milk River finally enters the Missouri River below Fort Peck Reservoir.

The North Milk River tributary also originates in the Blackfeet Indian Reservation in Montana, northeast of the town of Babb. It flows into Canada where it joins the Milk River upstream of the Town of Milk River. There is no active irrigation in Montana. However, before entering Canada, the North Milk River is substantially augmented by water from the St. Mary River, delivered through the U.S. St. Mary Canal. In Canada, the North Milk River irrigates 1,249 acres upstream of its confluence with the Milk River.

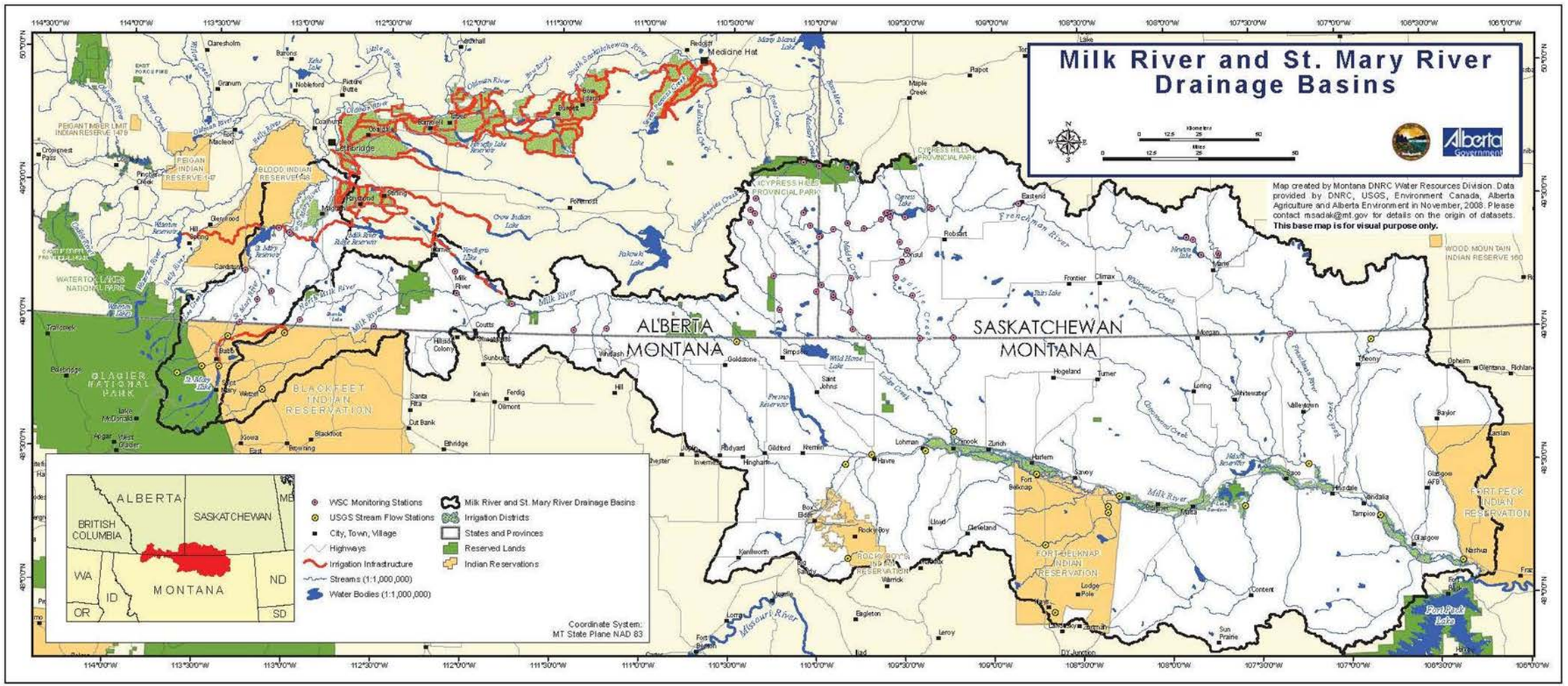


Figure 1. Milk River and St. Mary River Drainage Basins

2.2 Natural Water Supply

At the International Boundary, the 45-year average annual natural flow volumes for the 1959 to 2003 period in acre-feet (ac-ft) are:

St. Mary River	640,287 ac-ft
Milk River at Western Crossing	55,893 ac-ft
Milk River at Eastern Crossing	124,529 ac-ft
North Milk River	22,908 ac-ft

2.3 Storages and Diversion Structures

2.3.1 St. Mary River Basin

In Montana, there is one controlled storage reservoir and one diversion. Lower St. Mary Lake is a natural lake located just upstream of the U.S. St. Mary Canal Diversion Dam. Water released from Sherburne Reservoir (the controlled reservoir in the system) into Swift Current Creek is routed into Lower St. Mary Lake. Lower St. Mary Lake maximum level is about 4,468.2 feet (ft). It has no constructed outlet structure.

Sherburne Reservoir, on the Swift Current Creek tributary, is controlled by a dam with an outlet structure. At full supply level of 4,788 ft, the storage volume is 66,200 ac-ft. The maximum release rate is 5,910 cubic feet per second (cfs or ft^3/sec). On an annual basis, maximum operating levels are:

- 4,759.74 ft on November 1st, rising to 4,788.00 ft on July 1st
- July 1st to September 30th, steady at 4,788.00 ft
- 4,788.00 ft on September 30th, falling to 4,759.74 ft on November 1st

Downstream of Lower St. Mary Lake outlet, St. Mary Canal diverts water from St. Mary River to North Milk River through the Blackfeet Indian Reservation, from about March 15th to October 15th (dependent on weather and flow conditions). The design and as-constructed capacity of this canal is 850 cfs; however, over many years, the canal has deteriorated and today its capacity beyond the St. Mary River siphon is nominally about 650 cfs. The U.S. Congress has authorized the re-habilitation (and possible expansion to the original 850 cfs design capacity) of the canal but the necessary funding has yet to be secured.

In Alberta, there is one storage reservoir and one diversion: St. Mary River flows into St. Mary Reservoir, which has a capacity of 322,025 ac-ft at its maximum level of 3,620.74 ft. It has two controlling outlet structures:

- The irrigation diversion outlet maximum capacity is 3,200 cfs

- The spillway structure has a maximum capacity of 46,440 cfs

On an annual basis, maximum operating levels are:

- October 1st to March 1st, steady at winter level 3,608.92 ft
- 3,608.92 ft on March 1st, rising to 3,620.74 ft on May 1st
- May 1st to September 1st, steady at summer level 3,620.74 ft
- 3,620.74 ft on September 1st, falling to 3,608.92 ft on October 1st

Diversion from St. Mary Reservoir is via the St. Mary Project main canal, which supplies the four irrigation districts that comprise the St. Mary Project. The canal operates from April 1st to October 31st. Canal capacity is 3,200 cfs.

2.3.2 Milk River Basin

In Montana, downstream of the Eastern Crossing, there is one on-stream storage, and two off-stream storage facilities supplied by a common diversion canal. Fresno Reservoir is the on-stream storage, which currently holds about 90,000 ac-ft at maximum operating level of 2,573.62 ft.

For the purpose of modelling, it was assumed that the reservoir will continue to lose storage to sedimentation at a rate of about 500 ac-ft per year, and that the storage mid-way into the future planning period (about 15 years from present) will be about 83,000 ac-ft. Fresno Reservoir has a controlling outlet structure for downstream releases; the maximum release rate is 2,560 cfs at the 2,573.62 ft level.

On an annual basis, maximum operating levels are:

- September 1st to January 1st, steady at winter level 2,563.22 ft
- 2,563.22 ft on January 1st, rising to summer level 2,573.62 ft on April 1st
- April 1st to July 15th, steady at summer level 2,573.62 ft
- 2,573.62 ft on July 15th, falling to winter level 2,563.22 ft on September 1st

Fresno Reservoir was originally constructed in 1937-1939 with a capacity of 137,000 ac-ft at the summer level, but siltation has reduced the storage by approximately 47,000 ac-ft. No practicable options to reclaim the lost storage have been identified.

Downstream of Dodson near Malta, the Malta South Diversion Canal conveys water to the Upper Malta Irrigation District and to the off-stream storage facilities of Nelson Reservoir and Lake Bowdoin. The canal operates from about March 1st to October 31st (weather and flow dependent) and has a capacity of 500 cfs.

Lake Bowdoin is the center of the Bowdoin National Wildlife Refuge. It has a storage volume of 16,400 ac-ft at its year-round operating level of 2,213.45 ft, but water

generally only leaves the lake through evaporation. The annual volume of water diverted to it to maintain its function is about 3,500 ac-ft, with additional return flow water entering the lake from the Upper Malta Irrigation District.

Nelson Reservoir is the principal storage supporting the Lower Malta Irrigation District, and supplying supplemental water to the Glasgow Irrigation District. It has a storage volume of 79,220 ac-ft at its year-round operating level of 2,221.62 ft.

In Alberta, there is no storage and no major diversion on the Milk River. From the river, there are minor diversions to individual private irrigated areas.

3.0 Modelling of Water Supply, Demand and Management

3.1 Strategy

Modelling of a river basin requires a tool (or model) which can adequately represent the essential features of the basin in terms of reaches, structures, water supplies and demands.

"Reaches" simply describe the dendritic nature of the basin, dividing main stems and tributaries into stream lengths between junctions. Frequently, the dendritic basin structure is augmented by cross-connects, constructed to divert water between streams.

"Structures**"** are reservoirs with or without gated outlets, hydro plants, weirs, diversions and return channels.

"Water Supplies**"** are generally natural flows, derived from gauge measurements of stream flow and upstream inflows, diversions and impoundments.

"Water Demands**"** are either consumptive (e.g., for irrigation, municipal, industrial and other purposes) or non-consumptive (e.g., for instream ecology or legally required by a downstream jurisdiction). A key component of water demands is priority, which is determined by licence seniority or government policy. Simply expressed, in times of water shortage, the model used must be able to allocate water to higher priority demands first. For the Milk-St. Mary system, the model must also be capable of modelling the allocation of flow between the U.S. and Canada.

The purpose of modelling is either:

- Short-term, usually to determine the optimum use of water supply to meet water demands over the next few days; or
- Long-term, to plan the future development of the basin.

The St. Mary River - Milk River investigation clearly requires long-term planning-type modelling. A frequently used planning-type modelling method is "period of record" matching of supplies and demands. The basis of this method is to match water supplies over a historical period with expected future demands and management structures and policies. In this way, the model is used to simulate future conditions based on the past, although it is realized that the exact sequencing of past hydrologic conditions will not be repeated in the future.

The water supplies in the St. Mary River and the Milk River basins for the historical period 1959 to 2003 was selected as containing wet and dry year sub-periods of sufficient frequency and duration to represent a realistic basis for characterizing water supplies for planning. Future water demands and management structures were projected for a development period of 30 years into the future (2040).

3.2 Water Resources Management Decision Support System (WRMDSS)

Alberta Environment and Park's WRMDSS was developed in 1981 for long-term water planning in Southern Alberta. It has and continues to be used for that purpose. It contains the essential features listed in section 3.1 above.

The number of years simulated is unlimited and within each year the sequence of modelled time steps is flexible (specified in units of days) but limited to a maximum of 52 weekly periods. For the St. Mary River - Milk River modelling, 24 half-monthly time steps of 15 or 16 days were used.

Results for the simulation are stored in MS Access database tables. These can be viewed as charts which show the performance of individual components (reaches, storages, consumptive demands and diversions) on a per year basis or for the 45-year aggregated period.

WRMDSS provides the following model components:

Natural Channel

Used principally for a stream reach, this component has:

- An upper limit for flow rate;
- A preferred flow range (Ideal Zone); and
- Flow ranges above and below the Ideal Zone, usually used to simulate flood conditions, ecological and minimum flows needed to enable physically diversions from the stream.

The user can specify penalties (priorities) for the channel flow to be within a particular flow range other than the Ideal Zone. The penalties of the flow ranges below the Ideal Zone of the Natural Channel can also be used to assign priority to legally defined flows, such as:

- Inter-jurisdictional apportionment;
- Licensed diversions; and
- Instream requirements specified as a condition of licensed diversions.

Junction

Junctions are used to define locations where:

- Stream flows meet, such as at the confluence of a tributary; and
- Stream flows diverge, such as at a diversion.

A Junction can also be used in any off-stream flow network, such as an irrigation district. The principal property of a Junction is flow continuity, that is, the sum of flows entering and leaving must balance.

Major Withdrawal

Major Withdrawals are used to represent any consumptive use except irrigation, for example, for Municipal, Industrial and Riparian Vegetation. The consumptive use is defined as a rate (cfs). A portion of the water withdrawn may be spilled or re-cycled after use and returned, either to the stream from which it was withdrawn or to another point in the flow network. Such a portion is represented by a component called Return Flow (see below).

Irrigation Block

Irrigation Blocks are used to represent irrigation consumptive use. The consumptive use is specified in terms of depth of water applied (inches), the Irrigated Block area (acres) and irrigation efficiency. Similar to the Major Withdrawal, the Irrigated Block can have Return Flow.

Return Flow

The Return Flow component is a channel from either a Major Withdrawal or an Irrigation Block to a point in the flow network. Its quantity can be specified either as a fraction of the gross diversion to its originating component, or independently, in terms of cfs.

Storage

The Storage component is either a Natural Lake or a Reservoir. Its capacity is specified as a table of elevation (ft) versus either volume (ac-ft) or surface area (acres). It also captures precipitation and water losses to evaporation (both specified in inches). Storage operation is important to the use of water in the river basin. Via the use of drawdown levels and

penalties, the release of water supports downstream consumptive uses. In addition, its elevation change throughout the year defines its function as a provider of local recreation, wildlife habitat and a source of hydropower. Where the Storage is a reservoir, its release is controlled by an Outlet Structure(s) (see below).

Diversion Channel

Diversion channels are used to convey flow between two points in the flow network, for example, from a stream to an off-stream component or to another stream, and within an off-stream flow network such as an irrigation district.

The diversion channel has no priority (penalty). However, it is used to control water conveyance by being assigned opening and closing dates during the year, and by limiting annual conveyed volume (ac-ft). Its flow can be reduced by losses such as seepage, evaporation and vegetation uptake (e.g., by phreatophytes).

Apportionment Channel

Apportionment Channels are used to control stream flow (cfs) and volume (ac-ft) quantities that must be delivered to a downstream jurisdiction. The stream flows are instantaneous, that is, they are delivered for the modelled time steps (days), whilst volumes can be specified over any number of modelled time steps within the calendar year.

Hydro Plant

The Hydro Plant component is modelled to define the power in megawatts (MW) produced by a Hydro Plant at a reservoir outlet. The power is a function of the reservoir head (ft), outflow (cfs) and combined efficiencies of the turbine and generator.

Currently the Hydro Plant power generation cannot be prioritized (assigned a penalty). It is simply dependent on the two independent variables, head and outflow, which can each be specified and assigned a priority.

Inflow

An Inflow is a flow (cfs) increase due to either natural run-off or a diversion into the flow network. It can be specified at any point in the flow network.

Minor

A Minor is a water withdrawal (cfs) at a point in the flow network, similar to the Major Withdrawal, but without supply through a Diversion Channel and with no Return Flow. It is usually used to represent small withdrawals that must be met, such as the most senior licences, or unavoidable losses such as vegetation uptake.

Outlet Structure

An Outlet Structure is used to represent two types of control over channel flow:

- A gated reservoir outlet, where the reservoir releases (cfs) are governed by the reservoir head (ft); and
- A weir, which provides a pool of water from which stream flow can be diverted. The diverted flow is governed by the height of the pool flowing over the weir. In turn, the pool height is determined by the upstream flow. Thus, the diverted flow (cfs) is governed by the upstream flow (cfs).

4.0 WRMDSS Model of the St. Mary and Milk River Basins

A WRMDSS model of the St. Mary River basin and the Milk River basin integrated across both the U.S. and Canada would be impractically large, so two sub-models were created:

Sub-model 1. Joint United States and Canada Milk River Basins Model, using bi-monthly time steps (the bi-monthly time step was chosen because of the long time it takes water to travel through the basin) (the Milk Model); and

Sub-model 2. Canada St. Mary River Basin Model, known as the "Alberta Southern Tributaries Model", using weekly time steps (the STRIBS Model).

St. Mary River flows crossing the International Boundary (U.S. into Canada) were determined from the Milk Model and input into the STRIBS Model. The modelled period was based on the 45-year water supply flows for 1959 to 2003.

4.1 Schematics

Schematics are shown in Figure 2 (*Joint United States and Canada Milk River Basins Model Schematic*) and Figure 3 (*Alberta Southern Tributaries Model Schematic*).

The Alberta Southern Tributaries model includes the Waterton and Belly River basins, since the St. Mary, Waterton and Belly Rivers are diverted into the Waterton-St. Mary Head Works, which supplies the St. Mary Project Irrigation Districts.

The numbers shown on Reservoirs, Channels and Consumption Blocks are simply label numbers internal to the model and do not represent physical quantities. The exception to this is the acres number shown inside each Irrigation Block. In both Canada and the U.S., these are the areas currently irrigated and the values apply in many of the options modelled. Within these options

that use current areas, the irrigation performance (success) varies. As well, there are further options that provide sufficient additional water, such that new acres can be supported.

Irrigation consumption and return flow modelling is described further in Sections 4.4 and 4.5. Channel 170 is prioritized to deliver, as a minimum, the Canadian share of the St. Mary River. This is a unique value for every bi-monthly time step of every year, calculated according to the rules of the 1921 Order of the International Joint Commission. The natural flow of the St. Mary River at the International Boundary is the sum of the following:

- Infl198 – Natural Inflow to Sherburne Reservoir;
- Infl199 – Natural Inflow to Lower St. Mary Lake; and
- Infl45 – Incremental Natural Inflow between Lower St. Mary Lake and the International Boundary.

Flow deliveries in Channel 170 can exceed the Canadian share, specifically when natural inflows are large and the ability of the U.S. to retain (store in Lake Sherburne Reservoir) or divert (through the U.S. St. Mary Canal) its share is reduced (e.g., during the winter months, November to March, and during spring runoff in years of higher flow).

Channel 294 is prioritized to deliver as a minimum:

- U.S. share of the Milk River (a unique value for every bi-monthly time step of every year, calculated according to the rules of the 1921 Order); plus
- Flow diverted from the St. Mary River to the North Milk River (Channel 970), reduced by evaporative losses. Flow deliveries in Channel 294 can exceed the minimum specified above, specifically when Canadian Milk River consumers are unable to use the Canadian share of the Milk River (e.g., during winter months, November to March and during spring runoff).

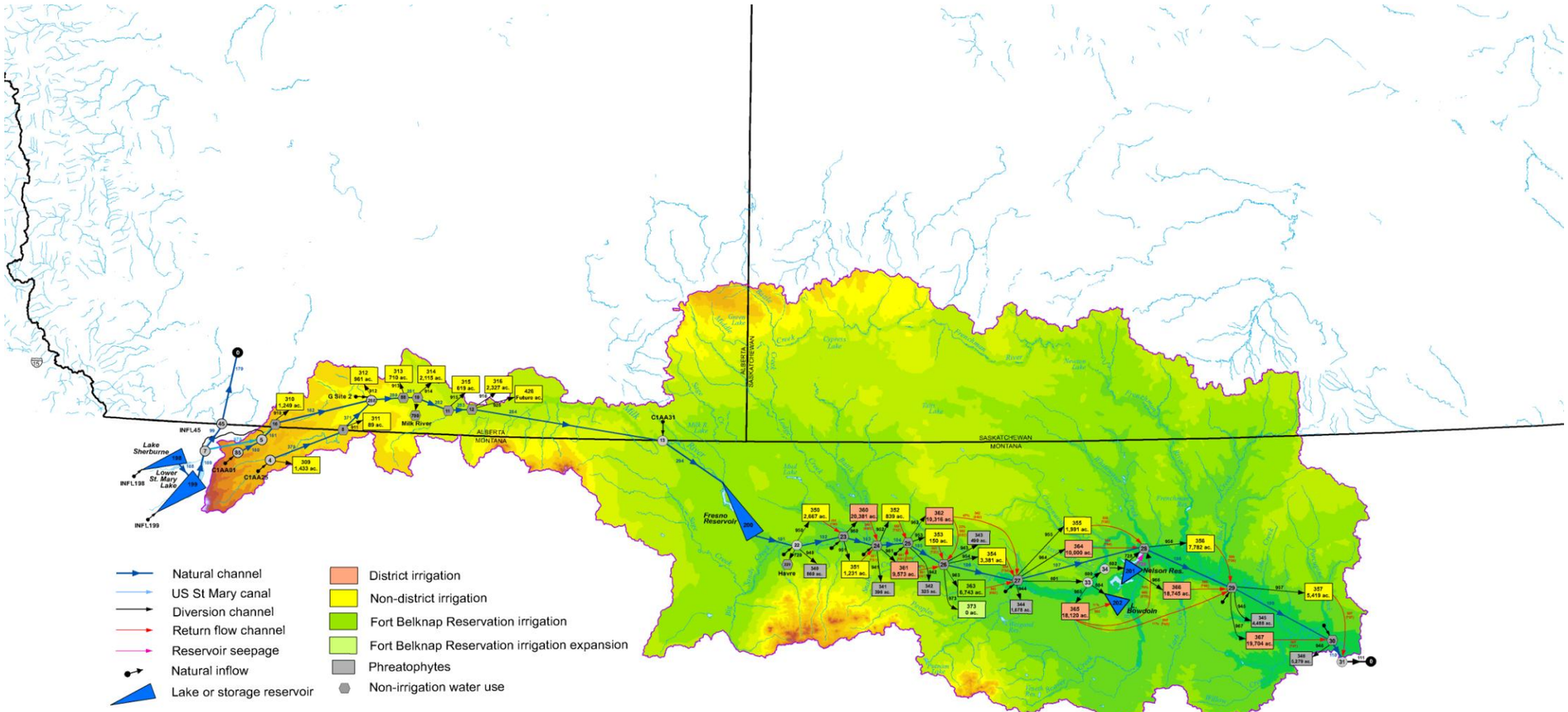


Figure 2. Joint United States and Canada Milk River Basins Model Schematic

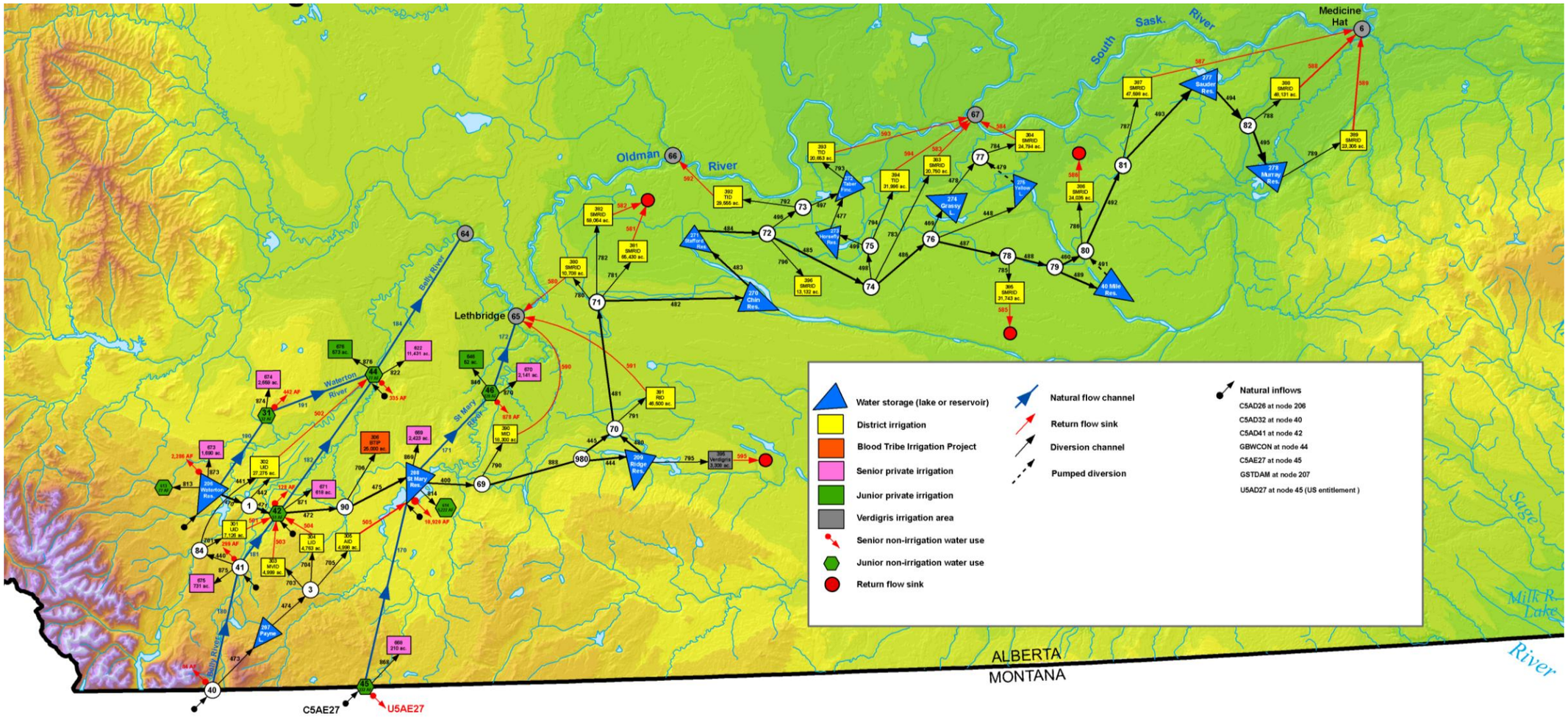


Figure 3. Alberta Southern Tributaries Model Schematic

4.2 U.S. Hydrometeorology and Instream Losses

4.2.1 Hydrometeorology

Natural Inflows, both total and incremental, were computed from stream flow, diversion flow and lake elevation gauge records as presented in Table 1 (*Stream Flow and Reservoir Monitoring Stations used to Develop Natural Inflow Data for the Milk Model*).

Table 1. Stream Flow and Reservoir Monitoring Stations used to Develop Natural Inflow Data for the Milk Model

U.S. GAUGE REFERENCE	CANADA GAUGE REFERENCE	MEASURED PARAMETER	UNITS	LOCATION
05014500	-	Flow	cfs	Swift Current Creek at Many Glacier
05016000	05AE033	Flow	cfs	Swift Current Creek at Sherburne (Sherburne Reservoir Outflow)
05015500	05AE036	Elevation	ft	Sherburne Dam
05017500	-	Flow	cfs	St. Mary River near Babb (Lower St. Mary Lake Outlet)
05018500	05AE029	Flow	cfs	St. Mary Canal at St. Mary Crossing near Babb
05020500	05AE027	Flow	cfs	St. Mary River at the International Boundary
06133500	11AA001	Flow	cfs	North Milk River above St. Mary Canal
06133000	11AA025	Flow	cfs	Milk River at the Western Crossing of the International Boundary
06135000	11AA031	Flow	cfs	Milk River at Eastern Crossing of the International Boundary
06139500, 06140000, 06141600, 06142100, 06142400, 06145500, 06164800, 06149500, 06151500, 06154550, 06156000, 00664000, 06166000, 06167500, 06169500, 06172200, 06174000, 06175000		Flow	cfs	The listed U.S. Geological Survey Gauges on Milk River tributaries below Fresno Reservoir were used to compute tributary inflow to the lower Milk River.

Total Natural Inflows:

To Lower St. Mary Lake (Infl99) were computed as:

- Gauge Outflow (05017500) plus or minus change in Storage (05015500).

To the North Milk River and the Milk River at the Western Crossing were computed as:

- Gauge Flow (11AA001) plus Gauge Flow (11AA025).

Incremental Natural Inflows:

Infl45 and "Gains" at Havre, Belknap, Paradise, Harlem, Dodson, Vandalia and Mouth are computed from the relationship:

- Gain = Tributary Inflow, plus Upstream Diversions and Losses, minus Upstream Returns.

Where:

- Tributary Inflows are estimated inflow gains based on gauged data and estimation;
- Upstream Diversions are for St. Mary Canal, Irrigation and Other Human Uses;
- Upstream Losses are River Evaporation and Phreatophyte consumption (Section 4.2.2);
- Upstream Returns are Irrigation surface and groundwater returns (Section 4.4.1 and 4.5.1); and
- Gross Evaporation on Lakes and Reservoirs is computed from an evaporation pan, obtained from the station (*Table 2.Gross Evaporation on Lakes and Reservoirs*).

Table 2. Gross Evaporation on Lakes and Reservoirs

GAUGE REFERENCE	MEASURED PARAMETER	UNITS	LOCATION
Fort Assiniboine	Net Evaporation	Inches	Just south of Havre, Montana

The Fort Assiniboine gross pan evaporations were multiplied by a factor of 0.74 to adjust the pan evaporation values to what might be expected from a reservoir. Net evaporation volume (ac-ft) for Fresno Reservoir was computed by taking the coefficient adjusted gross evaporation from the Fort Assiniboine pan, adding the Fort Assiniboine precipitation and multiplying this by the surface area of the reservoir during a time-step (with adjustments made for the necessary inches-feet-acres conversions).

For Nelson Reservoir and Lake Bowdoin, the net evaporation was computed in a similar way, where precipitation for the Malta, Montana weather station was used rather than that for Fort Assiniboine. Net evaporation is subtracted each time-step from Fresno Reservoir, Lake Bowdoin and Nelson Reservoir.

For Sherburne Reservoir, no evaporation estimates are made in the model; it is assumed that precipitation on the reservoir surface is similar to evaporation. Because St. Mary Lake is an uncontrolled natural lake, no evaporation estimates are included in the model for it. The volume subtracted is the product of the Unit Depth (inches) and Surface Area (acres).

4.2.2 Instream Losses

River Evaporation loss is equal to the product of the Net Evaporation Unit Depth (inches) and the reach Surface Area (acres) divided by the time step length (seconds). It is expressed as cfs. Table 3 (*River Evaporation*) shows the reaches, their length and Surface Areas.

Table 3. River Evaporation

REACH	FROM	TO	LENGTH (miles)	SURFACE AREA (acres)
102	Havre	Fort Belknap Canal	44	533
103	Fort Belknap Canal	Paradise Valley	18	196
104	Paradise Valley	Harlem	18	175
105	Harlem	Fort Belknap Reservation	24	233
106	Fort Belknap Reservation	Dodson	59	358
107	Dodson	Cree Crossing	98	594
108	Cree Crossing	Vandalia	59	715
109	Vandalia	Mouth	117	851

Phreatophyte consumption loss is represented as Irrigation consumption (cfs), defined in terms of Evapotranspiration Unit Depth (inches) and the Phreatophyte Surface Area (acres) divided by the time step length (seconds). Table 4 (*Phreatophyte Consumption*) shows the Irrigation Block number, reach and its Surface Area.

Table 4. Phreatophyte Consumption

IRRIGATION BLOCK	FROM	TO	SURFACE AREA (ACRES)
340	Havre	Fort Belknap	860
341	Fort Belknap	Paradise Valley	396
342	Paradise Valley	Harlem	325
343	Harlem	Fort Belknap Reservation	490
344	Fort Belknap Reservation	Dodson	1678
345	Dodson	Vandalia	3063
346	Vandalia	Mouth	5279

St. Mary Canal Diversion losses are due to the following:

- Leakage from the canal which is estimated to be 2% of the flow, and removed using the Channel Loss function on Diversion Channel 970; and
- Evaporative loss on the diversion flow in Canada, equal to the product of the Evaporation Unit Depth (inches) and the increased surface area (acres) due to the diverted flow in the Canadian portion of the Milk River divided by the time step length (seconds). This loss is removed at Node 20 (just upstream of Fresno Reservoir).

4.3 Canadian Hydrometeorology and Instream Losses

4.3.1 Hydrometeorology

Natural Inflows, both total and incremental, were computed from the instream and diversion gauge flow records shown in Table 5 (*Stream Flow and Reservoir Monitoring Stations used to Develop Natural Inflow Data for the Milk and STRIBS Model*).

Table 5. Stream Flow and Reservoir Monitoring Stations used to Develop Natural Inflow Data for the Milk and STRIBS Models

CANADA GAUGE REFERENCE	U.S. GAUGE REFERENCE	MEASURED PARAMETER	UNITS	LOCATION
05AE006	-	Flow	cfs	St Mary River near Lethbridge
05AE027	05020500	Flow	cfs	St. Mary River at International Boundary
C5AE027	-	Flow	cfs	Computed Natural Flow, St. Mary River at International Boundary
05AD032	-	Flow	cfs	Belly River near the International Boundary
05AD005	-	Flow	cfs	Belly River near Mountain View
05AD041	-	Flow	cfs	Belly River near Glenwood
05AD028	-	Flow	cfs	Waterton River near Glenwood
05AD027	-	Flow	cfs	Waterton-St. Mary Headworks Diversion
05AD026	-	Elevation	ft	Waterton Reservoir Elevation
C5AD026	-	Flow	cfs	Computed Natural Flow at Waterton Reservoir
11AA001	-	Flow	cfs	North Milk River near International Boundary
C1AA001	-	Flow	cfs	Computed Natural Flow, North Milk River near International Boundary
11AA005	-	Flow	cfs	Milk River at Milk River
11AA025	06133000	Flow	cfs	Milk River at Western Crossing of the International Boundary
C1AA005	-	Flow	cfs	Computed Natural Flow, Milk River at Milk River
C1AA031 (11AA031)	06135000	Flow	cfs	Computed Natural Flow, Milk River at Eastern Crossing of the International Boundary

The Total Natural Inflows at:

- Belly River headwaters flow is simply equal to the Gauge flow 05AD032.
- Waterton Reservoir (C5AD026) is computed from Gauge Flow (05AD028) plus Storage Increase (05AD026) plus Waterton-St. Mary Headworks Diversion (05AD027) plus Storage Net Evaporation.

The Incremental Natural Inflows at:

a) St. Mary Reservoir is the difference of (GSTDAM – C5AE027), where:
   - GSTDAM is the Natural Flow at St. Mary Reservoir, computed from proportioning the Natural Flows at Lethbridge and the International Boundary according to basin area ratio.

b) Town of Milk River is the difference of (C1AA005 – C1AA001 – 11AA025), where:
   - C1AA005 is the Natural Flow at the Town of Milk River, computed as Gauge Flow (11AA005) minus Upstream Inflow (U.S. St. Mary Canal gauge) plus Upstream Irrigation Diversions.

c) Eastern Crossing of Milk River is the difference of (C1AA031 – C1AA005), where:
   - C1AA031 is the Natural Flow at the Eastern Crossing.

Precipitation on Lakes and Reservoirs was obtained from precipitation gauge records as per Table 6 (*Precipitation Gauging Location*).

Table 6. Precipitation Gauging Location

GAUGE REFERENCE	MEASURED PARAMETER	UNITS	LOCATION
PG LETH	Depth	inches	Lethbridge CDA *(STRIBS Model)*
PG TABR	Depth	inches	Taber *(STRIBS Model)*
PG CARDS	Depth	inches	Cardston *(STRIBS Model)*
PG MBEYE	Depth	inches	Mountain View Birdseye *(STRIBS Model)*
GS2 PCP	Depth	inches	Milk River Site 2 *(Milk Model)*
ASSINPCP	Depth	inches	Assiniboine precipitation *(Milk Model)*
MALTAPCP	Depth	inches	Malta precipitation *(Milk Model)*

Precipitation volume (ac-ft) is added each time step to Reservoir or Lakes. The volume added is the product of the Unit Depth (inches) and Surface Area (acres).

Gross Evaporation on Lakes and Reservoirs is computed from Air Temperature and Relative Humidity, obtained from the gauge records shown in Table 7 (*Evaporation and Gauging Location*).

Table 7. Evaporation Gauging Location

GAUGE REFERENCE	MEASURED PARAMETER	UNITS	LOCATION
EGD LETH	Depth	inches	Lethbridge *(STRIBS Model)*
EGD MHAT	Depth	inches	Medicine Hat *(STRIBS Model)*
GS2 EVP	Depth	inches	Milk River Site 2 *(Milk Model)*
ASSINEVP	Depth	inches	Assiniboine evaporation *(Milk Model)*
MALTAEVP	Depth	inches	Malta evaporation *(Milk Model)*

Evaporation volume (ac-ft) is subtracted each time step from reservoirs and lakes. The volume subtracted is the product of the Unit Depth (inches) and Surface Area (acres).

4.3.2 Instream Losses

River Evaporation and Phreatophyte losses on the Waterton, Belly and Canadian portions of the St. Mary and Milk Rivers are not modelled specifically. They are included in the Incremental Natural Flow computations for these rivers.

4.4 U.S. Consumptive Withdrawals

4.4.1 Irrigation

The WRMDSS models irrigation as a consumptive use (CU) block supplied by a gross diversion (GD) channel. The CU block has a defined acreage and for each time interval, the depth of water applied is specified in inches. Thus, the CU for the time interval is a flow rate given by:

- CU = area (acres) * depth applied (inches) / time interval (seconds) and subsequently converted to cfs.

Optionally, a fraction (F) of the water diverted (GD) can be specified as returning to a point on the stream from which it is withdrawn, or to a different point in the flow network. The Return Flow (RF) is computed as:

RF = F * GD cfs; or
RF = F * (CU + RF) cfs; since GD = CU + RF cfs.

Lastly, the return flow may be split into up to five separate return flows, each returning a portion of the total RF to a point in the flow network. Figure 4 (*Multiple Return Flow Locations – Upper Malta Irrigation District*) illustrates the WRMDSS representation of the Upper Malta Irrigation District.

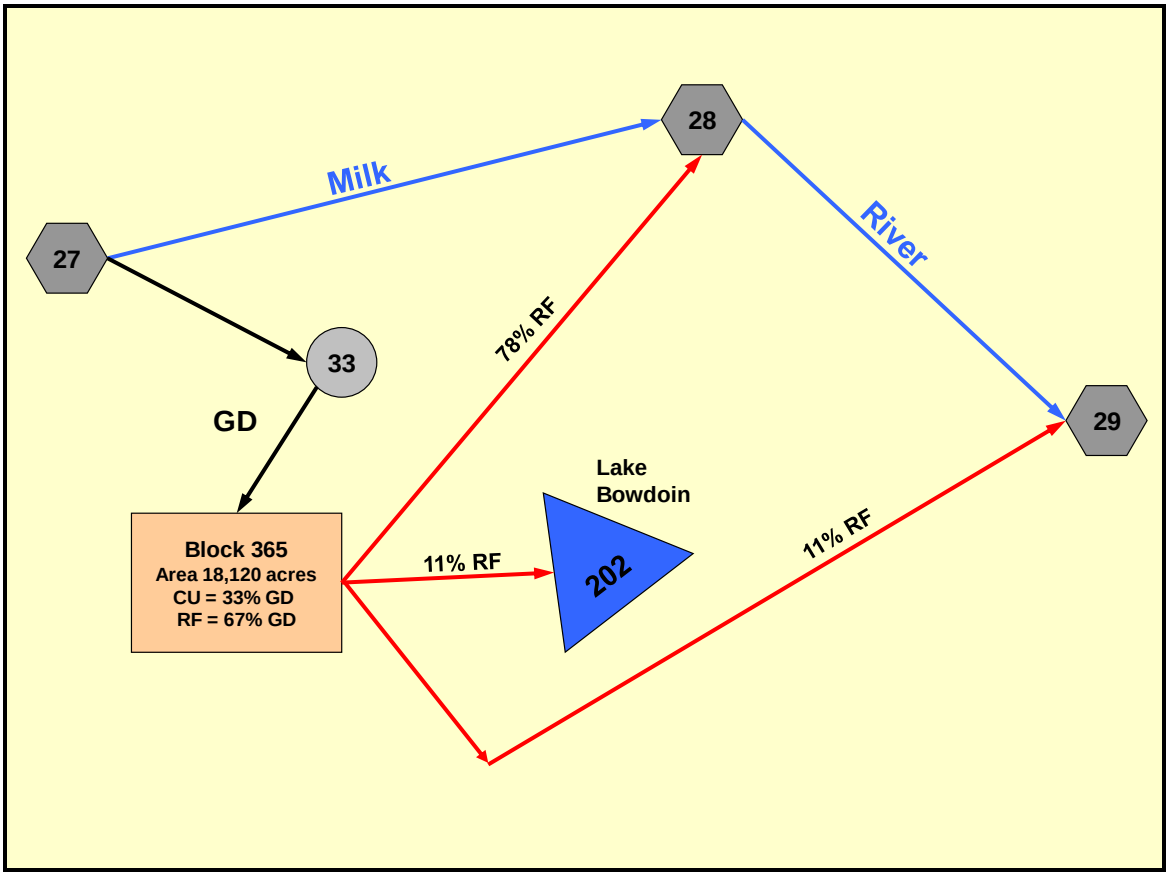


Figure 4. Multiple Return Flow Locations – Upper Malta Irrigation District

This District is representative of the larger districts in the lower Milk River in that it returns flow to more than one location on the Milk River: 78% of the total return flow to Node 28, 11% of the total return flow to Node 29 and 11% to Lake Bowdoin. Some of the irrigation districts (e.g., Glasgow Irrigation District) and Non-District Irrigation blocks (e.g., Block 353) have only one Return Flow.

Irrigation blocks on the Milk River upstream of the International Boundary (e.g., Block 309) and those Irrigation blocks used to represent Phreatophyte losses in the lower Milk River (e.g., Block 343) have no Return Flow because all water is modelled to be consumed.

The block Consumptive Use includes all crop consumption and all losses (e.g., canal leakage and evaporation, internal block storage, leakage and evaporation). The crop consumption itself is variable throughout the year and is different for different years, reflecting the kind of year represented (hot, dry, cool or wet). The depth applied to the crop is the difference between what a crop needs for growth and what it receives naturally through precipitation (called moisture deficit).

Computation of CU for large blocks such as an irrigation district is further complicated by a number of factors:

- Management of internal storages (including wildlife management);
- Method of irrigation (flood, sprinkler) (type affects application rate and evaporative loss);
- Soil type (permeability affects saturation level and deep percolation);
- Crops grown (require different moisture levels);
- Irrigation practices (under-irrigation, where irrigation is below the optimal crop requirement, is common);
- Capture and re-use of Return Flow; and
- Deliveries for other uses (stock, feedlots, domestic use, small municipal and commercial).

For all of the U.S. Irrigation Blocks, the CU was computed using current conditions. Alberta's Department of Agriculture and Forestry has developed a computer program, the Irrigation (District) Requirements Model (IRM), which computes a time series of CU values that accounts for the above factors. The IRM was run for all of the blocks shown in the schematics of Appendix 1*(WRMDSS System Specific Model Schematics)*. CU time series values were generated for the 45-year period 1959-2003.

Appendix 2 (*Irrigation Demand Area, Consumptive Use and Return Flows*) details all of the U.S. Milk River Irrigation blocks, listing for each block the Area Irrigated, 45-year Average Annual CU and Return Flow fraction of Gross Diversion.

Each Return Flow consists of 30% surface return flow, all of which re-enters the Milk River downstream in the same time step as the block diversion (GD). The remaining 70% of return flow is groundwater return flow, which re-enters the river over a much longer time, as shown in Table 8 (*Diversion Month*).

Table 8. Diversion Month = GDM

Diversion Month	GDM	GDM+1	GDM+2	GDM+3	GDM+4	GDM+5	GDM+6	GDM+7 to GDM+11
RF Fraction re-entering river	.50	.15	.13	.08	.04	.03	.02	.01 per month

Thus, a diversion (GD) in the month of June generates a groundwater component of which only 50% returns to the river in the same month, 15% in the following month, continuing with reduced return fractions in subsequent months. The last return (1%) occurs 11 months later (May of the following year). This groundwater return flow pattern occurs for all diversions in the irrigation year, with the fractions from each diversion adding to the fractions from previous diversions.

In order to model this, a fictitious storage was created to collect all the return flow fractions and to release them via an outlet structure whose discharge versus storage volume relationship gave the correct flow release to the river for each time interval. The modified WRMDSS representation of the Upper Malta Irrigation District that contains the fictitious storage is shown in Figure 5 (*Groundwater Return Flow Lagging Scheme*).

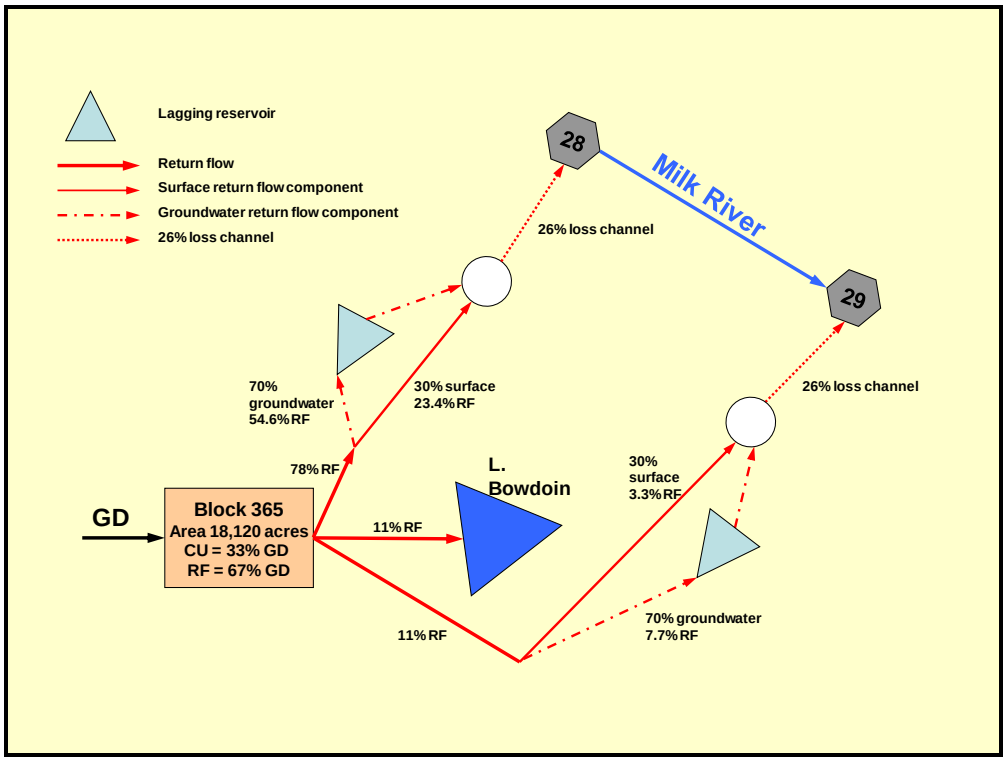


Figure 5. Groundwater Return Flow Lagging Scheme

As can be seen in Figure 5, the surface return joins the delayed groundwater return before reaching the river. A final feature is that the total return is reduced by losses (irrecoverable losses due to evaporation, evapotranspiration by non-target plants, and losses to deeper aquifers) equal to 26% of the total return flow before reaching the river. Consequently, the Channel Loss function of WRMDSS is applied to the channels entering Nodes 26 and 27, such that Outflow = 0.74 * Inflow.

The above-described return flow schematic is replicated in the WRMDSS model for all of the irrigation blocks with a groundwater component of Return Flow.

4.4.2 Non-Irrigation

The only significant non-irrigation withdrawal is for the City of Havre, set at 5 cfs continuous flow rate.

4.5 Canadian Consumptive Withdrawals

4.5.1 Irrigation

Irrigation supplied by diversions from both the St. Mary River and the Milk River are modelled as blocks, similar to the modelling of U.S. irrigation. There are however, the following differences:

a) For Canadian Irrigation District blocks supplied from the St. Mary River (Milk River in Alberta has no Irrigation Districts):

- Consumptive Use is computed using the Irrigation (District) Requirements Model referenced in Section 4.4.1, but with several of the listed factors adjusted to represent future conditions. These future conditions are based on the assumption that improved irrigation practices will eventually reduce water losses and return flows; for example, eliminating flood irrigation, use of more efficient sprinkler systems, improved storage management and increased capture and re-use of return flow.

b) Only Canadian Irrigation District blocks have Return Flows and these are all surface returns, that is, unlike U.S. District and Non-District blocks, no portion of the return flow is groundwater.

c) Canadian Non-District blocks have no Return Flow. All water that is diverted but not applied to and used by crops is irretrievably lost.

Appendix 2 details all of the Canadian St. Mary River and Milk River irrigation blocks, listing for each block the Area Irrigated, 45-year Average Annual CU and Return Flow fraction of Gross Diversion.

4.5.2 Non-Irrigation

There are no significant non-irrigation withdrawals from the St. Mary River. Non-irrigation uses within Districts are included in the irrigation Consumptive Use computation.

From the Milk River, non-irrigation withdrawals are modelled for each river reach. Their magnitudes are based on current licences. The most significant withdrawal is for the Town of Milk River, set at 0.64 cfs for every week, every year.

5.0 Calibration

5.1 Calibration Overview

The purpose in calibrating a water Supply/Demand/Management model is to ensure that the following parameters are correctly represented:

Natural Inflows
These are the ***Total*** and ***Incremental*** Natural Inflows, computed as described in Sections 4.2.1 (U.S. Hydrometeorology) and 4.3.1 (Canadian Hydrometeorology).

Consumptive Uses and Losses
The ***Consumptive Uses*** are those (diversion minus return) flows for Irrigation and Other Uses, computed as described in Sections 4.4 (U.S. Consumptive Withdrawals) and 4.5 (Canadian Consumptive Withdrawals).

The ***Losses*** are the instream Losses, computed as described in Sections 4.2.2 (U.S. Instream Losses) and 4.3.2 (Canadian Instream Losses).

Management
This is the Operation of Storages and Diversion Canals, described in Sections 2.3.1 (St. Mary River basin) and 2.3.2 (Milk River basin).

The calibration procedure is to input the above quantities and operations for a period of years, run the model and then compare the output results with the same gauged quantities. Discrepancies between the output results and the same gauged quantities would indicate

if certain inputs have not been adequately estimated, or that management practices have been misrepresented.

In the St. Mary and Milk River basins, the Natural Inflows and Management of Storages and Diversion Canals are reasonably well known, because there are gauges measuring flows and storage elevations. The biggest uncertainties are Consumptive Uses and Losses.

Both of these quantities have more than one sub-component. Irrigation is the largest Consumptive Use sub-component in both the U.S. and Canada. Vegetation (Phreatophytes) is the largest Loss component in the U.S. Losses in Canada are small by comparison to irrigation consumption.

5.2 Calibration Components of the St. Mary River / Milk River Model

For calibration purposes, the model was divided into four components:

1) **The St. Mary River Water Distribution and Irrigation System within Canada** This system includes the Waterton, Belly, and St. Mary Rivers (often referred to as the Southern Tributaries of the Oldman River basin) and the canal system which moves water between them and to the irrigation districts within the basins;

2) **The Milk River in Canada**, which comprises the river reach from the Western Crossing of the Milk River into Canada to the Eastern Crossing where it returns to the U.S.;

3) **The St. Mary River and Milk River Headwaters,** which includes all portions of the St. Mary River within Montana including Lake Sherburne Reservoir, Lower St. Mary Lake, the U.S. St. Mary Canal, and all portions of the upper Milk River within Western Montana; and

4) **The Lower Milk River**, which covers all areas of the Milk River from the Eastern Crossing into the U.S. to its confluence with the Missouri River.

The four model components are shown in Figure 6 (*Major Modelling Components*).

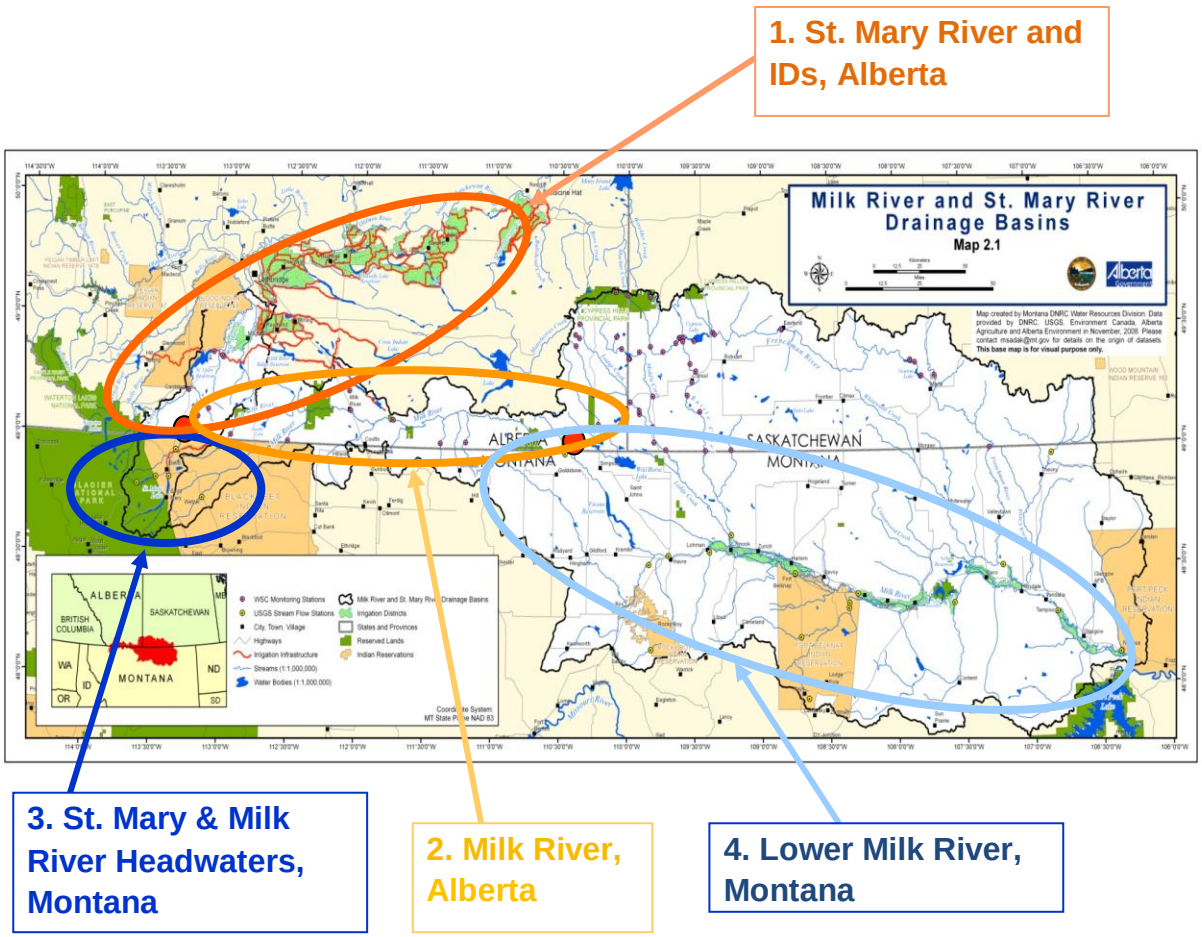


Figure 6. Major Modelling Components

5.2.1 Calibration of St. Mary River and Irrigation Districts, Alberta

The model for the St. Mary River and Irrigation Districts, Alberta, better known as the "Southern Tributaries Model (STRIBS)", was developed in the 1980s and 1990s for use in the South Saskatchewan River basin planning studies. As the model is quite complex and had been previously calibrated for use in the planning studies, a further calibration of this model was not carried out.

5.2.2 Calibration of the Milk River, Alberta

The model for the Milk River, Alberta, had been previously developed and calibrated for studies involving the evaluation of the following:

- Site 2 storage site; and
- Potential diversion of Canadian St. Mary water to the Milk River via a diversion canal from the Milk Ridge to various locations in the Milk River.

However, for the purpose of this analysis the model was again calibrated by applying:

- Recorded historical U.S. St. Mary canal diversions;
- Generated local inflows;
- Historical crop water demands; and
- Estimates of historical natural, and enhanced evaporation (due to added river surface area created by the diversions).

As there were no measurements of diversions nor of evaporation, model performance (the reliability of the calibration) was evaluated by how well the model replicated the historically observed/recorded flows for the Milk River at the Eastern Crossing of the International Boundary.

Figure 7 (*Milk River at Eastern Crossing*) compares the modelled to observed flows for the Milk River at the Eastern Crossing for the last nine years of simulation. The high level of agreement between observed and modelled flows provides a high level of confidence in the model being able to simulate the impact of human activities and the water management process for this reach of the Milk River.

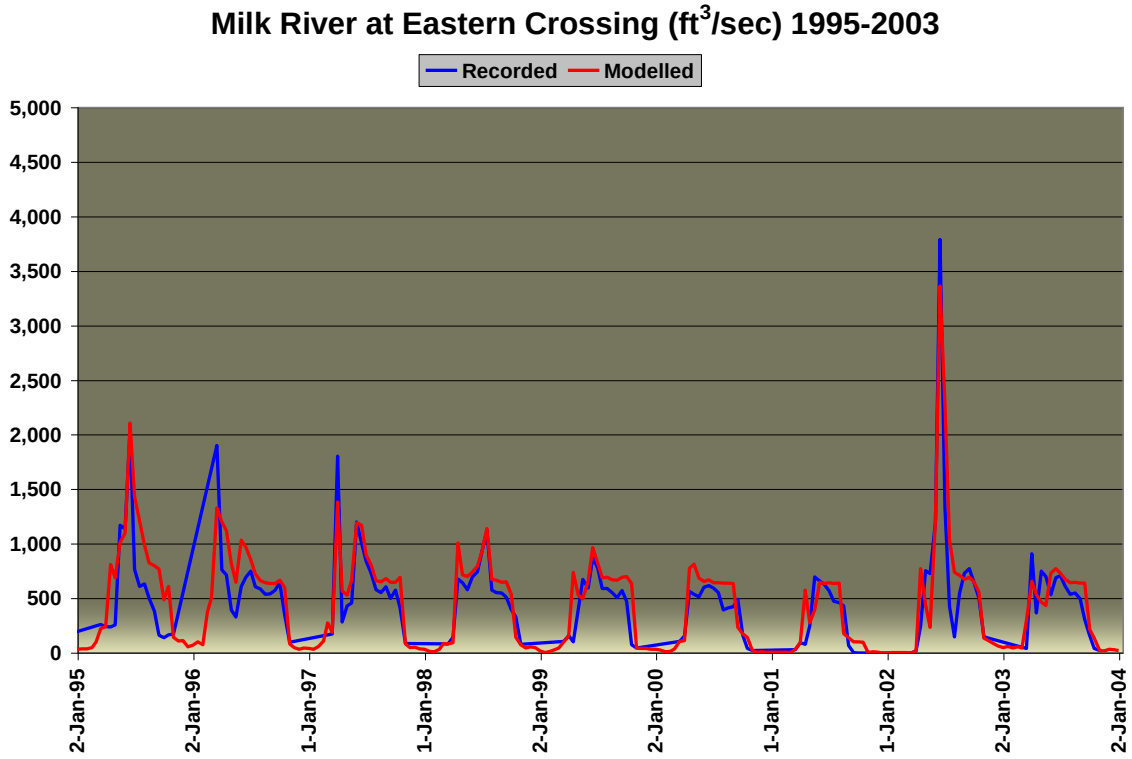


Figure 7. Milk River at Eastern Crossing (Note that similar graphs for the remaining years of simulation are in Appendix 3 – *Calibration Run Results: Upper Milk River*.)

5.2.3 Calibration of St. Mary River and Milk River Headwaters, Montana

This model simulates the operations of the St. Mary and Milk River headwaters within the U.S. It includes:

- Operation of Lake Sherburne Reservoir and Lower St. Mary Lake;
- Operation of the U.S. St. Mary Diversion Canal (including canal losses); and
- Local inflows generated within the Milk River basin upstream of the International Boundary.

Figure 8 (*U.S. St. Mary Diversion Canal Facilities*) shows the headwaters and elements whose operations were included in the modelling of this reach.

In simulating the operation of the U.S. St. Mary Diversion Canal it is noted that:

- Historically, the start and end of diversions via the U.S. St. Mary Diversion Canal has varied considerably for various reasons including climatic factors, maintenance and lack of adequate water supplies.
- Over the years, the effective capacity of the canal has decreased to about 650 cfs; in the earlier period, capacities might have been as high as 850 cfs.
- There have been a number of instances in the historical period when the canal was shut down during the irrigation season due to slope or siphon failures, or for maintenance.

Within the calibration, however, it was assumed that the canal always starts diversion on April 1 and that diversions would cease when either:

- U.S. entitlements and storage could not maintain a minimum diversion of 100 cfs; or
- October 15 was reached.

No attempt was made to simulate canal failure.

Figure 9 (*U.S. St. Mary Diversion Canal*) compares modelled to observed flows at the St. Mary River crossing for the most recent nine years (1995-2003) of the simulation. The modelled and observed flows show good agreement with the exception of 1995 and early 1996, when the canal was shut down for a significant period of time due to a major failure following a flood in June 1995, and a second shut down in 2002 due to canal failure.

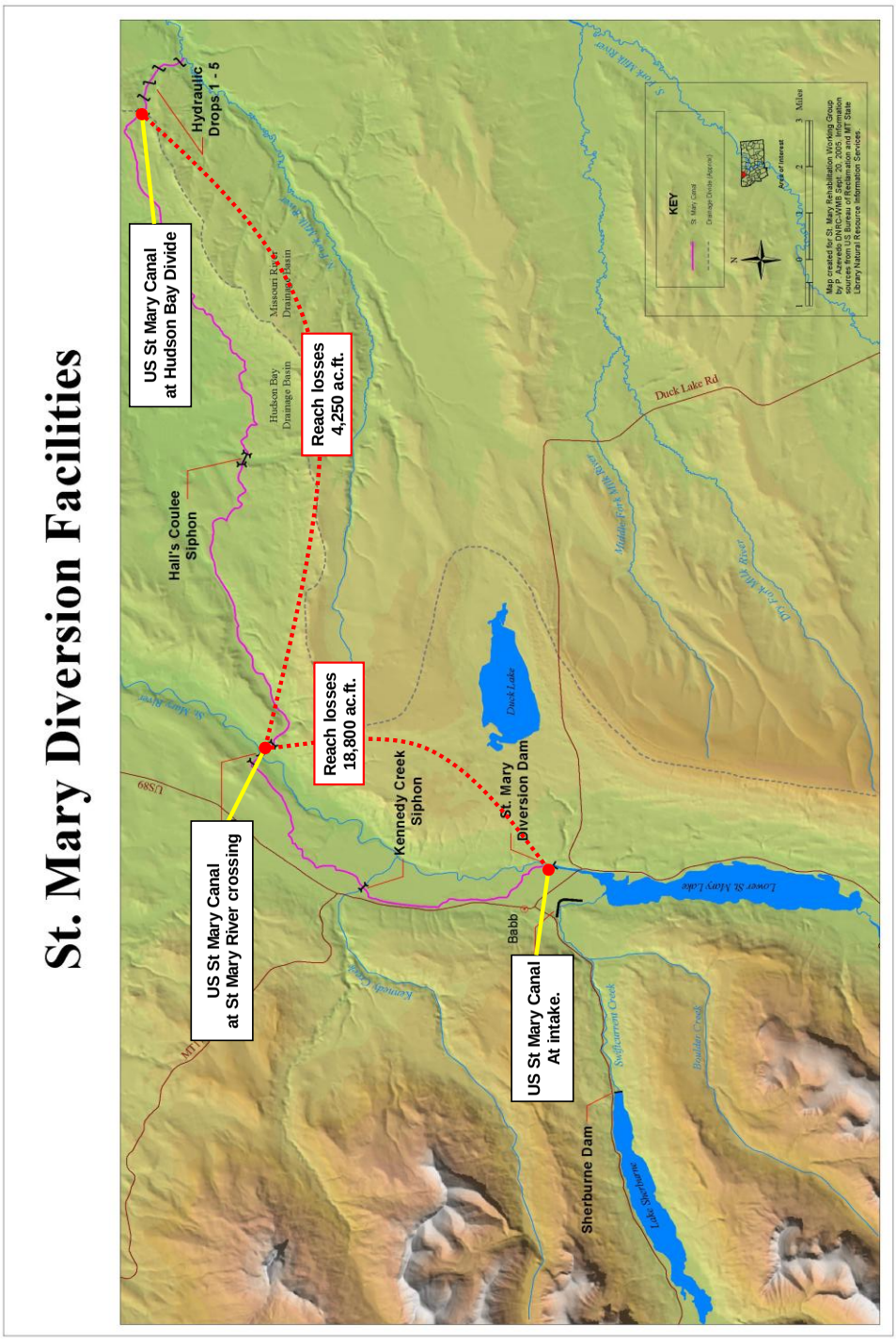


Figure 8. U.S. St. Mary Diversion Canal Facilities

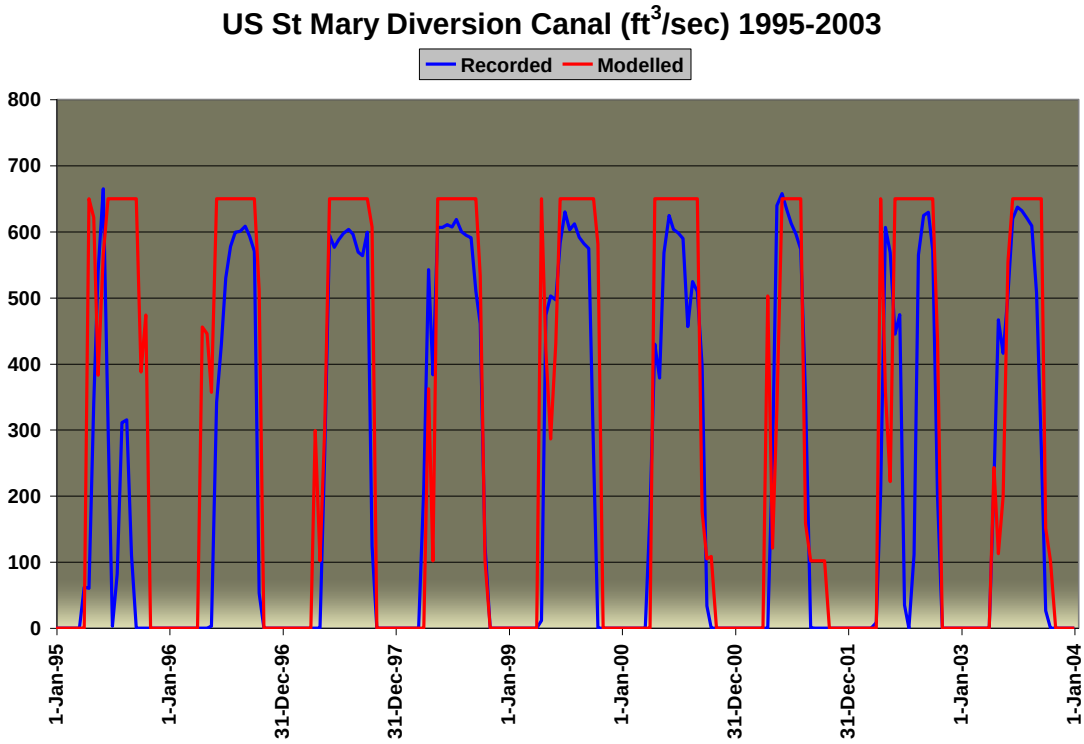


Figure 9. U.S. St. Mary Diversion Canal (Note: Similar graphs for the remaining years of simulation are in Appendix 3.)

Lake Sherburne Reservoir operations were simulated with the following two assumptions:

- The U.S. St. Mary Diversion Canal would be maintained at capacity by water arising within the unregulated catchment area upstream of the canal diversion; and
- All flow entering Lake Sherburne, up to its full supply capacity, would be stored and only released if U.S. entitlements from the unregulated area were insufficient to maintain the canal at full capacity.

Figure 10 (*Sherburne Reservoir Storage*) compares the modelled to recorded water levels for the Lake Sherburne Reservoir for the same period. With the exception of late fall storage in 1996 and 1997 due to a temporary change in policy respecting the winter target pool level, the modelled and observed storages compare well. Figure 11 (*Sherburne Reservoir Releases*) compares modelled to recorded Sherburne Reservoir releases.

There is a high level of agreement between the observed and modelled storage for Lake Sherburne Reservoir and Sherburne Reservoir releases. This indicates a high degree of confidence in the model being able to simulate the operation of U.S. infrastructure within the headwaters of the St. Mary and Milk Rivers.

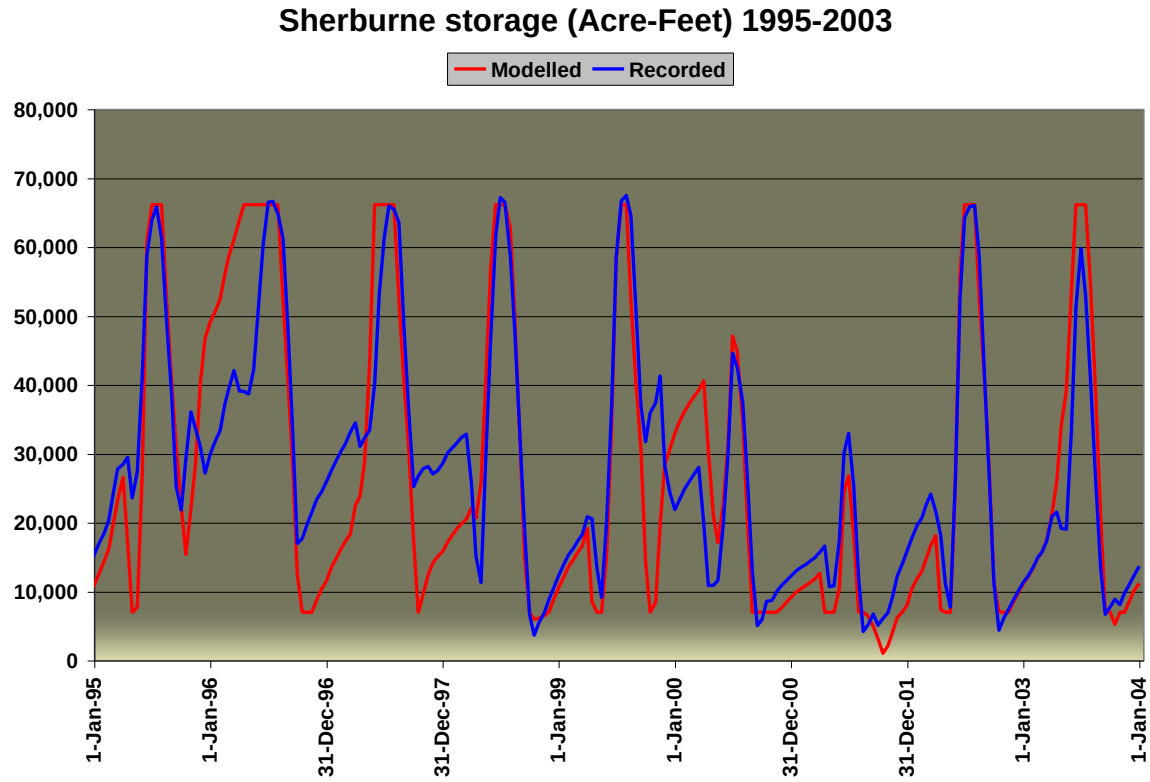


Figure 10. Sherburne Reservoir Storage

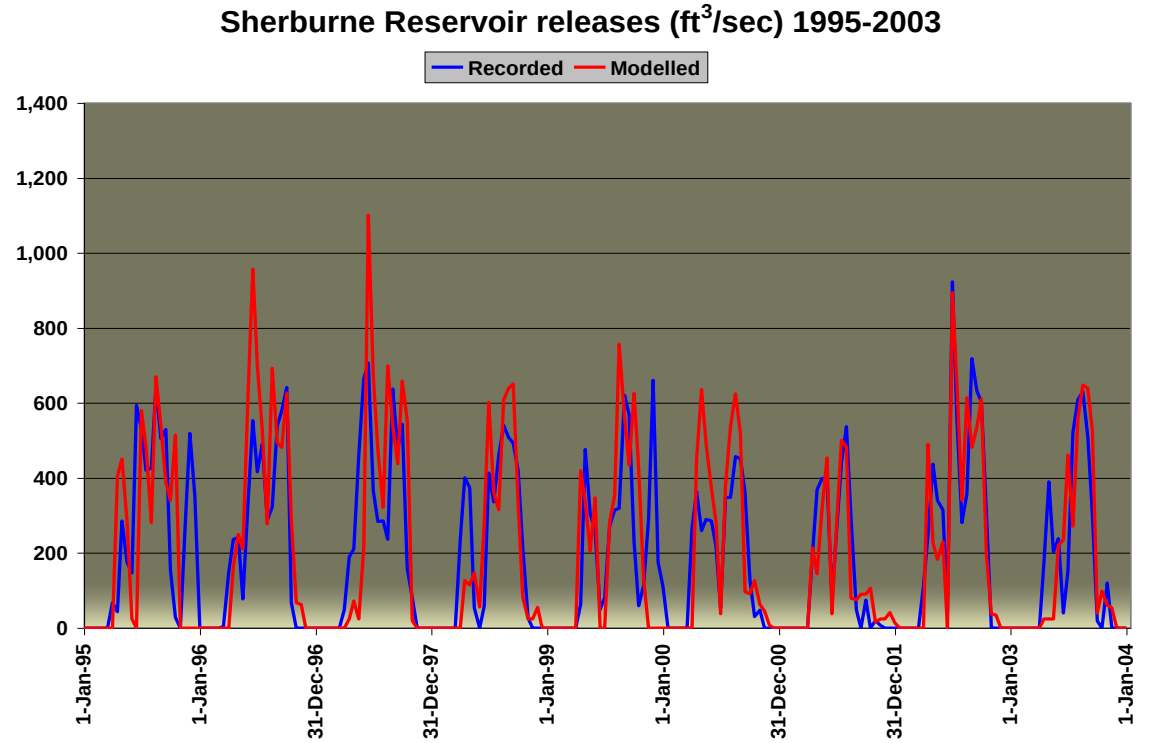


Figure 11. Sherburne Reservoir Releases (Note: Similar graphs for the remaining years of simulation are in Appendix 3.)

5.2.4 Calibration of the Lower Milk River, Montana

The calibration of the Lower Milk River portion of the model was carried out by applying the historical recorded flows for the Milk River at the Eastern Crossing; recorded and generated flows for tributaries between the Eastern Crossing and the Milk River's confluence with the Missouri; and crop water demands and meteorological parameters (evaporation and precipitation) to the model representation of the physical and regulatory system within this reach of the Milk River. As the measurements of irrigation diversions were incomplete, the parameters used to assess the accuracy of the calibration were comparisons between modelled and observed:

- storage in Fresno Reservoir;
- storage in Nelson Reservoir;
- flows for the Milk River at Havre;
- flows for the Milk River at Harlem; and
- flows for the Milk River at Nashua.

Irrigation diversion is the primary water use in the reach and there only are limited measurements of these diversions. Hence, the model calibration was carried out using an iterative process in which the on-farm water application, as a percent of optimum crop water demand, was adjusted until there was a high level of agreement between the modelled and observed values for the river flows and reservoir storages. Figures 12 through 16 show the comparisons of the observed to modelled values for the above noted locations/parameters. Note that similar graphs for the remaining years of simulation are in Appendix 4 (*Calibration Run Results: Milk River Downstream of Eastern Crossing*).

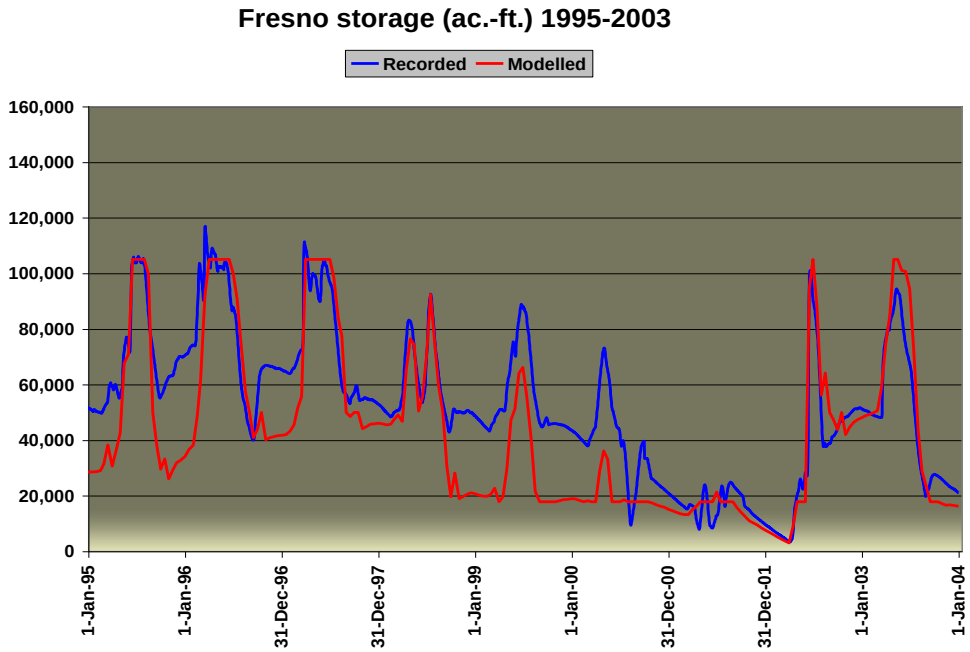


Figure 12. Fresno Reservoir Storage

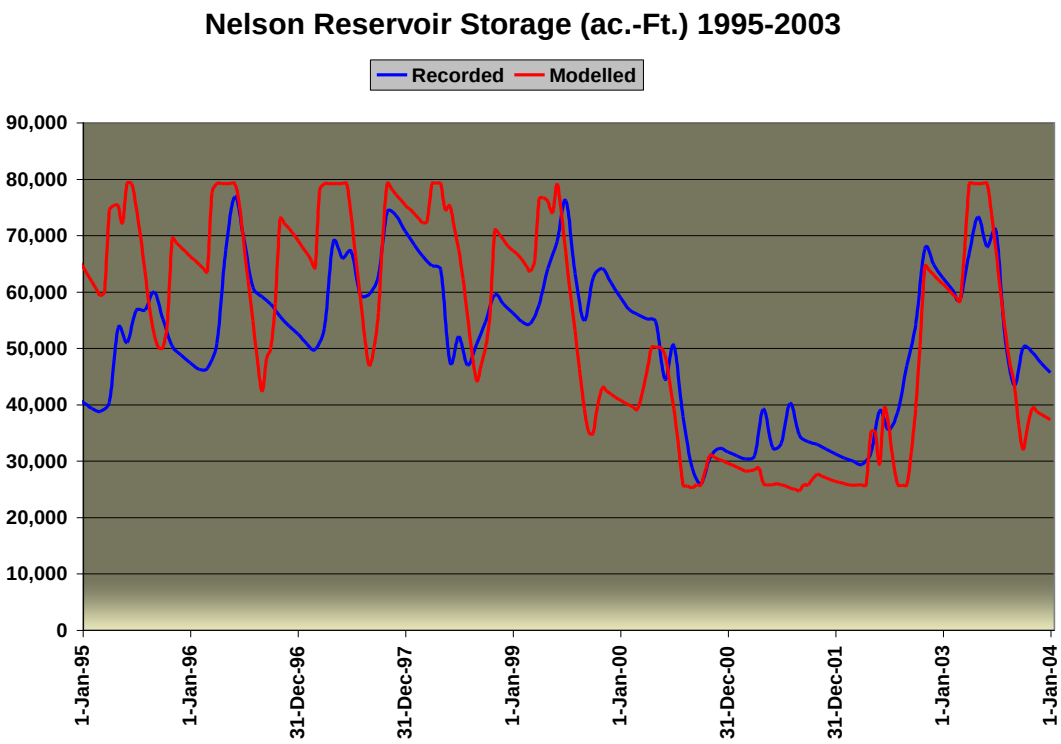


Figure 13. Nelson Reservoir Storage

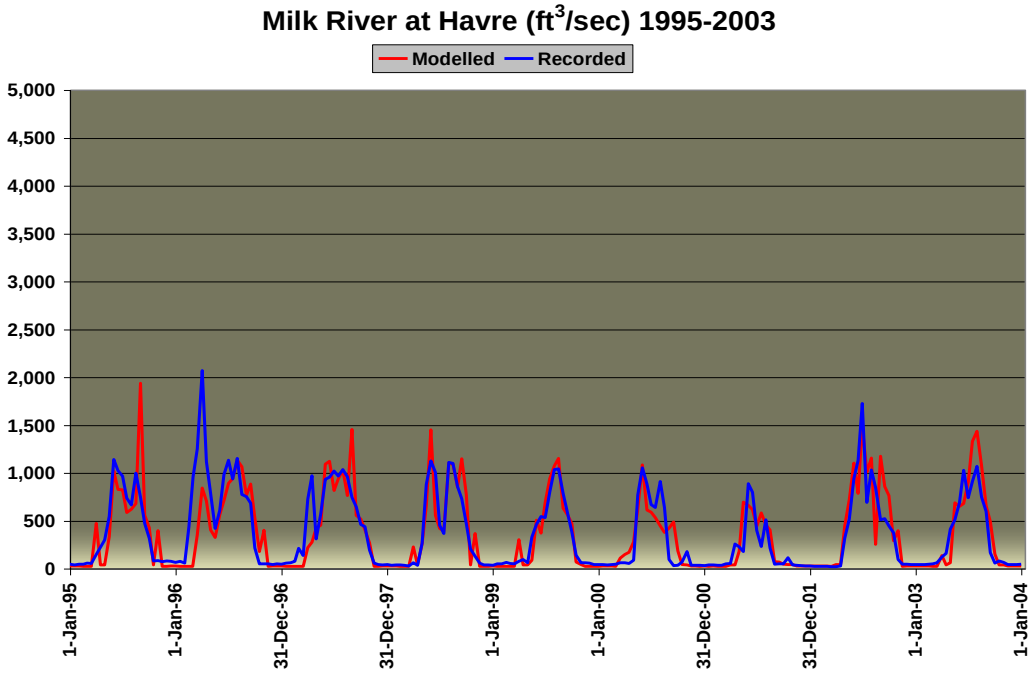


Figure 14. Milk River at Havre

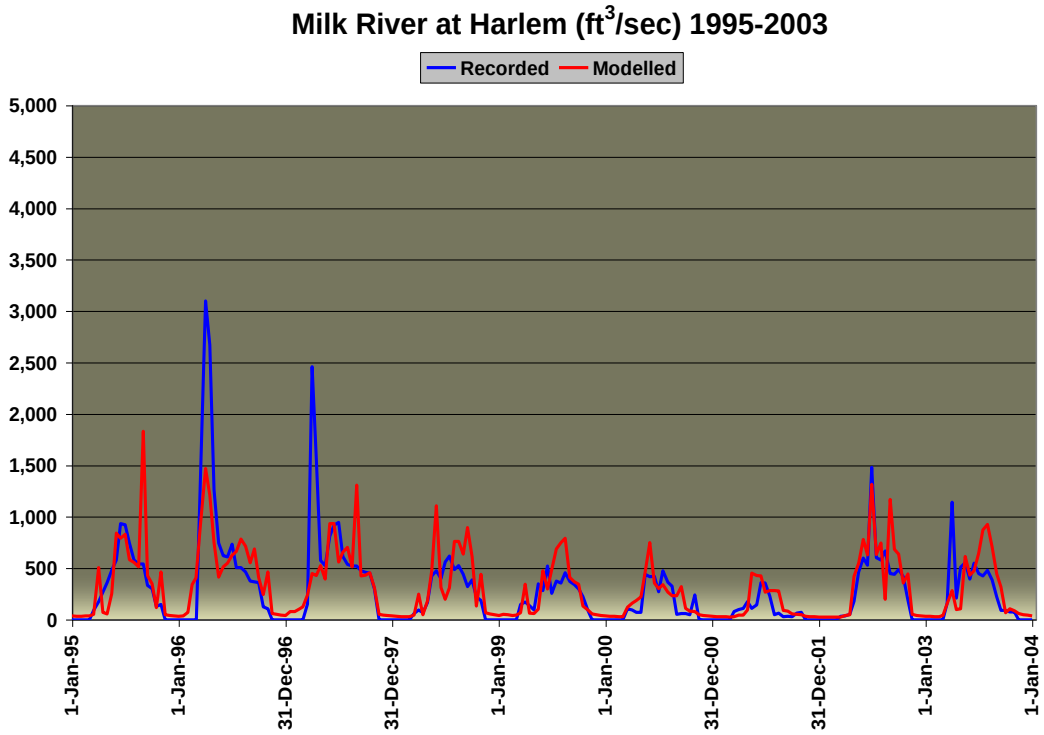


Figure 15. Milk River at Harlem

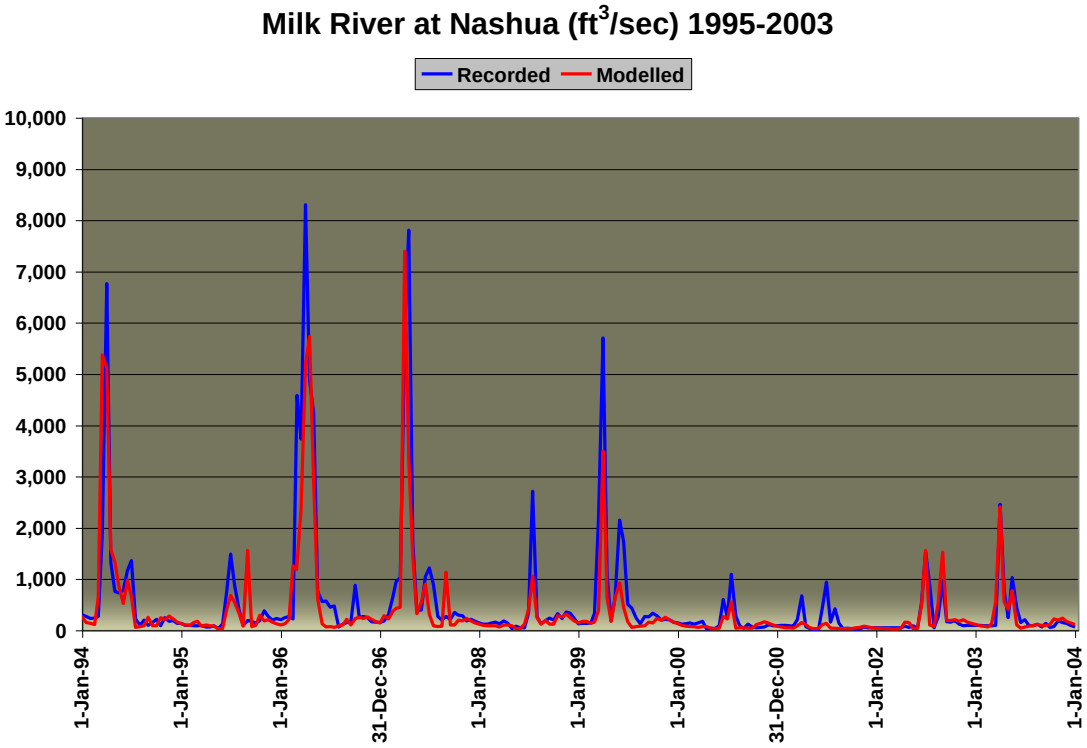


Figure 16. Milk River at Nashua

The calibrations for the Lower Milk River portion of the model were complicated by a number of factors including:

- The gradual reduction in live storage for Fresno Reservoir from its original capacity of 137,000 ac-ft to its current capacity of 90,000 ac-ft. The calibration run uses a capacity of 105,000 ac-ft for the period of 1983 to 2003;
- Changes in policy regarding the fall target level for Fresno Reservoir; and
- The ad-hoc transfer of flows into Nelson Reservoir, depending on the presence or absence of nesting plovers.

However, the high level of agreement between observed and modelled storage levels and flows at all locations for which there is actual data provides a high level of confidence in the model being able to simulate the water management operations for this portion of the Milk River.

6.0 Options Modelled

While over 300 water management scenarios were explored, 100 options were investigated through modelling. A wide range of parameters was modelled, including:

- The capacity and operation of existing structures;
- New structures;
- The administration of national entitlements;
- Minimum instream flows; and
- Irrigated areas.[1]

To make the options presentation comprehensible, options were sub-divided into two broad categories, 'Structural' and 'Administrative'. The options were then further sub-divided within the two broad categories (see below). Option-specific schematics are shown in Appendix 1 (Figures 1-2.1 to 1-2.23). For a full discussion of the options, conclusions and recommendations refer to the Montana - Alberta St. Mary and Milk Rivers Water Management Initiative *Recommendations Report*.

6.1 Structural Options

These options examined the increase in access to entitlements and water utilization that can be realized through:

[1] The irrigated areas modelled were current for the majority of options. In those options where additional irrigated areas were modelled, the values used were those that could be sustained with the additional water obtained as a result of the option. The additional amount of water was determined from modelling the option; it resulted from both structural and/or administrative changes.

- Changes to the *Capacity and Operation of Existing Structures;* and
- Creation of *New Storage (Reservoirs).*

The Structural Options are divided into three sub-categories:

1) Independent U.S. Infrastructure
   These options examined improvements to U.S.-owned infrastructure. The improvements investigated included: increases in diversion canal capacities, increases in storage, and improvements in water delivery systems.

2) Independent Canadian Infrastructure
   These options examined the construction of a Milk River Dam within the Canadian Milk River Basin.

3) Shared Infrastructure
   These options examined joint improvements in infrastructure. The joint/shared improvements included the construction of shared storage on the Canadian Milk River; shared increased storage on Fresno Reservoir and St. Mary Reservoir; and shared use of the U.S. St. Mary Diversion Canal.

6.2 Administrative Options

The focus of these options was primarily to investigate the amount of increase in access to entitlements and water use that could be realized through modification to the 1921 Order or the current Administrative Procedures. Modifications included changes to:

- Entitlements for natural flows > 666 cfs;
- Balancing period; and
- Credit balance size and timing.

Additionally, to provide a more comprehensive evaluation, certain administrative options were examined in conjunction with structural enhancements, for example, larger U.S. St. Mary Canal capacity and Annual Balancing period. Options are divided into two sub-categories:

1) Entitlement Modifications to 1921 Order for Natural Flows > 666 cfs
   These options examined entitlement modifications to the 1921 Order for natural flows > 666 cfs.

2) Changes in Administrative Procedures
   The options examined were:
   i) Change in balancing period to seasonal or annual water year;
   ii) Deficit trading – Letter of Intent; and
   iii) Capped credit system based on surplus deliveries.

7.0 Results

A "Results Viewer", a 1 Mb Excel file, was developed to display key results for the 100 structural and administrative options modelled. The file is attached to this report as Appendix 5 (*Results Viewer*). Modelled options are grouped into categories for ease of comparison. Key results are displayed in tables in the main Excel spreadsheet accessed from the "Selection" tab, as described in Sections 7.1, 7.2 and 7.3 below.

7.1 Scope of Results

For both Montana and Alberta, the results for each option presents:

- The share of national entitlement that was accessed, by percentage and by volume (ac-ft); and
- The irrigation performance in terms of:
  - Area irrigated (acres);
  - Annual deficit (inches);
  - Frequency of annual deficits greater than four inches; and
  - Annual volumes delivered (ac-ft).

Although produced as part of model output, some quantities are not presented in the Results Viewer: reservoir storages, canal flows, stream reach flows, non-irrigation diversions and losses.

7.2 Detail of Results

Irrigation deficits are calculated on a yearly basis. Irrigation failure criteria for Alberta are defined as deficits of four inches or higher occurring once in every 10-year period. For this study, a maximum of five failures in 45 years of simulation was chosen as criteria to stop any further analyses.

Model output is divided into 24 bi-monthly intervals for all years modelled. Annual volumes are calculated on a yearly basis. However, the Results Viewer only presents:

a) Share of national entitlement that was accessed, for the annual average of the:
   - 11 driest years;
   - 22 driest years; and
   - 45 modelled years.

b) Irrigation annual average deficits (inches) and number of deficits greater than four inches for the 45 modelled years.

7.3 Comparison of Results

The Results Viewer's capability to compare between options is limited to the display of each option together with displays of two Base Case Options. These Base Case options are:

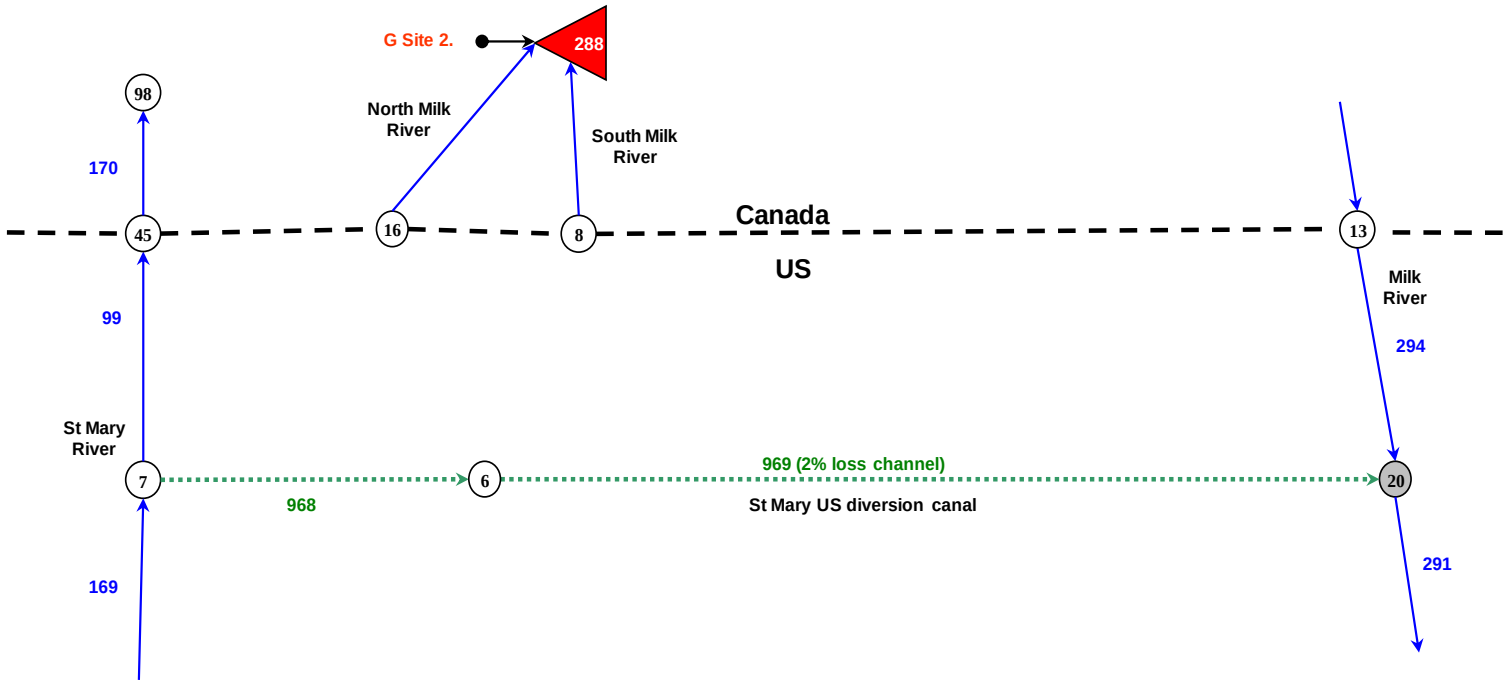
1) **1.1.1.1:** Existing (2010) Infrastructure (650 cfs U.S. St. Mary Canal) without Letter of Intent (Option 1a)

2) **2.2.2.1:** Existing (2010) Infrastructure (650 cfs U.S. St. Mary Canal), but deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (Option 10a)

Appendix 1 – WRMDSS Option Specific Model Schematics (1-2.1 to 1-2.23)

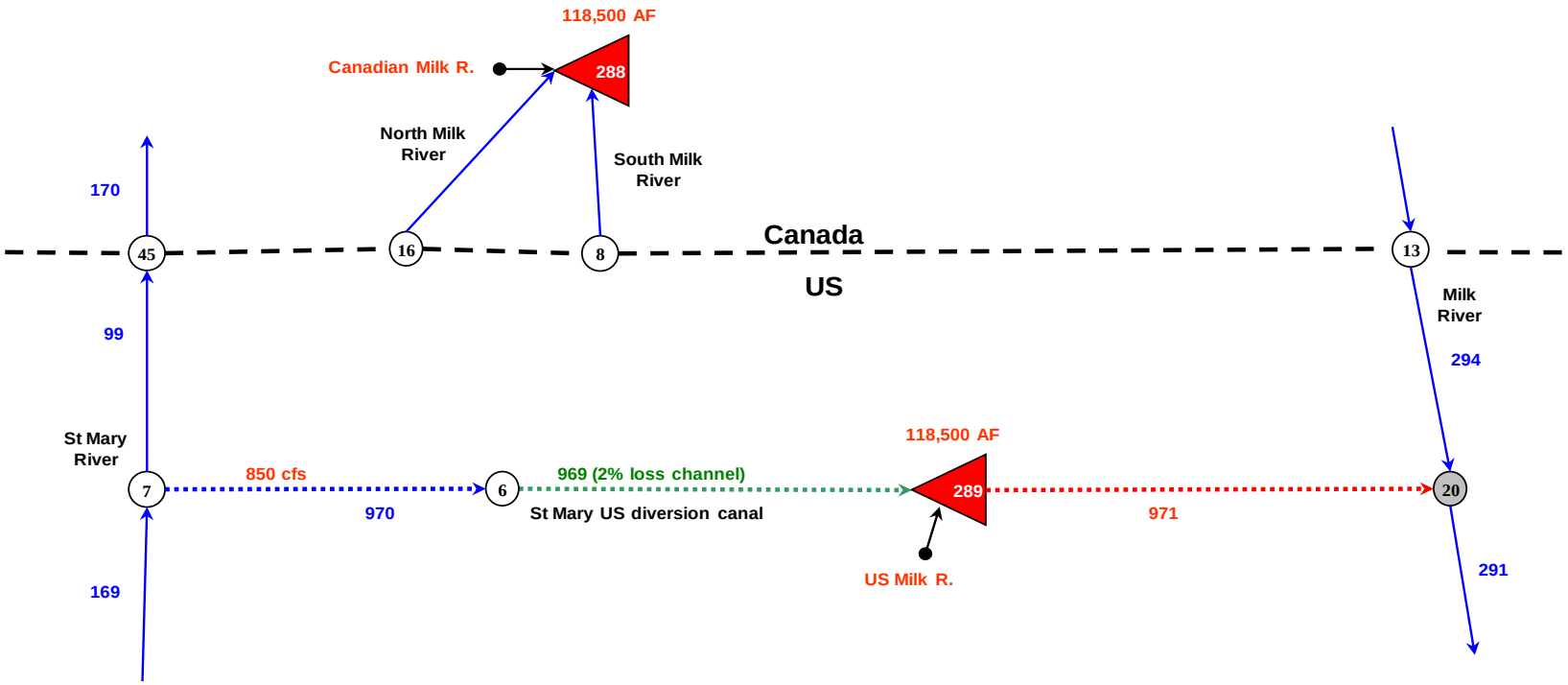
1-2.1 Milk River model schematic changes– Options 7 a,b,c

Canadian Milk River Reservoir
7a 122,000 ac-ft
7b 188,000 ac-ft
7c 237,000 ac-ft



1-2.2 Milk River model schematic changes– Options 8a

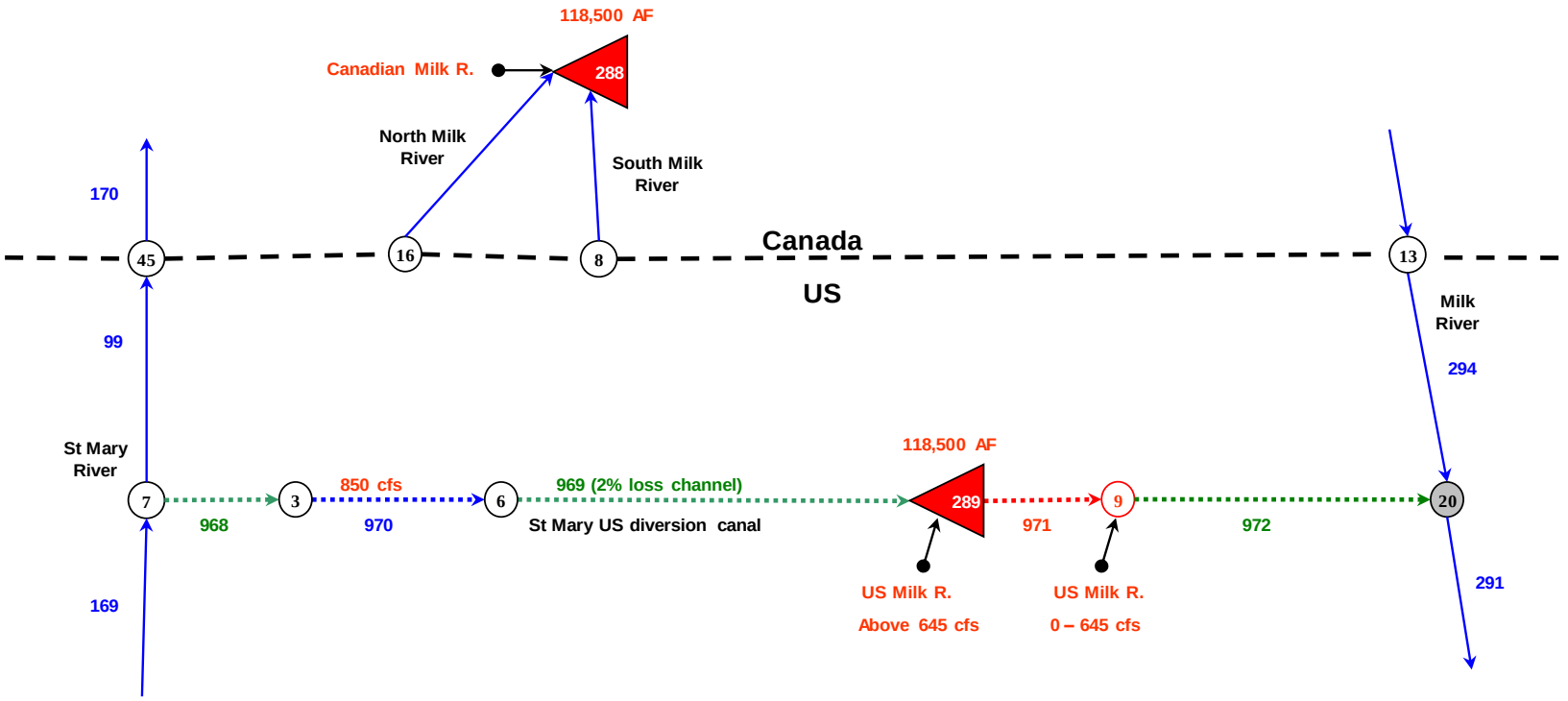
237,000 ac-ft Canadian Milk River Res. shared equally
Canadian share of Milk River into Canadian Reservoir
US share of Milk River and US canal into US Reservoir



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

1-2.3 Milk River model schematic changes– Options 8b

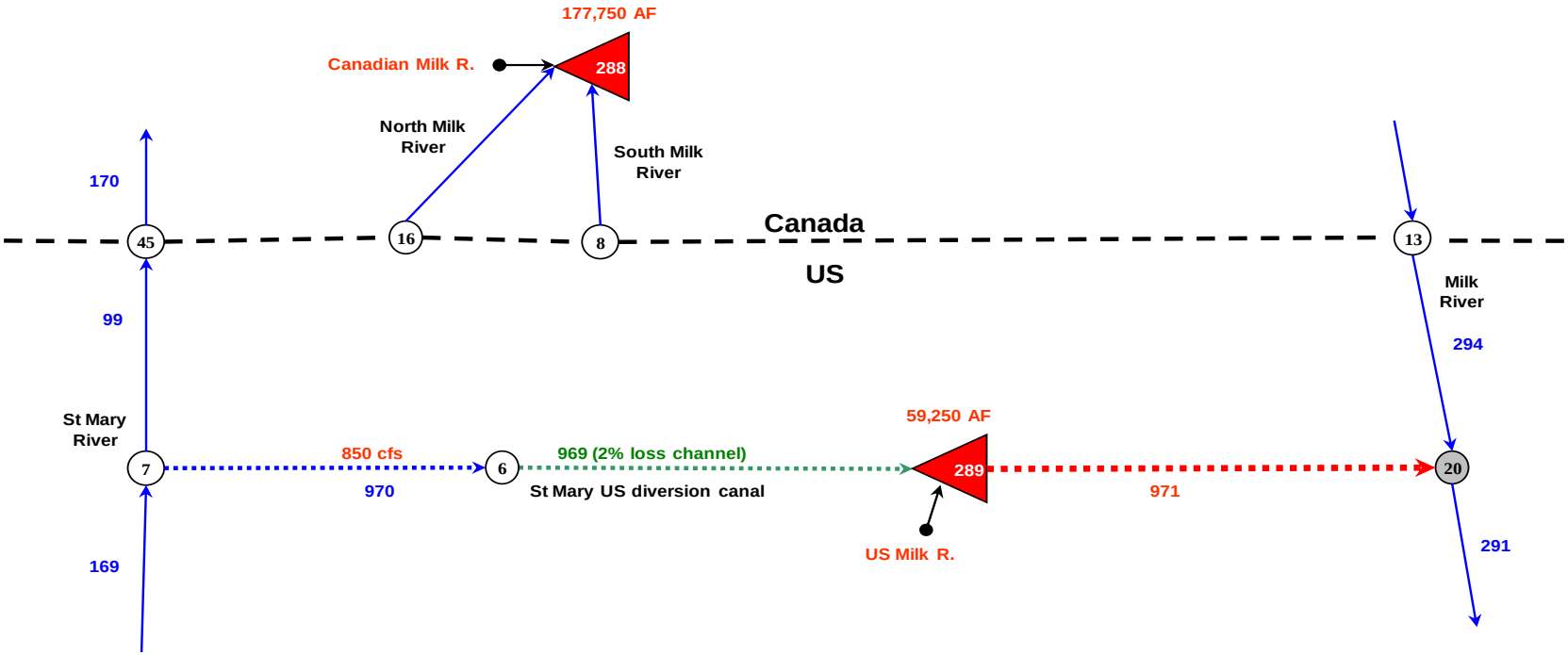
237,000 ac-ft Canadian Milk River Res. shared equally
Canadian share of Milk River into Canadian Reservoir
US share of Milk River above 645 cfs into US Reservoir



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

1-2.4 Milk River model schematic changes– Options 8c

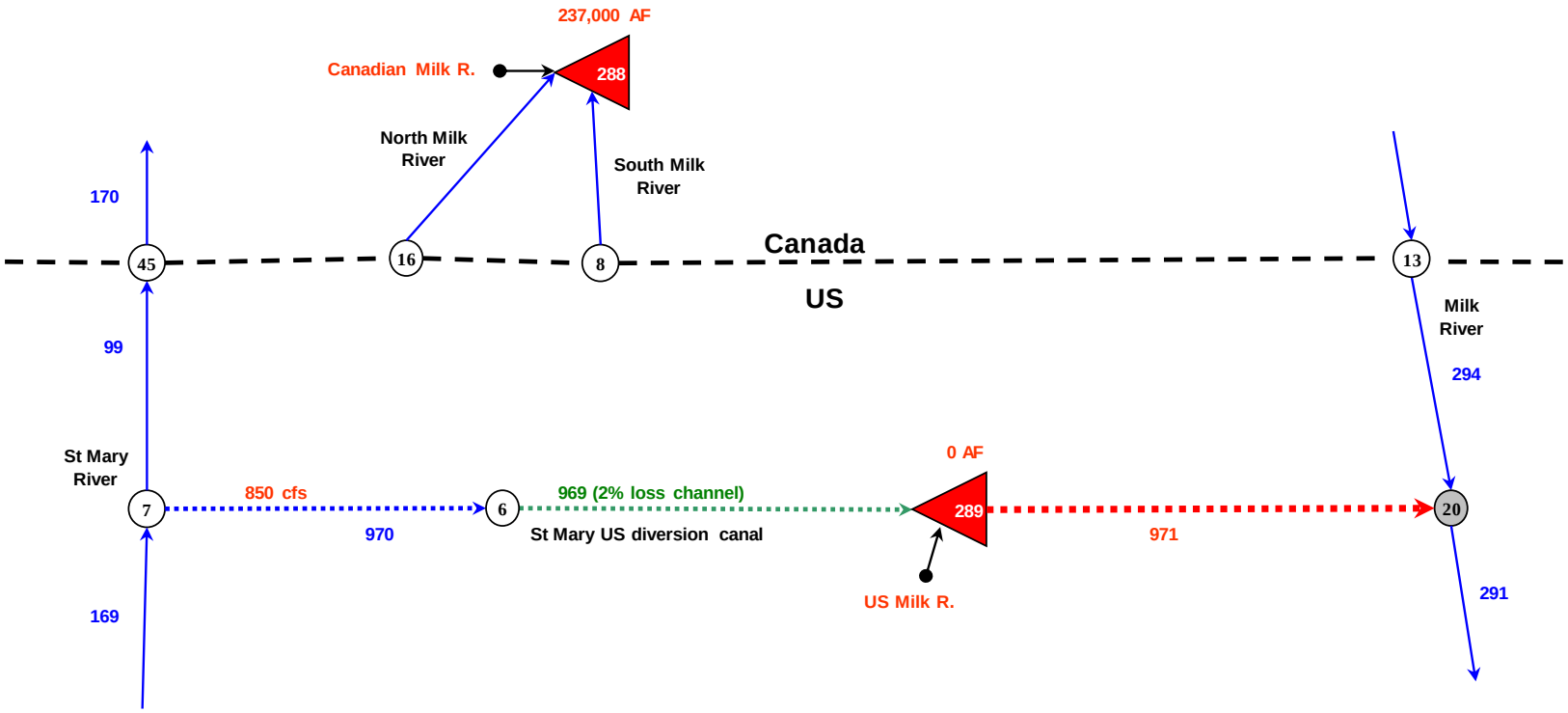
237,000 ac-ft Canadian Milk River Res. (AB75% MT/25%)
Canadian share of Milk River into Canadian Reservoir
US share of Milk River and US canal into US Reservoir



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

1-2.5 Milk River model schematic changes– Options 8d

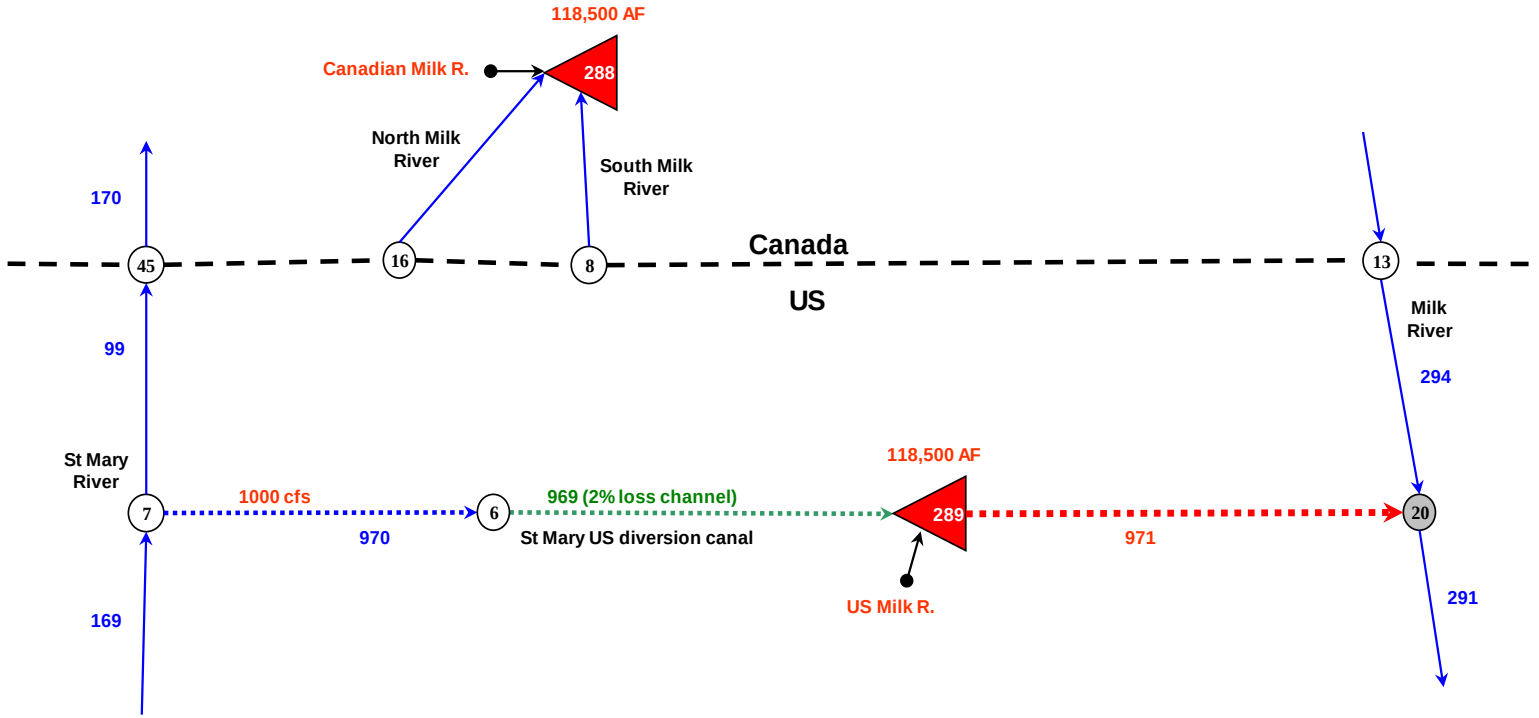
237,000 ac-ft Canadian Milk River Reservoir
Canadian share of Milk River into Canadian Reservoir



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

1-2.6 Milk River model schematic changes– Options 8e

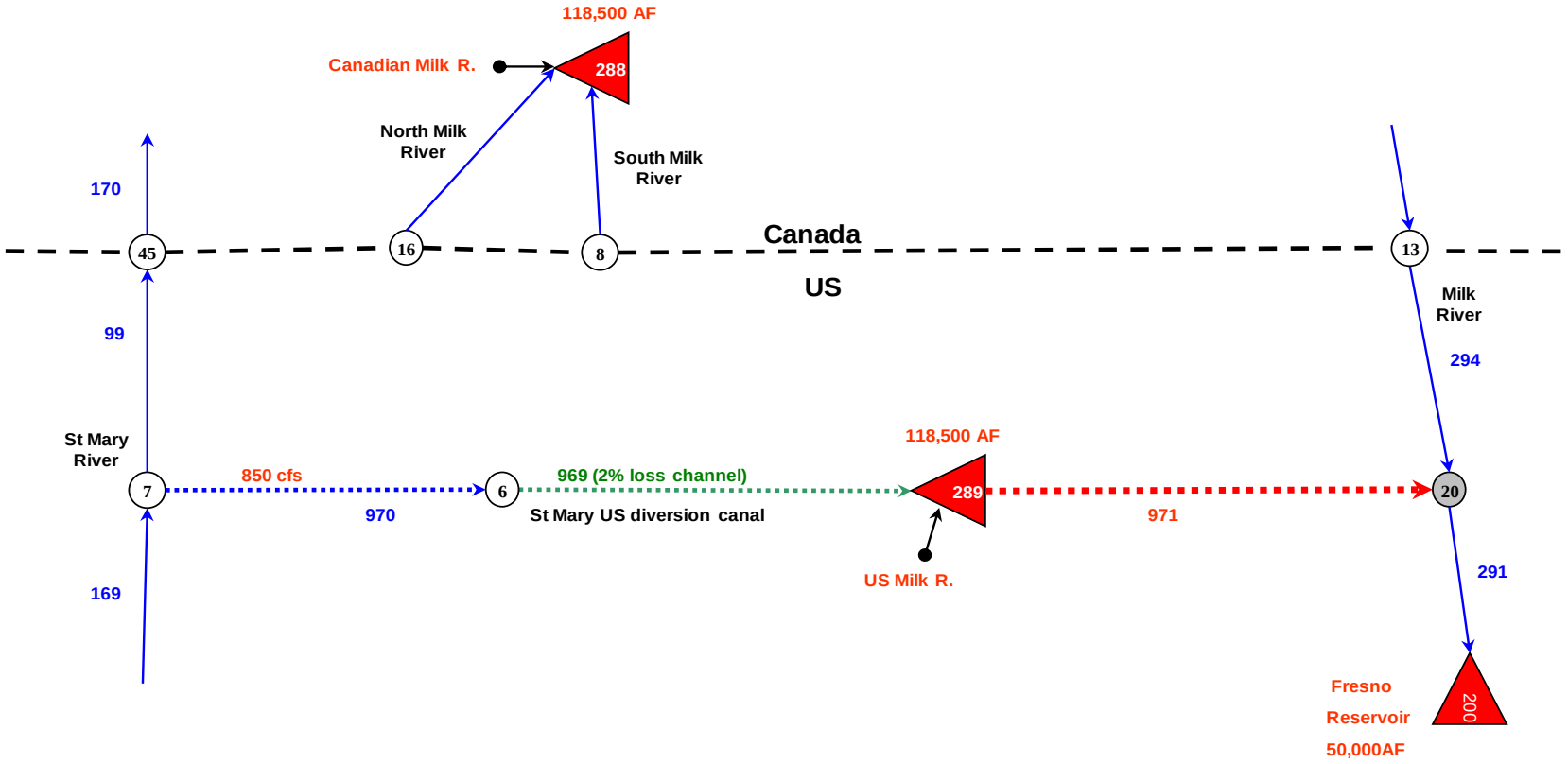
237,000 ac-ft Canadian Milk River Res. shared equally
Canadian share of Milk River into Canadian Reservoir
US share of Milk River and US canal into US Reservoir



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

1-2.7 Milk River model schematic changes– Options 8f

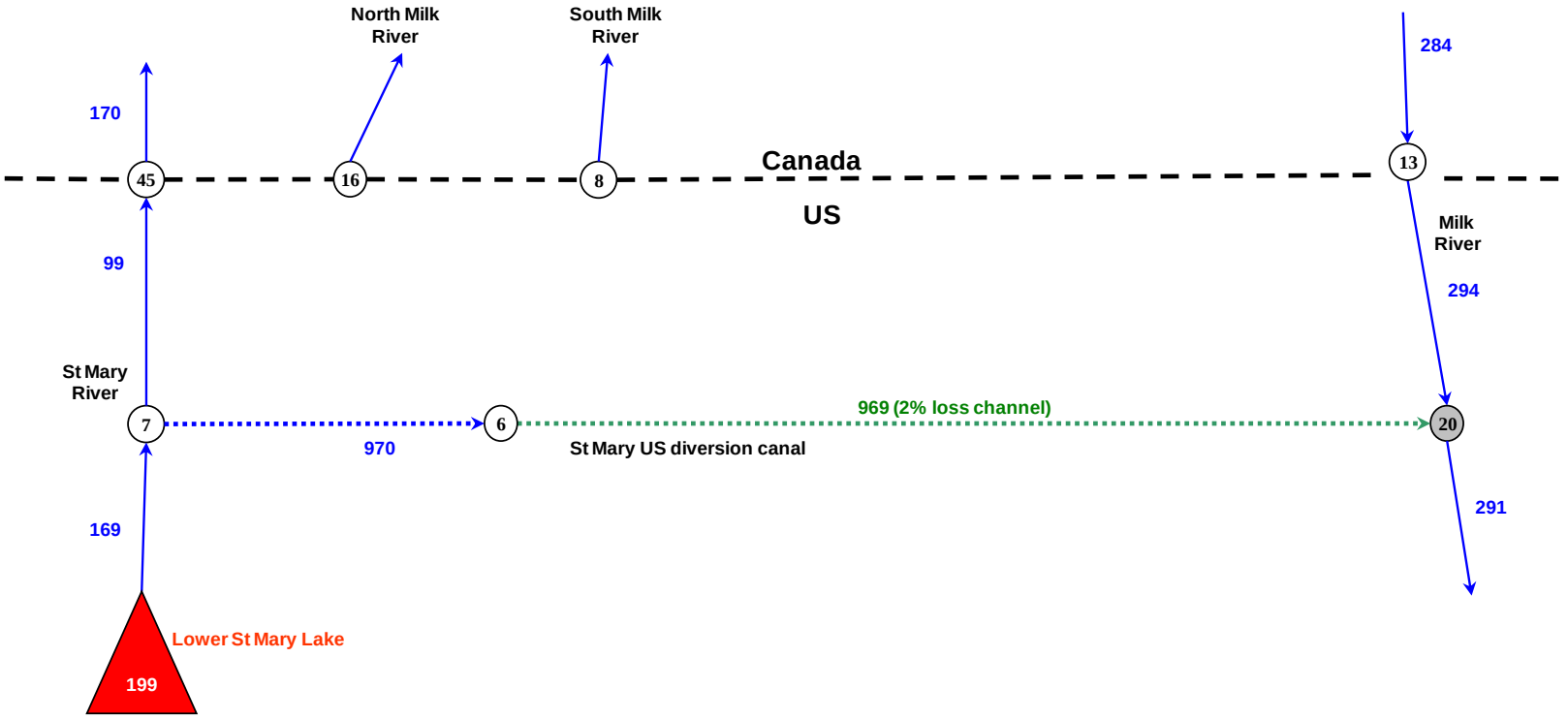
237,000 ac-ft Canadian Milk River Res. shared equally
Canadian share of Milk River into Canadian Reservoir
US share of Milk River and US canal into US Reservoir
Fresno Storage 50,000 ac-ft



Note: Shared Canadian Milk River Reservoir was divided into a Canadian and a US portion for modelling purpose

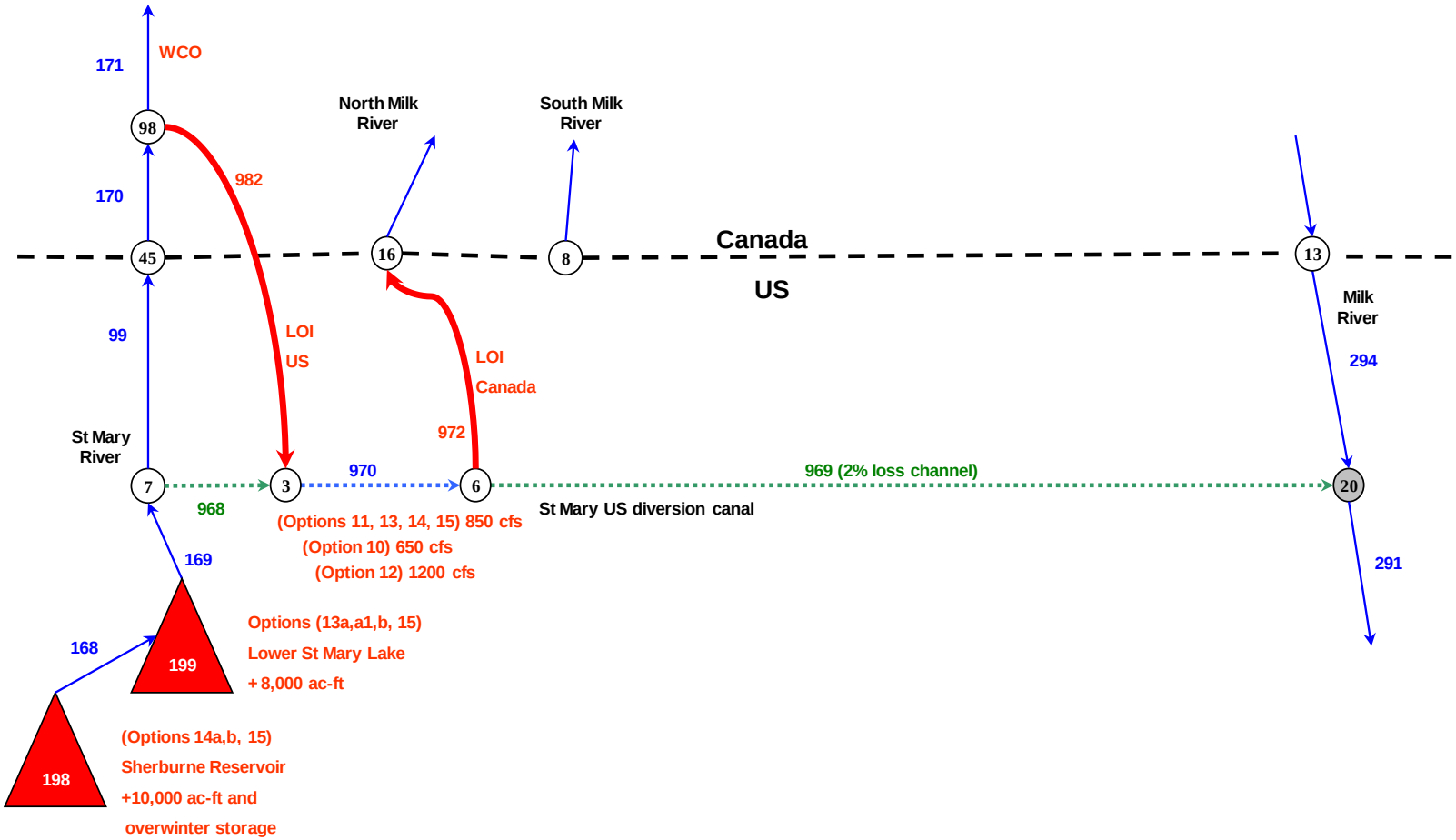
1-2.8 Milk River model schematic changes– Options 9

Adequate Lower St Mary Lake storage for Montana to access 100% of its St Mary River entitlement



1-2.9 Milk River model schematic changes– Options 10 a,b - 15 a,b

US takes an additional 8,000 ac-ft (a) or 20,000 ac-ft (b) from Mar. 1 to June 30
Canada takes an additional 4,000 ac-ft (a) or 10,000 ac-ft (b) from Jul. 1 to Dec. 31

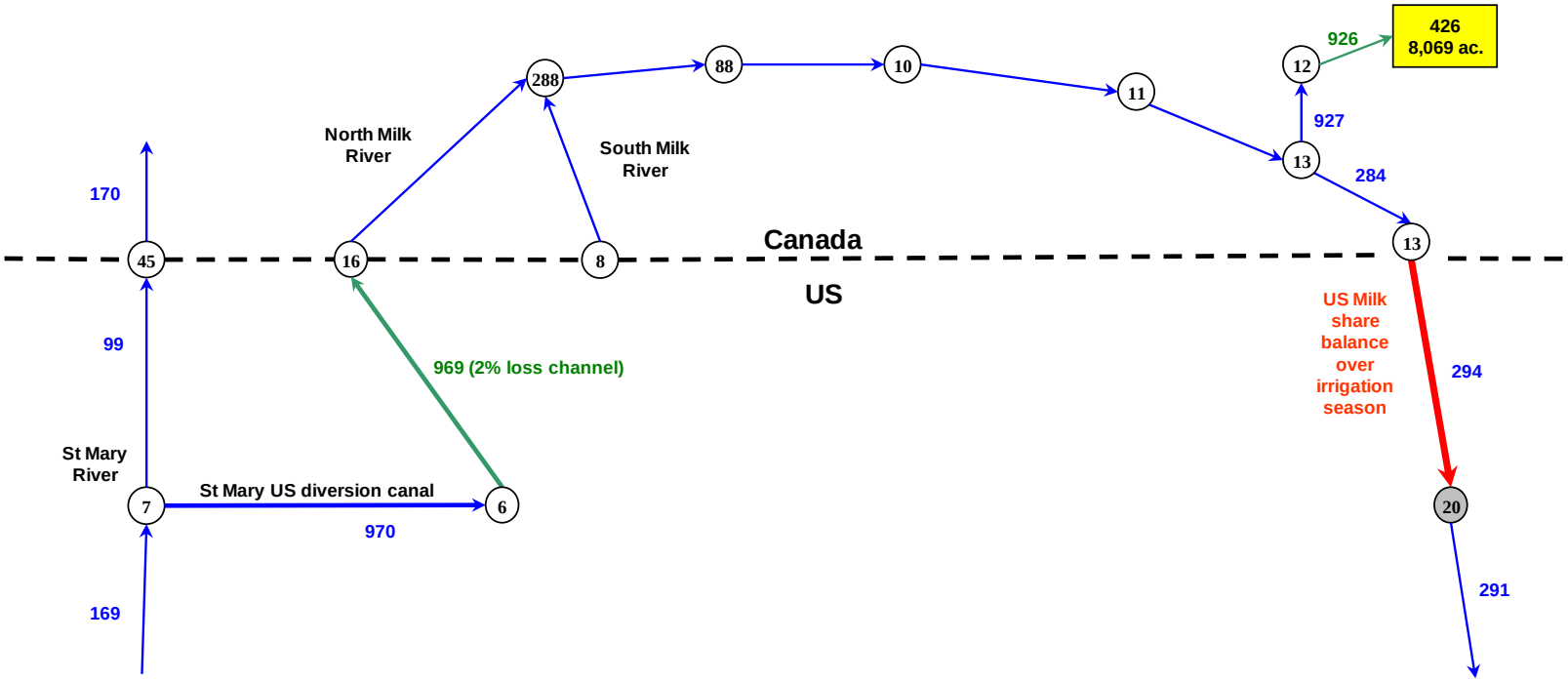


1-2.10 Milk River model schematic changes– Options 16 a,c

Balance over Irrigation Season (1 April – 31 October)

No Canadian access to US St Mary Canal water (16a)

With Canadian access to US St Mary Canal water (16c)

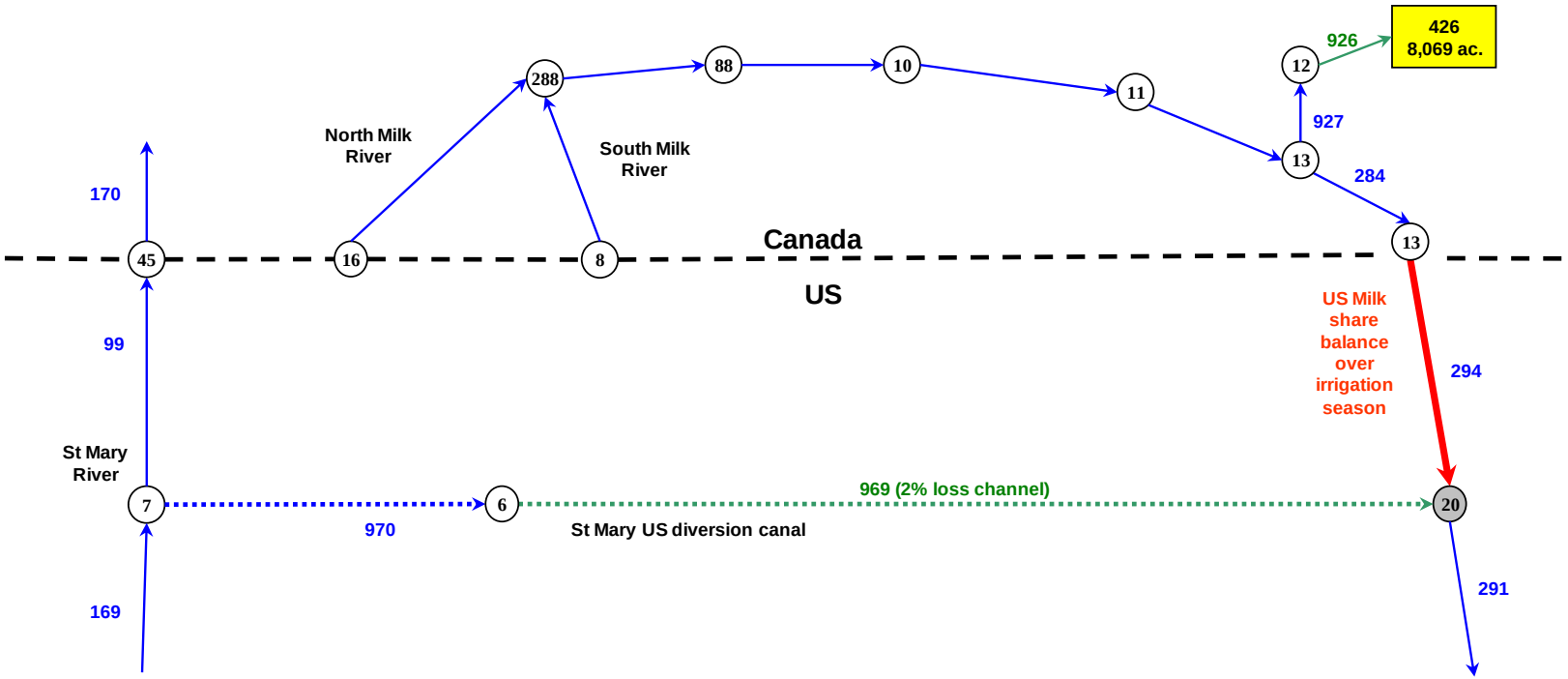


1-2.11 Milk River model schematic changes– Options 16 b,d

Annual (November 1 - October 31) Balance

No Canadian access to US St Mary Canal water (16b)

With Canadian access to US St Mary Canal water (16d)

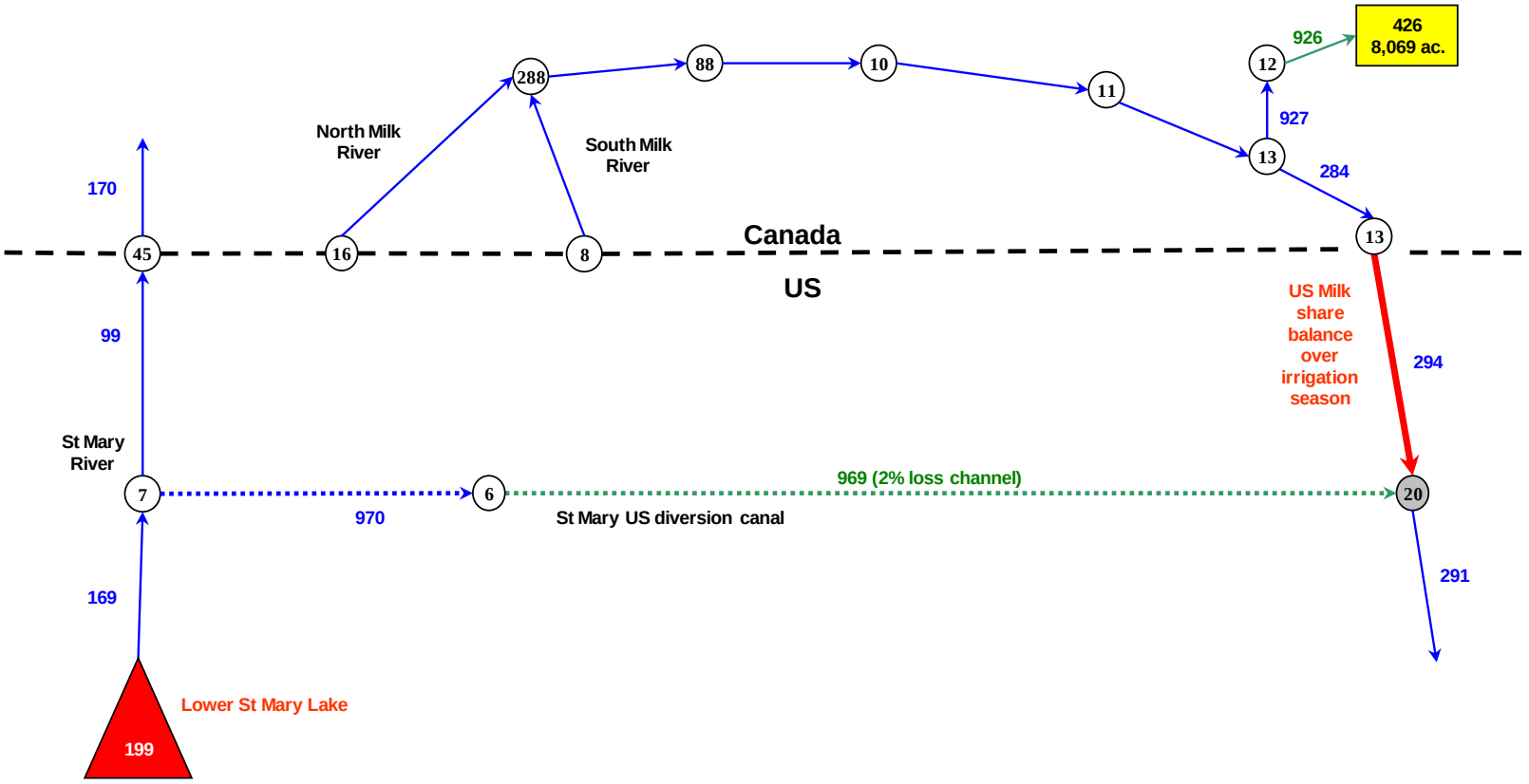


1-2.12 Milk River model schematic changes– Options 16 e

Annual (November 1 - October 31) Balance

With Canadian access to US St Mary Canal water

Additional storage at Lower St Mary Lake of 8,000 ac-ft



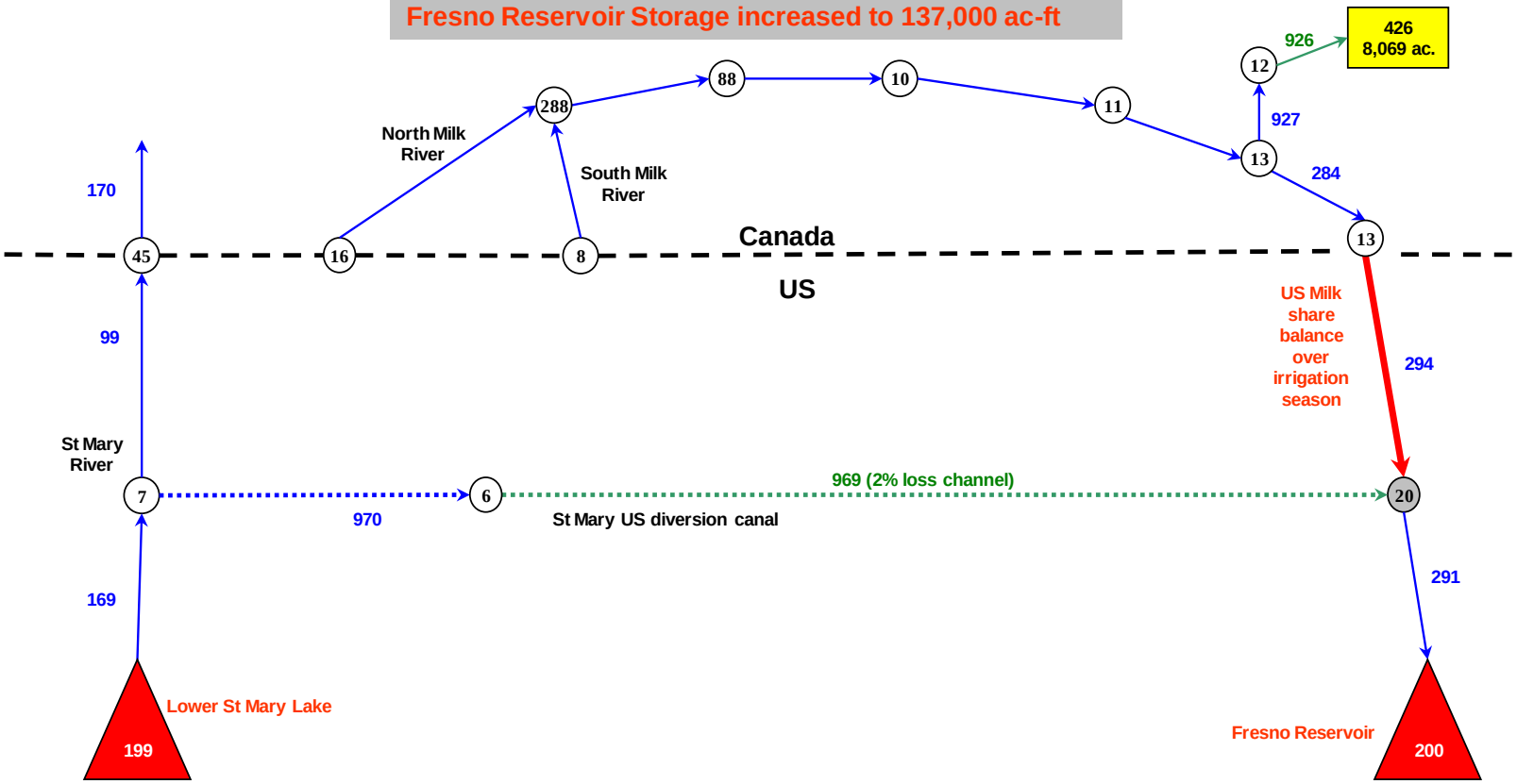
1-2.13 Milk River model schematic changes– Options 16 f

Annual (November 1 - October 31) Balance

With Canadian access to US St Mary Canal water

Additional storage at Lower St Mary Lake of 8,000 ac-ft

Fresno Reservoir Storage increased to 137,000 ac-ft



1-2.14 Milk River model schematic changes– Options 16 g

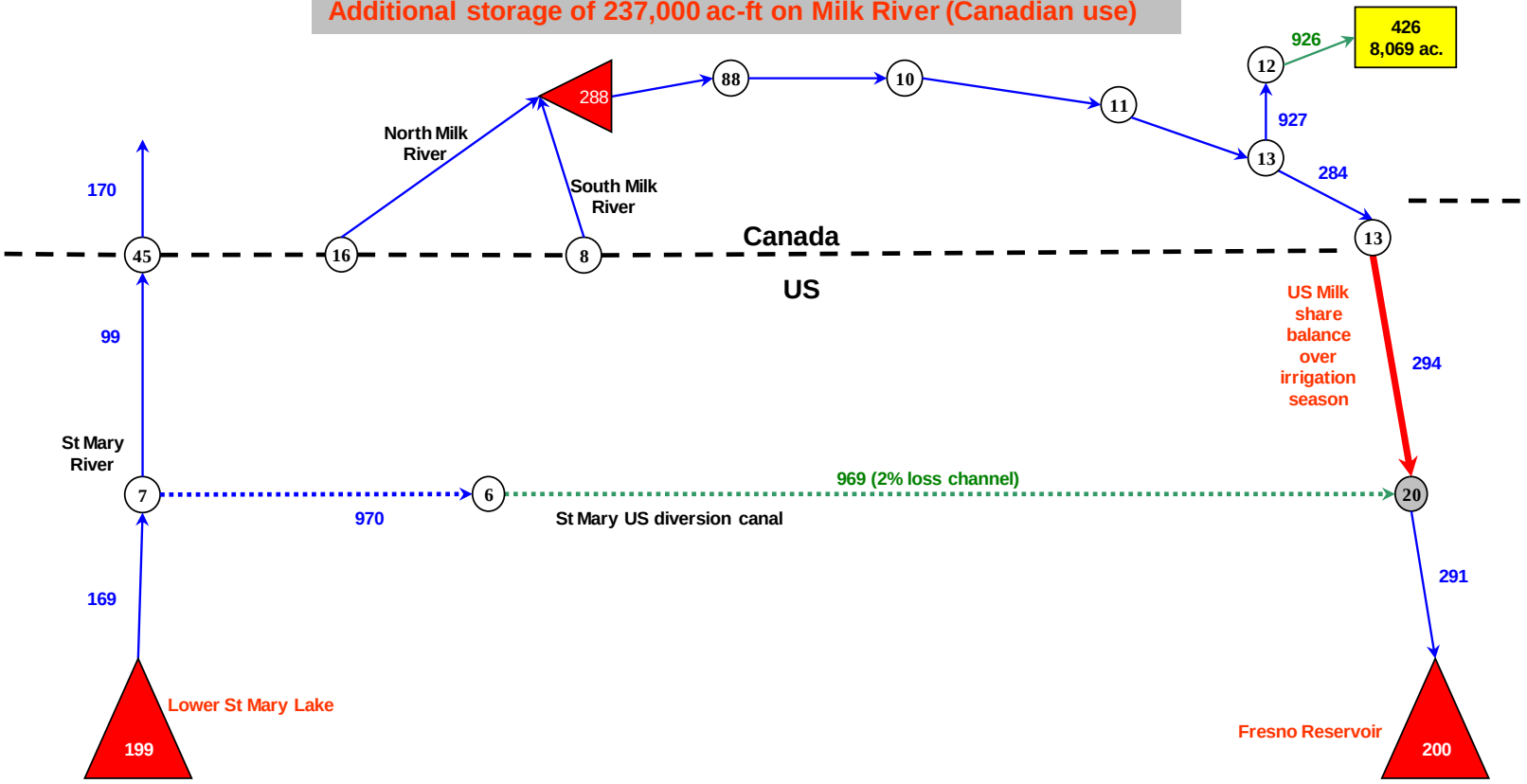
Annual (November 1 - October 31) Balance

With Canadian access to US St Mary Canal water

Additional storage at Lower St Mary Lake of 8,000 ac-ft

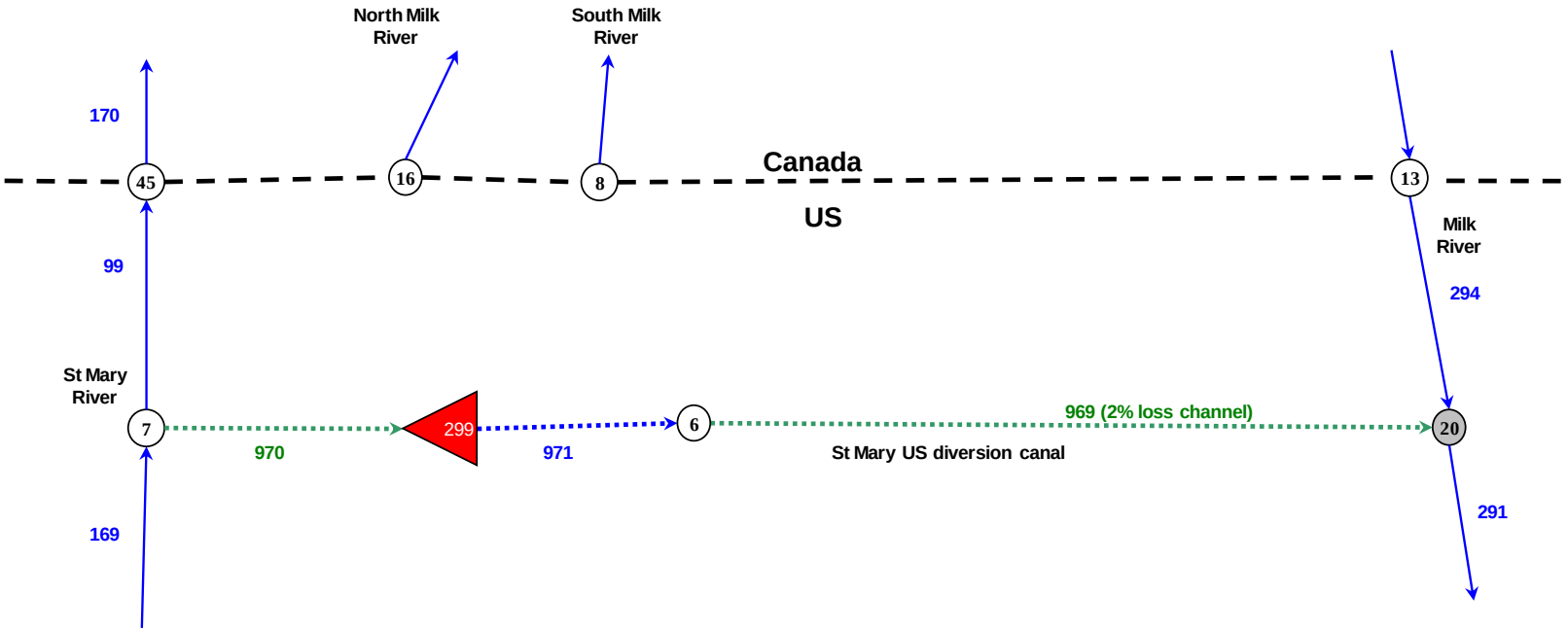
Fresno Reservoir Storage increased to 137,000 ac-ft

Additional storage of 237,000 ac-ft on Milk River (Canadian use)



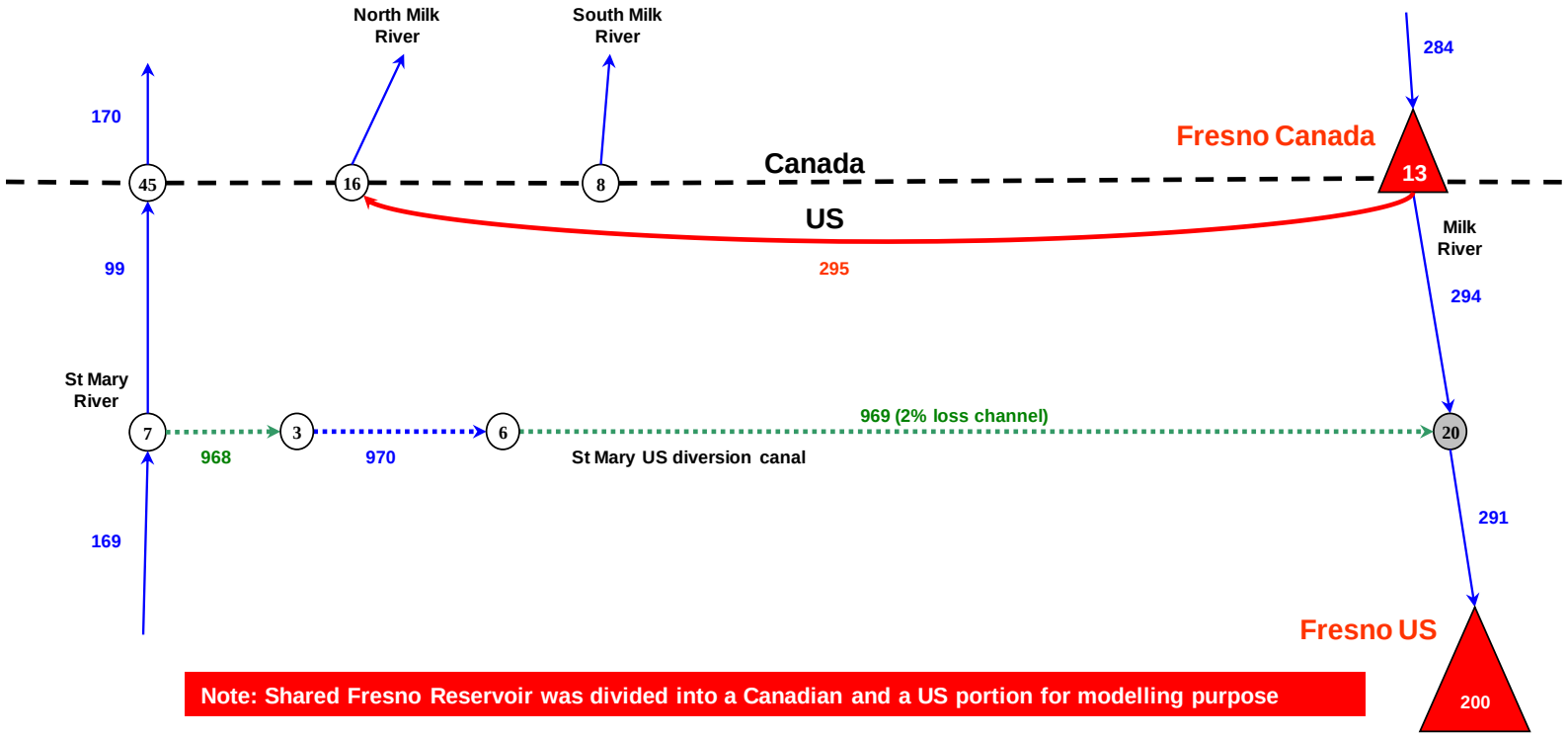
1-2.15 Milk River model schematic changes– Options 17 a,b,c

Off Stream storage on lower reaches of US St Mary Canal
(a) 5,000 ac-ft
(b) 10.000 ac-ft
(c) Adequate for US to access its entitlement of St Mary River



1-23.16 Milk River model schematic changes– Options 18 a,b

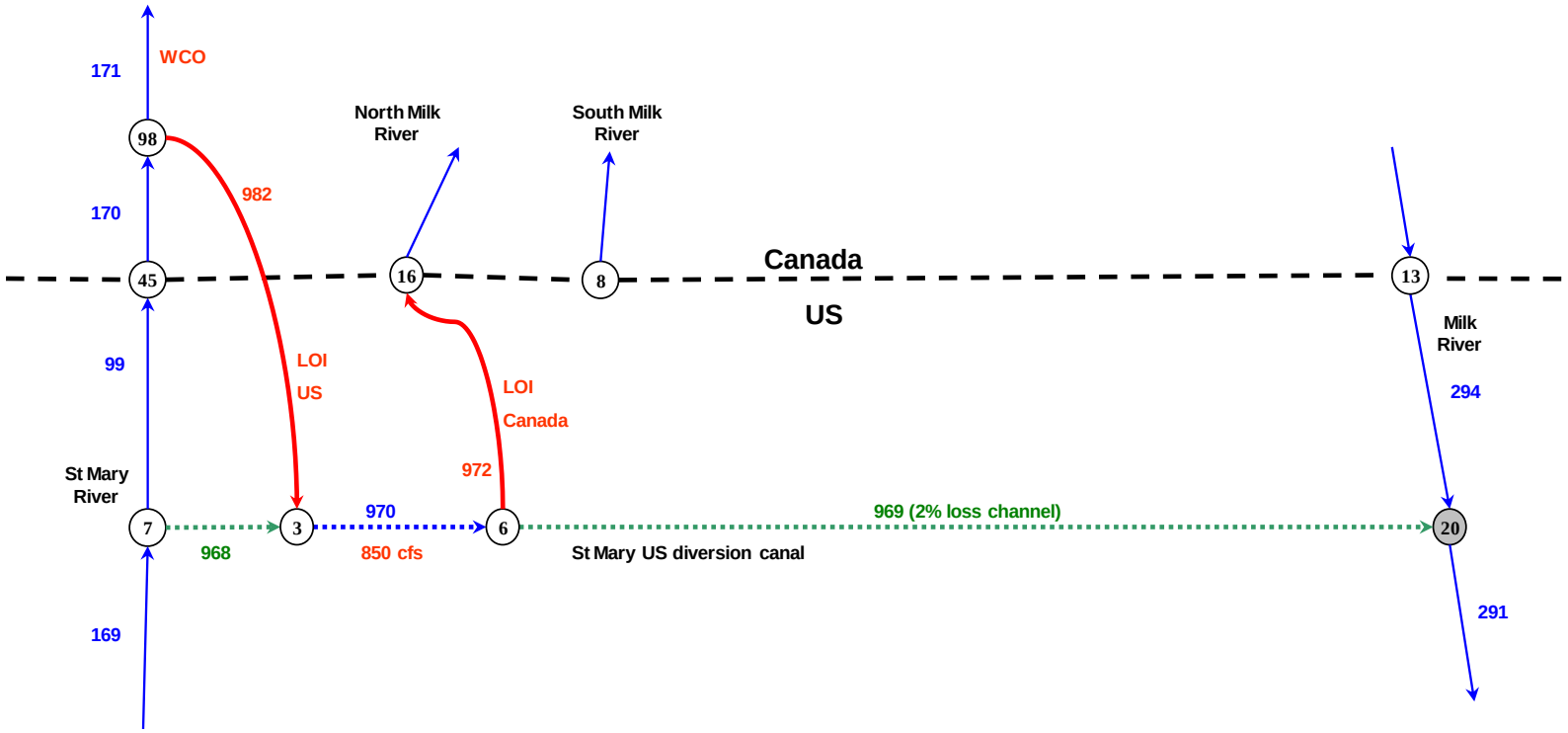
Shared 137,000 ac-ft Fresno Reservoir
US portion 110,000 ac-ft
Canada's portion 27,000 ac-ft
Option 18a, proportionally shared reservoir drawdown
Option 18b, drawdown from US reservoir drawdown



Note: Shared Fresno Reservoir was divided into a Canadian and a US portion for modelling purpose

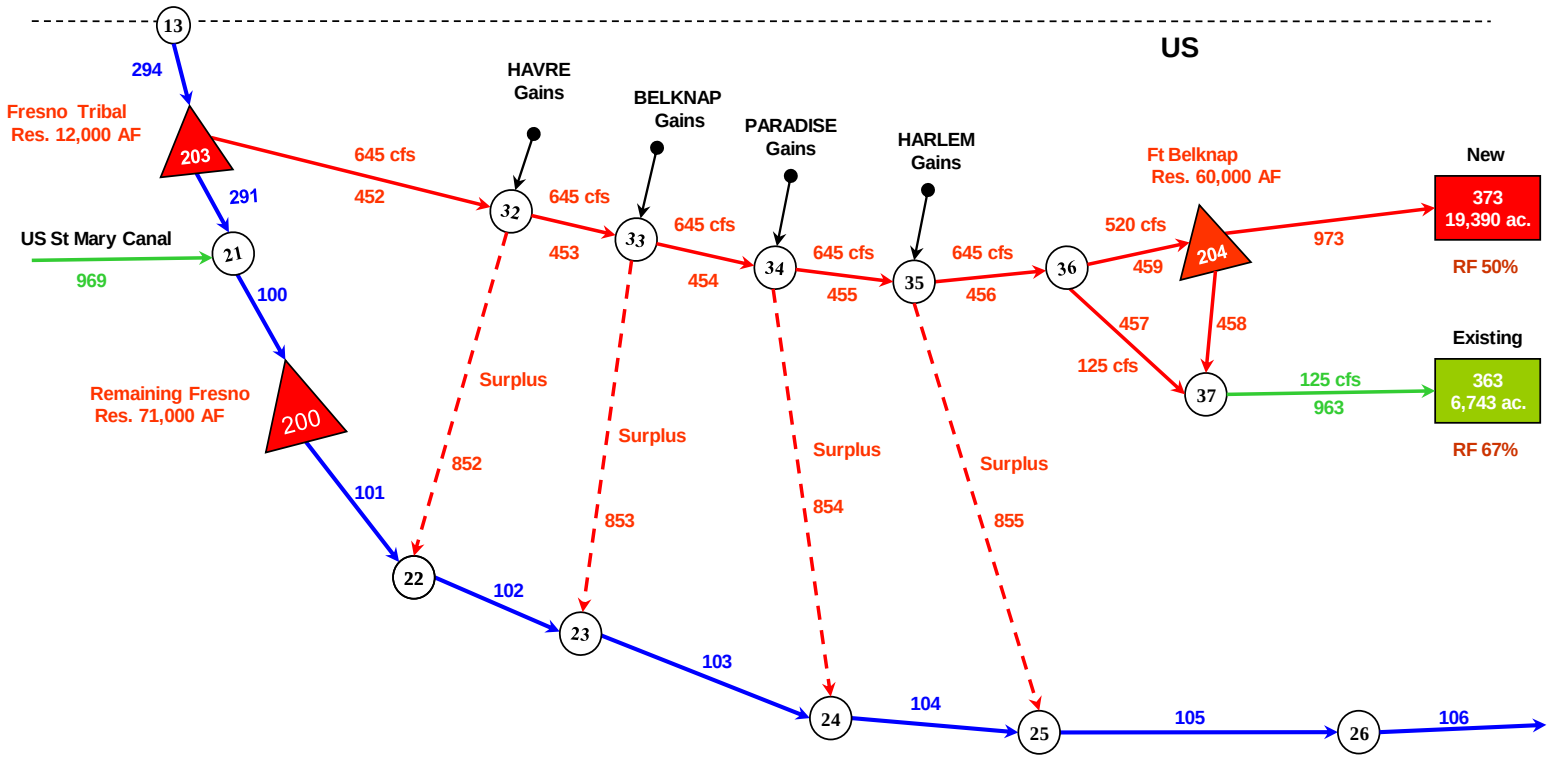
1-2.17 Milk River model schematic changes– Options 21d

Montana increased irrigation efficiency and LOI



1-2.18 Milk River model schematic changes– Options 22

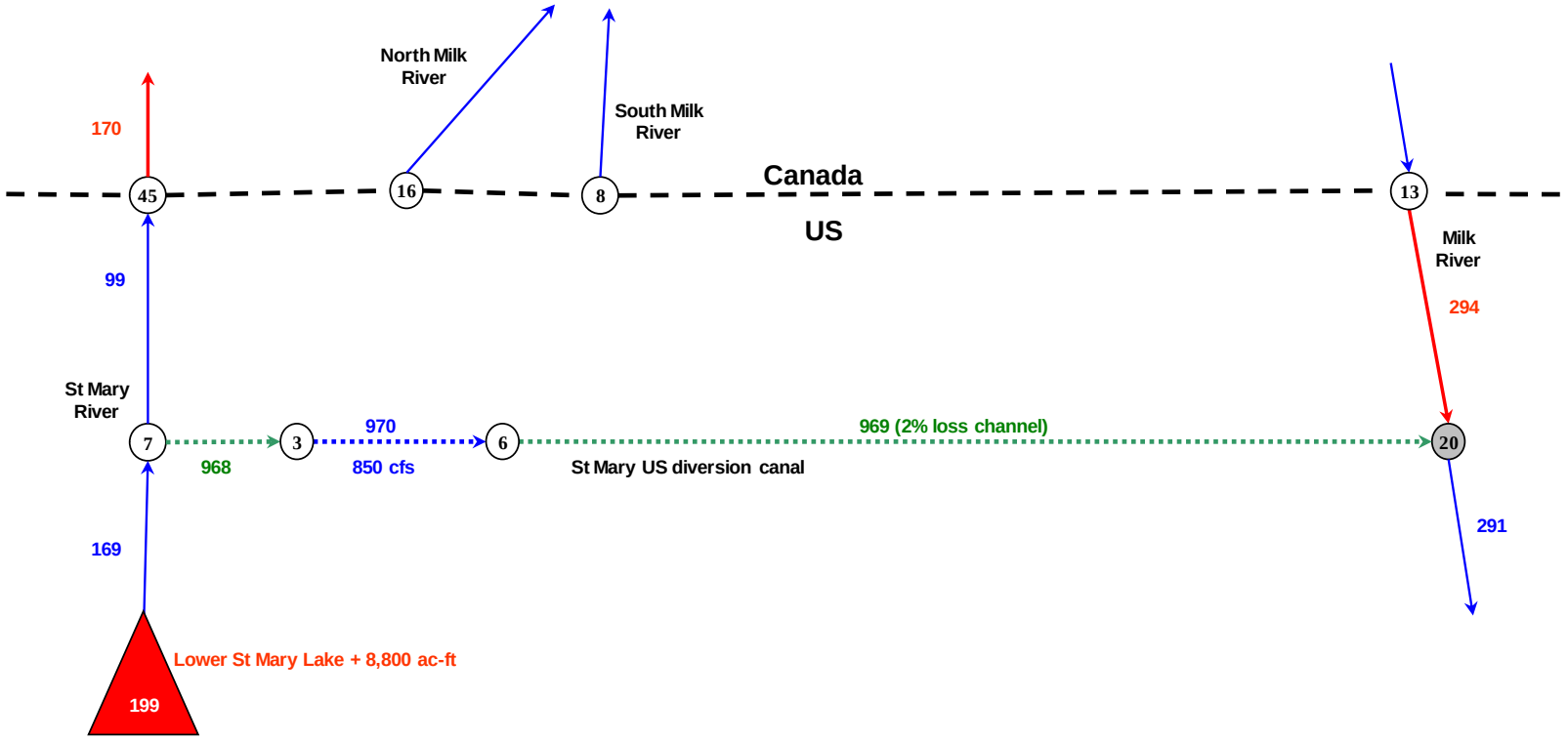
Tribal share of Fresno Reservoir 12,000 ac-ft
New 60,000 ac-ft reservoir on Fort Belknap Reservation
Reservation irrigation development (19,390 ac.)



Note: Shared Fresno Reservoir was divided into a Tribal and a non-tribal portion for modelling purpose

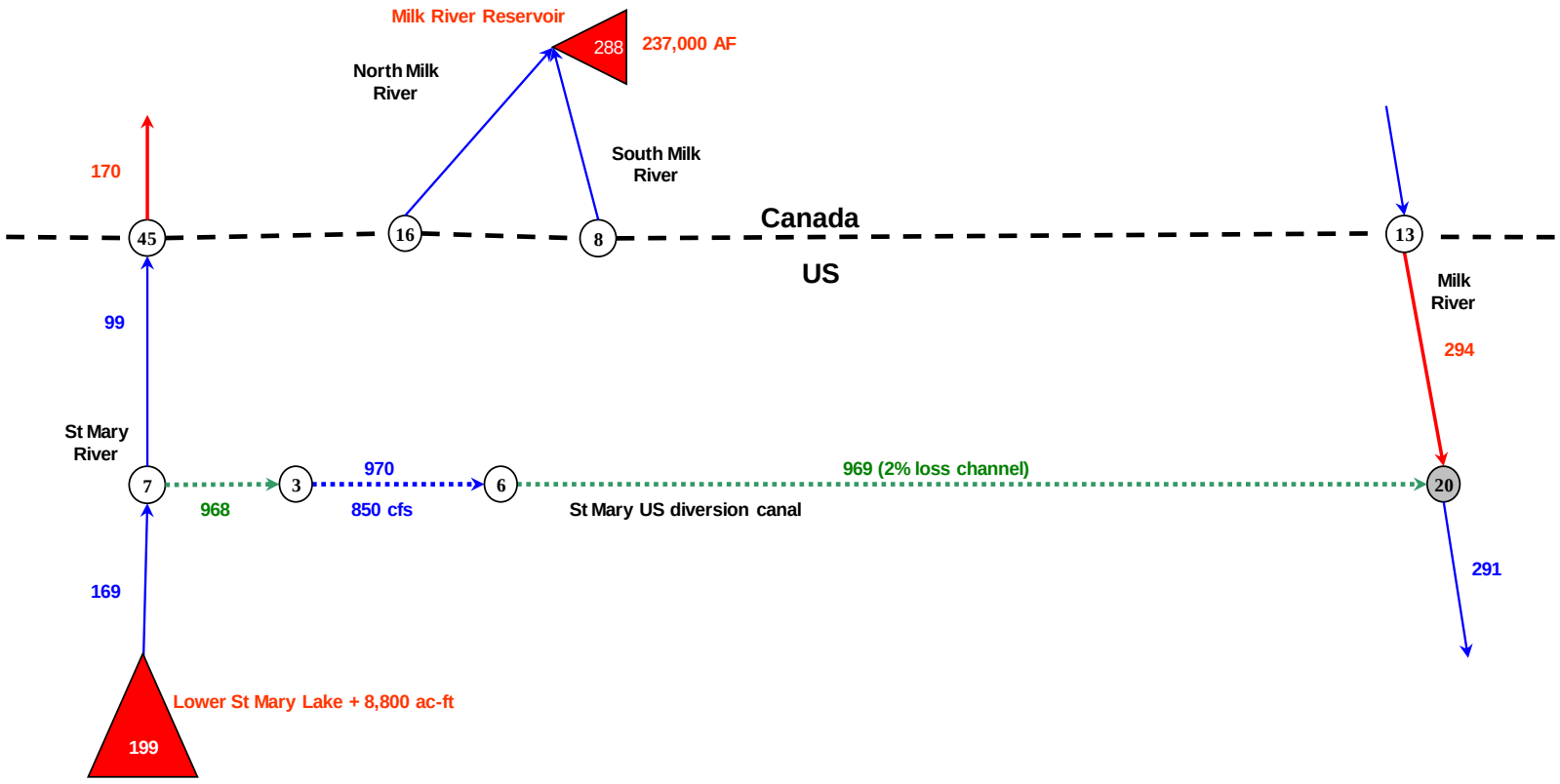
1-2.19 Milk River model schematic changes– Options 23c

Additional 8,800 ac-ft on Lower St Mary Lake
1st Modification of the 1921 Order



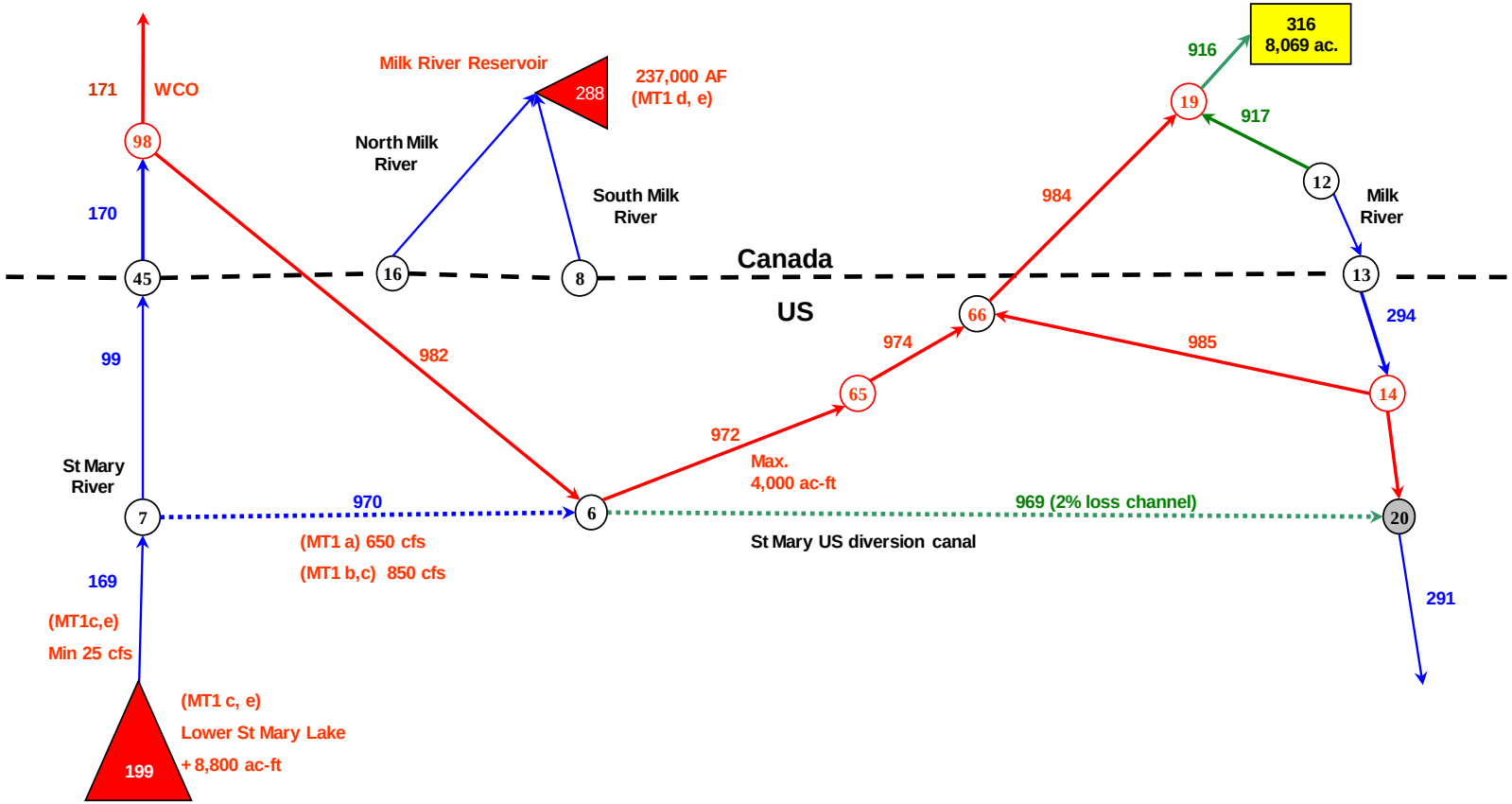
1-2.20 Milk River model schematic changes– Options 23d

Additional 8,800 ac-ft on Lower St Mary Lake
237,000 Alberta Milk Reservoir
1st Modification of the 1921 Order



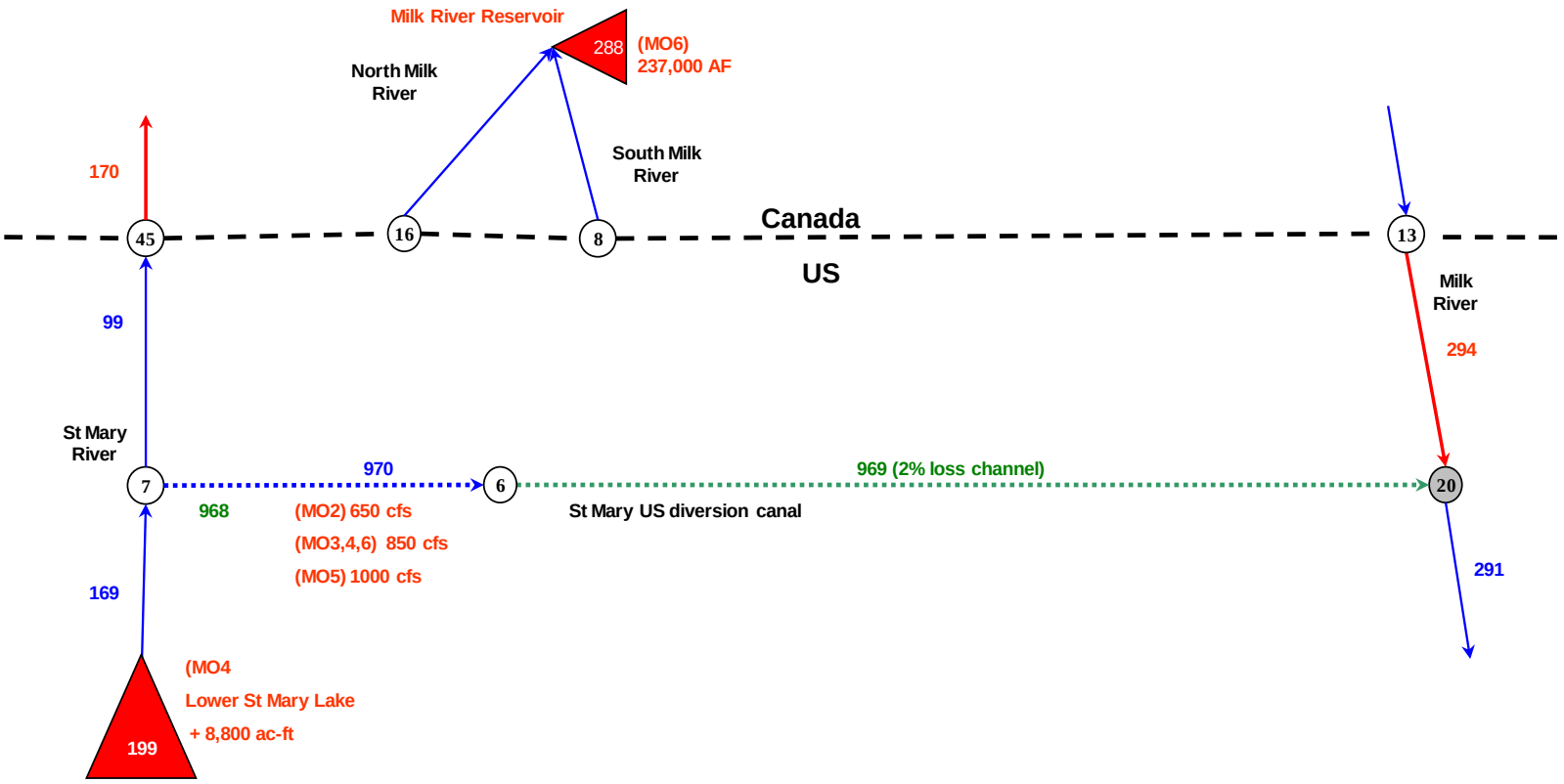
1-2.21 Milk River model schematic changes– Options MT1 a,b,c,d,e

US maximum credit 32,000 ac-ft
Canada maximum credit 16,000 ac-ft of which 4,000 ac-ft can be drawn from St Mary diversion and the balance directly from the Milk River



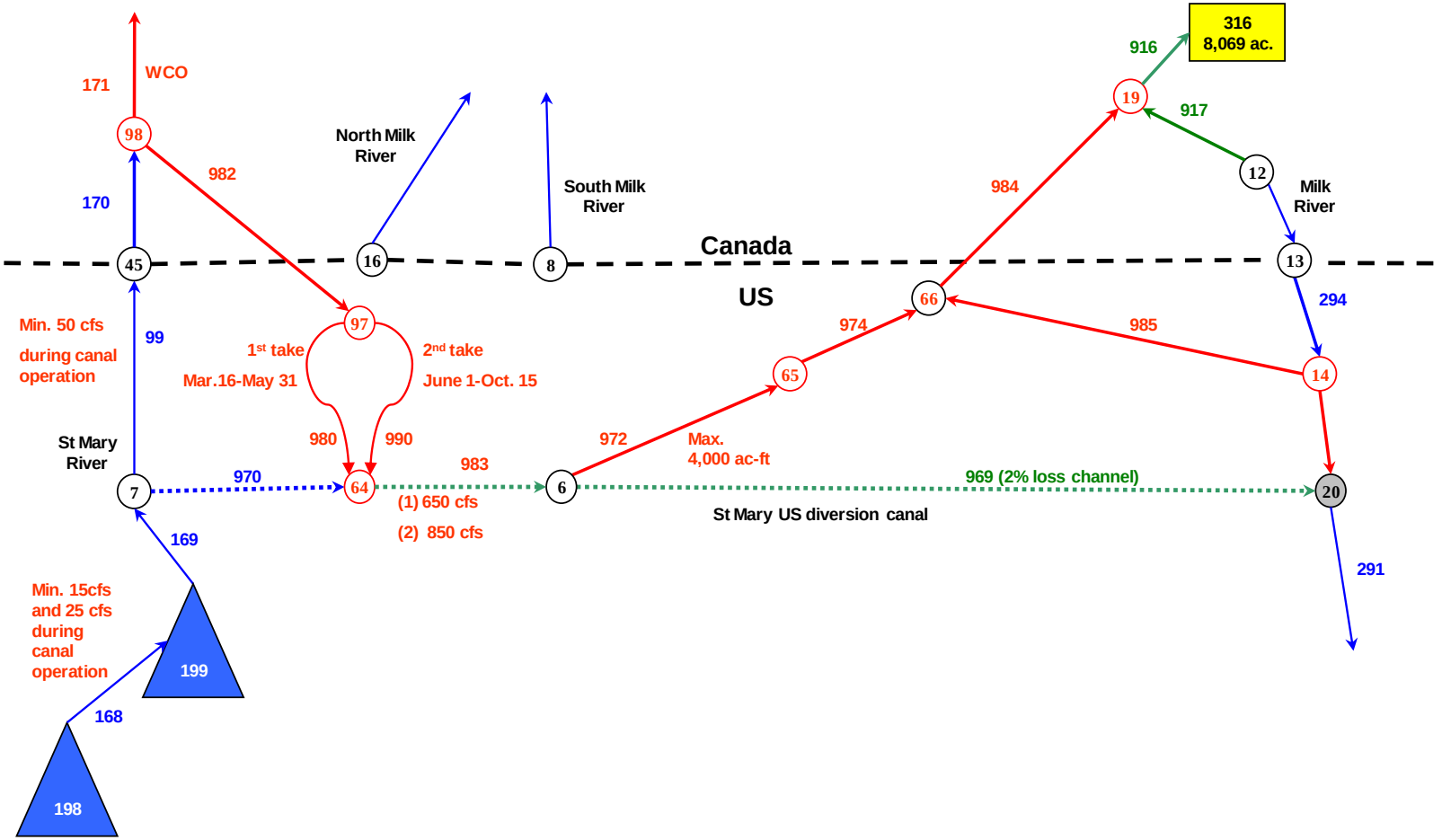
1-2.22 Milk River model schematic changes– Options MO2,3,4,5,6

Additional 8,800 ac-ft on Lower St Mary Lake
237,000 Alberta Milk Reservoir
2nd Modification of the 1921 Order



1-2.23 Milk River model schematic changes– Options CrSysLOICap1,2

Credit System with LOI Max. 32,000 ac-ft for the US and 16,000 ac-ft for Canada
Credit accumulated between Oct. 16 to May 31 and from June 1-Oct. 15 Milk River
Credit taken from Mar. 15 to Oct. 15



Appendix 2 – Irrigation Demand, Area, Consumptive Use (CU) and Return Flows

2-1 U.S. Milk River Basin Irrigation

2-2 Canada Milk River Basin Irrigation

2-3 Canada St. Mary River Basin Irrigation

2-1 U.S. Milk River Basin Irrigation

BLOCK #	Irrigation Category	Location	Area (acres)	45 Year Average Annual CU (inches)	Return Flow as fraction of Gross Diversion
309	Non-District	Milk River from Headwaters to Western Crossing of International Boundary	1,433	16.34	0.00
340	Phreatophytes	Milk River from Havre to Fort Belknap	860	25.32	0.00
341		Milk River from Fort Belknap to Paradise Valley	396	26.01	0.00
342		Milk River from Paradise Valley Irrigation District to Harlem Irrigation District	325	25.91	0.00
343		Milk River from Harlem Irrigation District to Fort Belknap Reservation	490	25.90	0.00
344		Milk River from Fort Belknap Reservation to Dodson	1,678	24.45	0.00
345		Milk River from Dodson to Vandalia	4,488	26.00	0.00
346		Milk River from Vandalia to Mouth	5,279	22.70	0.00
350	Non-District	Milk River from Fresno to Fort Belknap Irrigation District	2,667	17.17	0.55
351		Milk River from Fort Belknap Irrigation District to Paradise Valley Irrigation District	1,231	17.17	0.55
352		Milk River from Paradise Valley Irrigation District to Harlem Irrigation District	839	17.17	0.55
353		Milk River from Harlem Irrigation District to Fort Belknap Reservation Irrigation Project	150	17.17	0.55
354		Milk River from Fort Belknap Reservation Irrigation Project to Malta Irrigation District	3,381	16.85	0.55
355		Milk River from Malta Irrigation District to Cree Crossing	1,991	16.85	0.55
356		Milk River from Cree Crossing to Glasgow Irrigation District	7,782	17.33	0.55
357		Milk River from Glasgow Irrigation District to Mouth	5,419	17.46	0.55
360	District	Fort Belknap Irrigation District	20,381	17.17	0.67
361		Paradise Valley Irrigation District	9,573	17.17	0.67
362		Harlem Irrigation District	10,316	17.17	0.67
363		Fort Belknap Reservation Irrigation Project	6,743	19.39	0.67
364		North Malta Irrigation District	10,000	14.46	0.67
365		Upper Malta Irrigation District	18,120	14.46	0.67
366		Lower Malta Irrigation District	18,745	15.74	0.67
367		Glasgow Irrigation District	19,704	17.46	0.62

2-2 Canada Milk River Basin Irrigation

BLOCK #	Irrigation Category	Location	Area (acres)	45 Year Average Annual CU (inches)	Return Flow as fraction of Gross Diversion
310	Non-District	North Milk River from International Boundary to confluence with Milk River	1,249	10.18	0.00
311		Milk River from International Boundary to confluence with North Milk River	89	10.56	0.00
312		Milk River from confluence with North Milk River to Potential Ridge Canal Junction	961	12.91	0.00
313		Milk River from Potential Ridge Canal Junction to Town of Milk River	710	13.15	0.00
314		Milk River from Town of Milk River to Writing on Stone Provincial Park	2,115	12.93	0.00
315		Milk River from Writing on Stone Provincial Park to Kennedy Creek Confluence	619	13.63	0.00
316		Milk River from Kennedy Creek Confluence to International Boundary	2,327	13.78	0.00

2-3 Canada St. Mary River Basin Irrigation

(Does not include Irrigation Blocks on Waterton and Belly River Sub-basins)

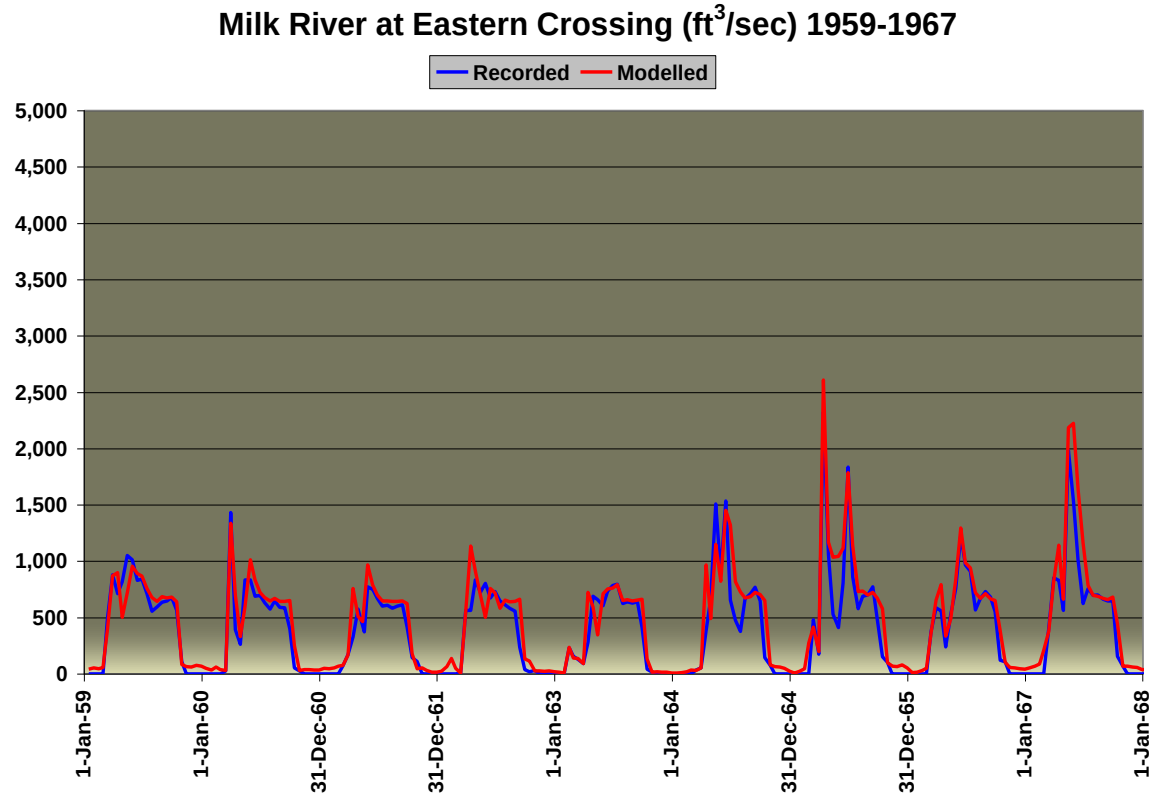
BLOCK #	Irrigation Category	Location	Area (acres)	45 Year Average Annual CU (inches)	Return Flow as fraction of Gross Diversion
668	Non-District	St. Mary River from International Boundary to St. Mary Reservoir (Senior)	210	12.91	0.00
669		St. Mary River off St. Mary Reservoir (Senior)	2,424	12.57	0.00
646		St. Mary River from St. Mary Reservoir to Mouth (Junior)	52	12.72	0.00
670		St. Mary River from St. Mary Reservoir to Mouth (Senior)	2,140	12.72	0.00
390	St. Mary Project Irrigation District	Magrath	18,300	17.49	Variable for every Time Interval, depending on Soil Moisture condition, Equipment and Timing of Irrigation Application
395		Verdigris Coulee	3,309	13.63	
391		Raymond	46,500	13.55	
380		St. Mary River above Chin Reservoir (1)	10,707	15.72	
381		St. Mary River above Chin Reservoir (2)	65,431	12.96	
382		St. Mary River above Chin Reservoir (3)	59,063	12.24	
392		Taber above Fincastle Lake	29,554	12.99	
393		Taber below Fincastle Lake	20,653	14.21	
394		Taber above Horsefly Reservoir	31,995	14.57	
396		St. Mary River below Stafford Reservoir (1)	13,131	16.76	
383		St. Mary River below Stafford Reservoir (2)	20,749	15.48	
384		St. Mary River below Grassy and Yellow Lakes	24,795	13.04	
385		St. Mary River above Forty Mile Reservoir	31,743	12.57	
386		St. Mary River below Forty Mile Reservoir (1)	24,036	12.53	
387		St. Mary River below Forty Mile Reservoir (2)	47,598	12.88	
388		St. Mary River below Sauder Reservoir	48,131	15.11	
389		St. Mary River below Murray Reservoir	23,305	16.45	

Appendix 3 – Calibration Run Results: Upper Milk River

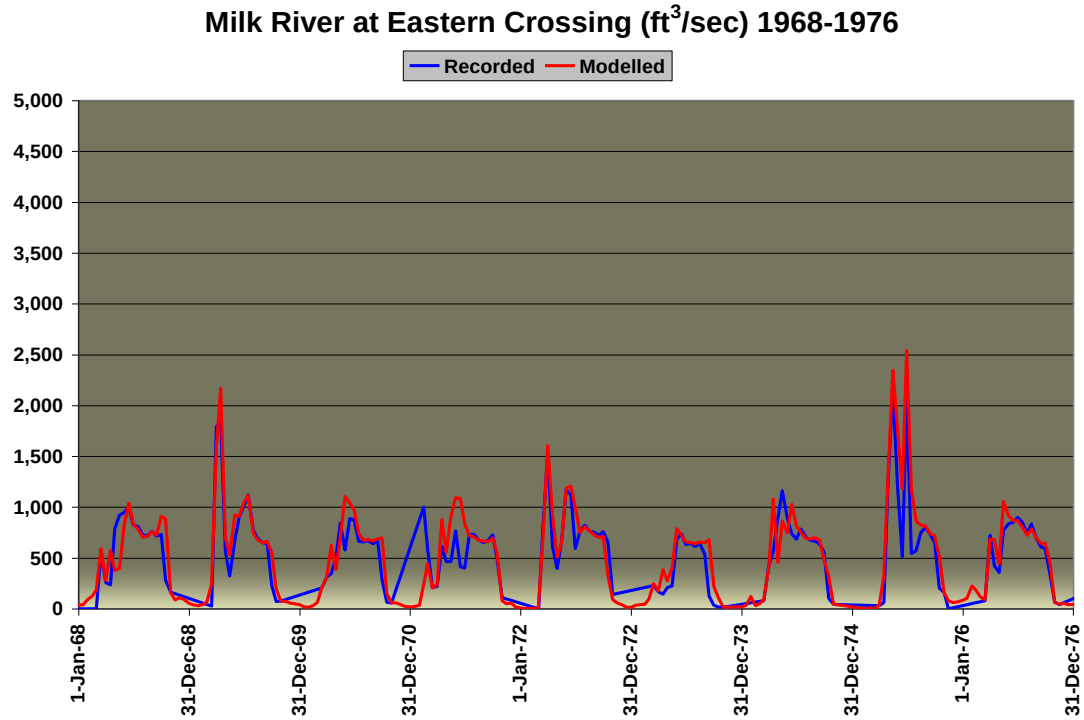
3-1 Milk River Flow at Eastern Crossing:

- **3-1.1 (1959 – 1967)**
- **3-2.2 (1968 – 1976)**
- **3-3.3 (1977 – 1985)**
- **3-4.4 (1986 – 1994)**
- **3-5.5 (1995 – 2003)**

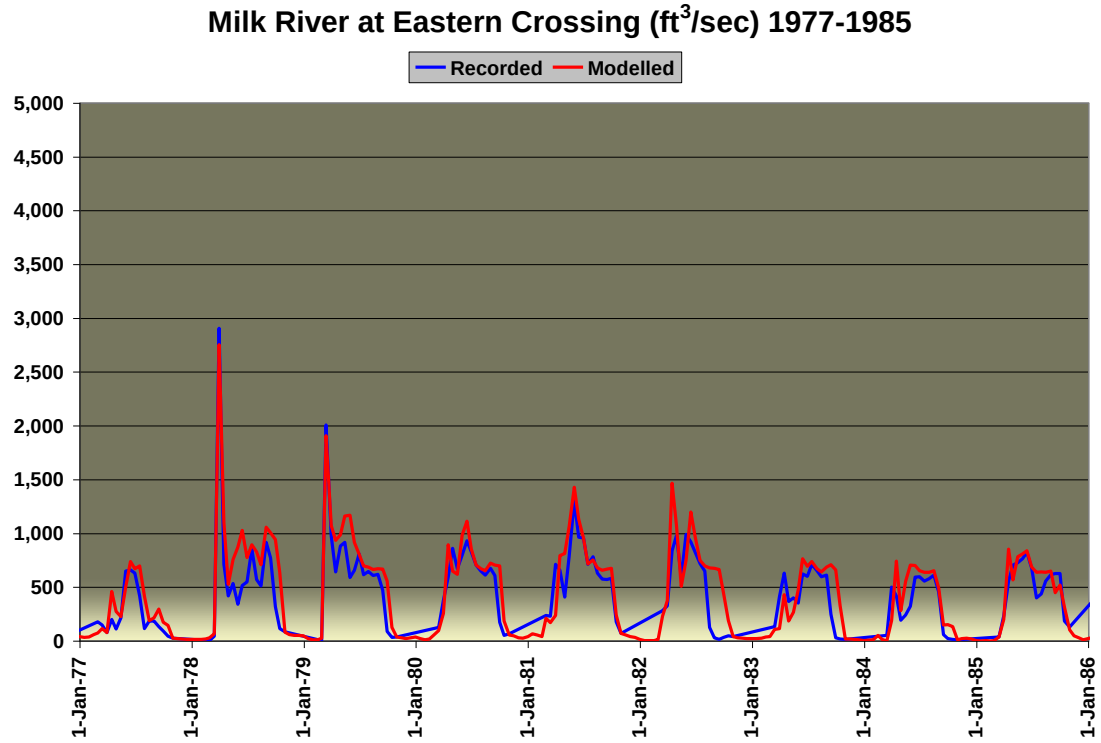
3-1.1



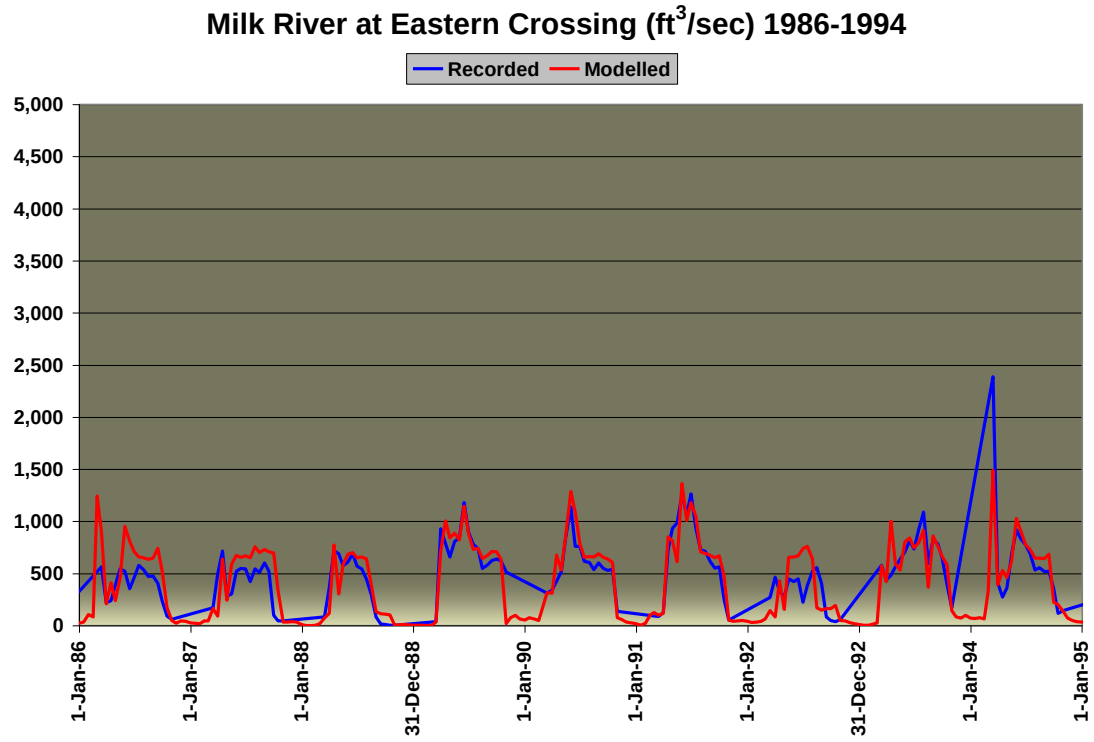
3-1.2


Milk River at Eastern Crossing (ft3/sec) 1968-1976
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

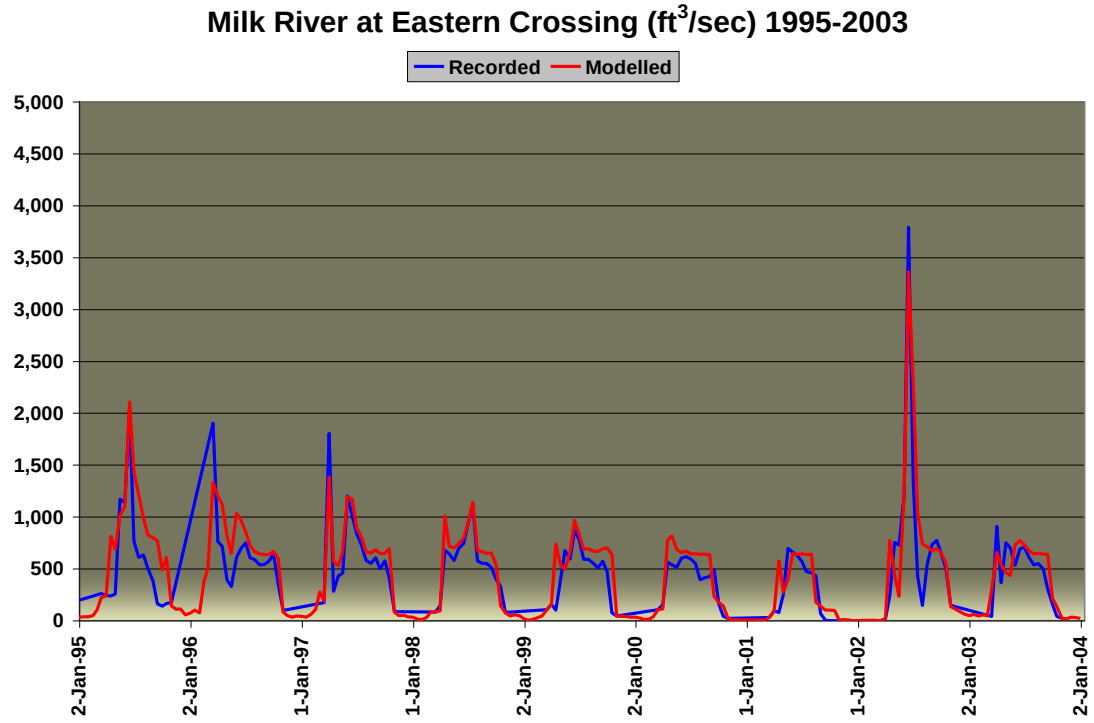
3-1.3


Milk River at Eastern Crossing (ft3/sec) 1977-1985
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

3-1.4


Milk River at Eastern Crossing (ft3/sec) 1986-1994
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

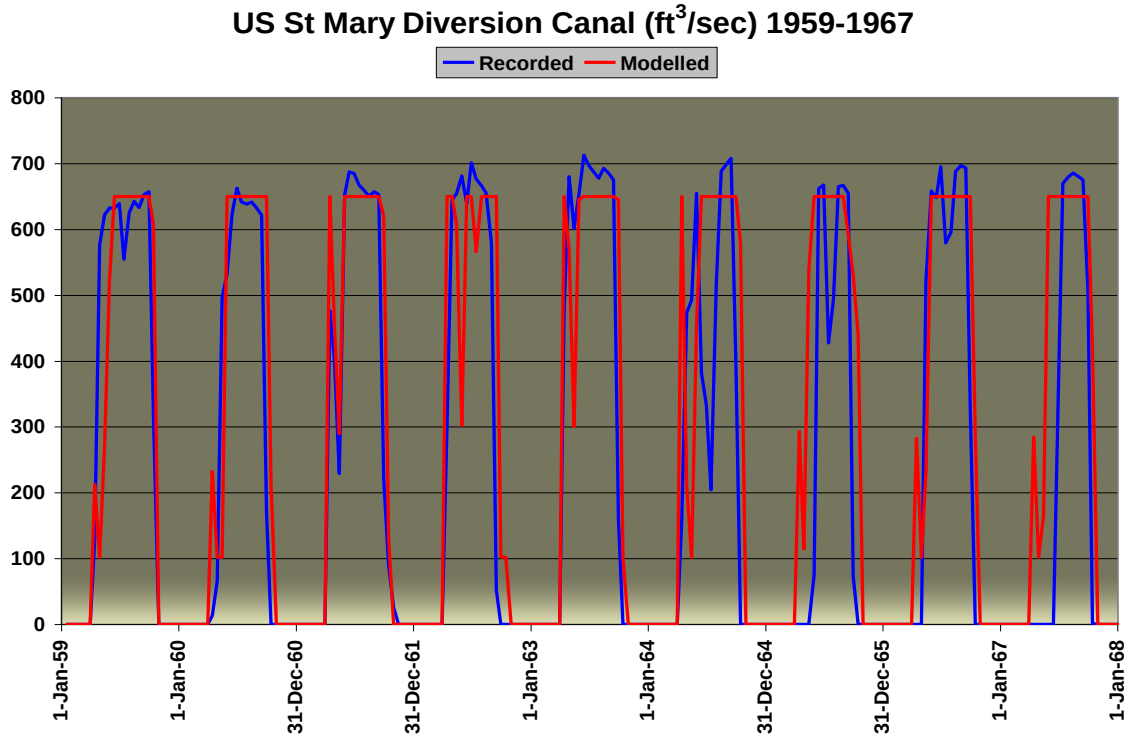
3-1.5


Milk River at Eastern Crossing (ft3/sec) 1995-2003
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
2-Jan-95
2-Jan-96
1-Jan-97
1-Jan-98
2-Jan-99
2-Jan-00
1-Jan-01
1-Jan-02
2-Jan-03
2-Jan-04

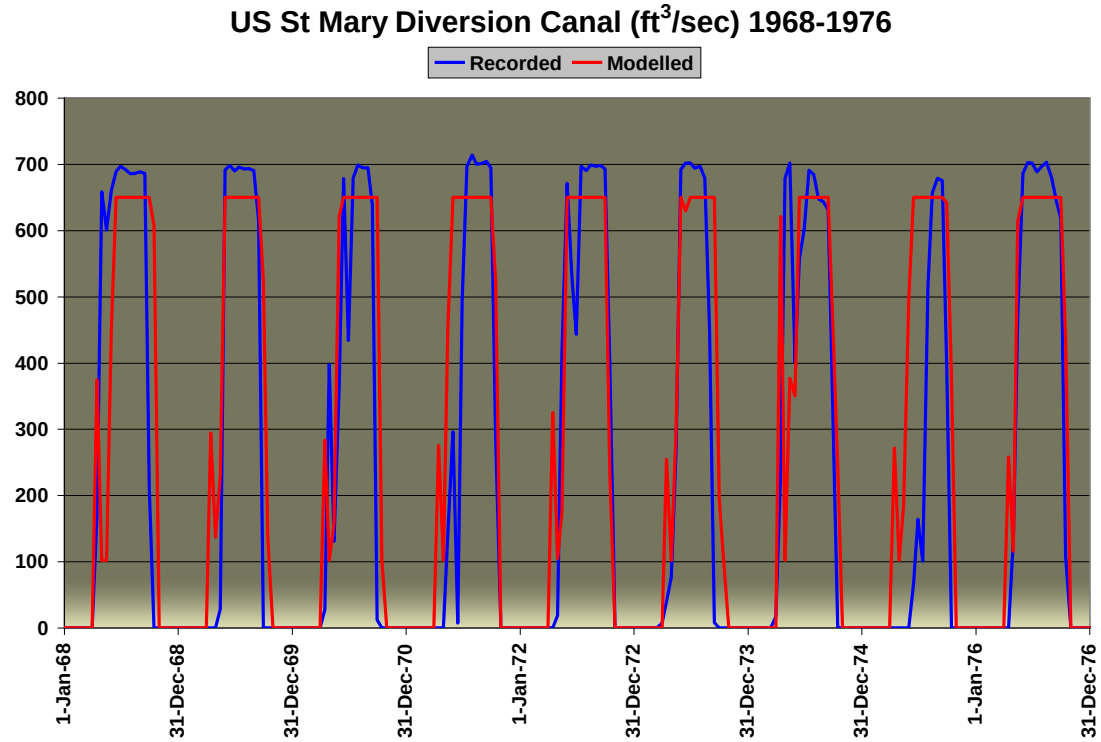
3-2 U.S. St. Mary Canal:

3-2.1 (1959 – 1967)
3-2.2 (1968 – 1976)
3-2.3 (1977 – 1985)
3-2.4 (1986 – 1994)
3-2.5 (1995 – 2003)

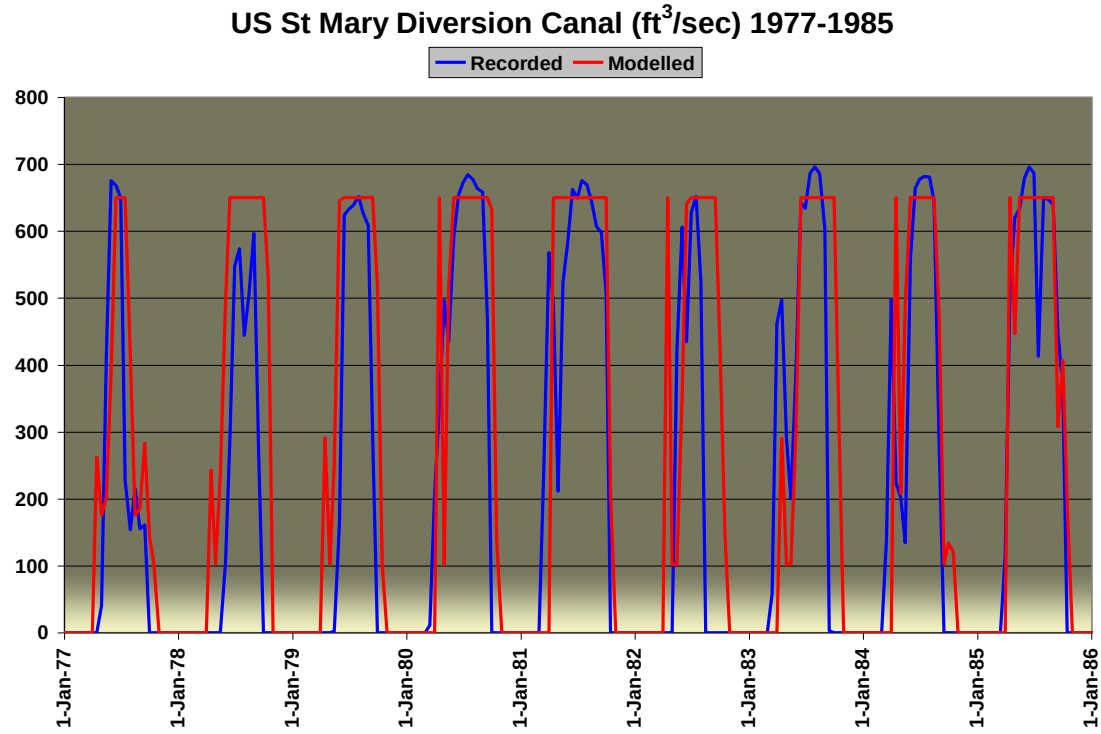
3-2.1



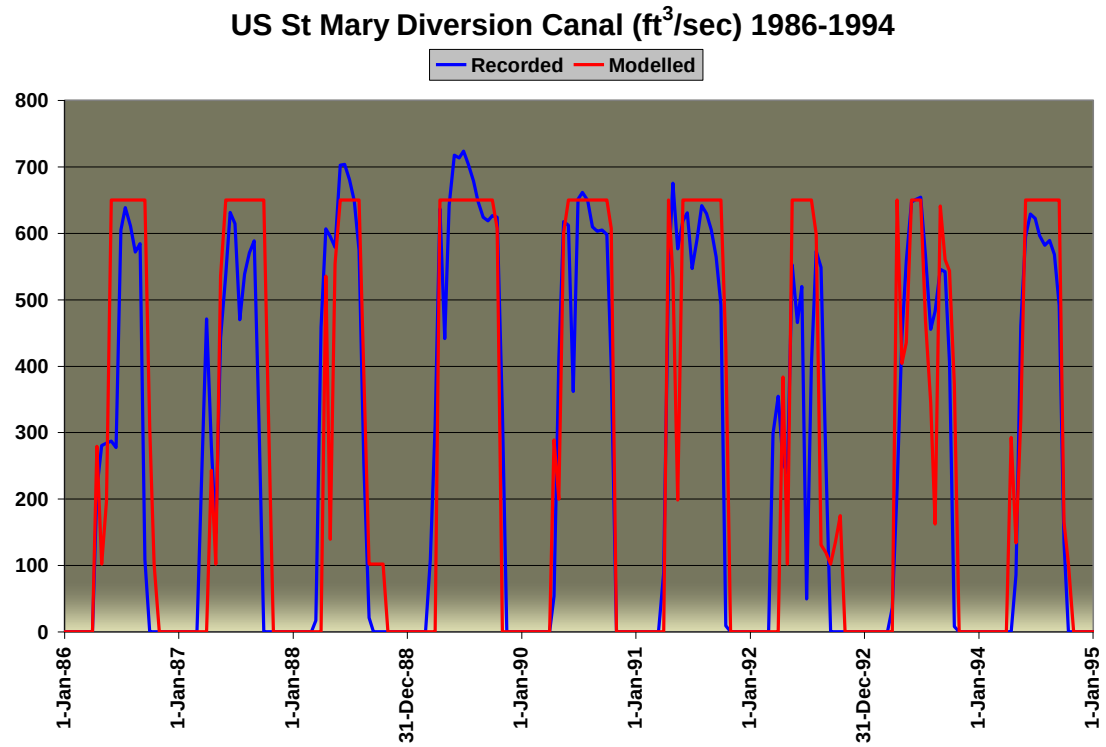
3-2.2


US St Mary Diversion Canal (ft3/sec) 1968-1976
Recorded
Modelled
800
700
600
500
400
300
200
100
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

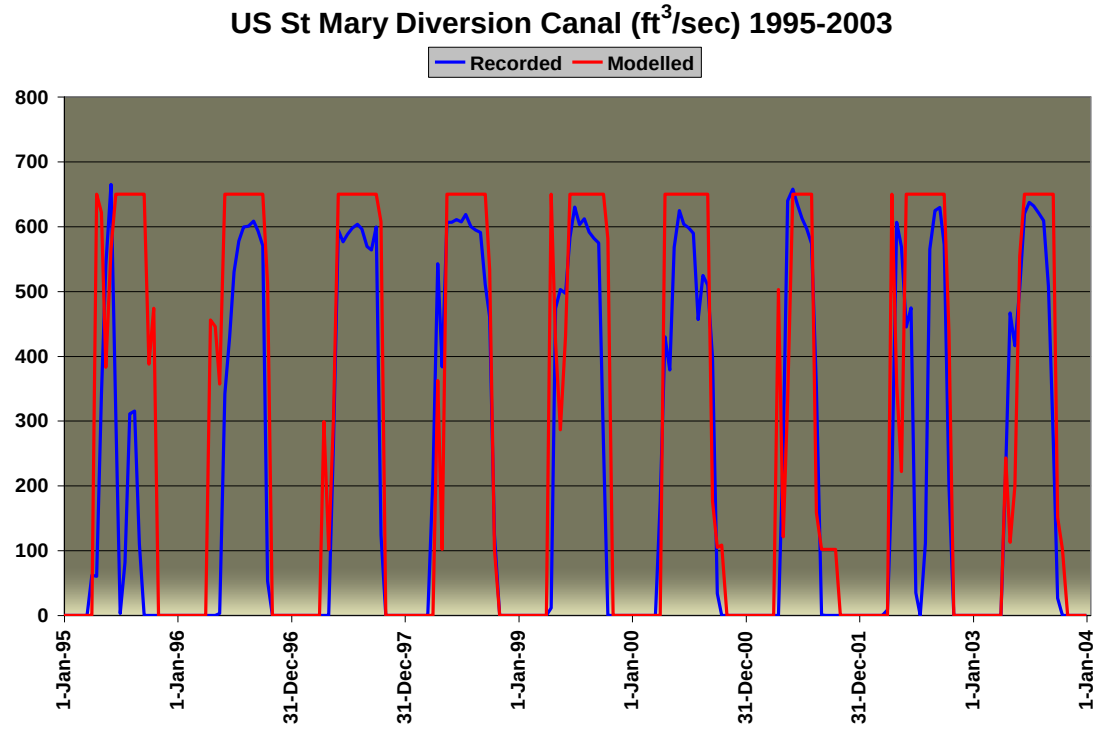
3-2.3


US St Mary Diversion Canal (ft3/sec) 1977-1985
Recorded
Modelled
800
700
600
500
400
300
200
100
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

3-2.4


US St Mary Diversion Canal (ft3/sec) 1986-1994
Recorded
Modelled
800
700
600
500
400
300
200
100
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

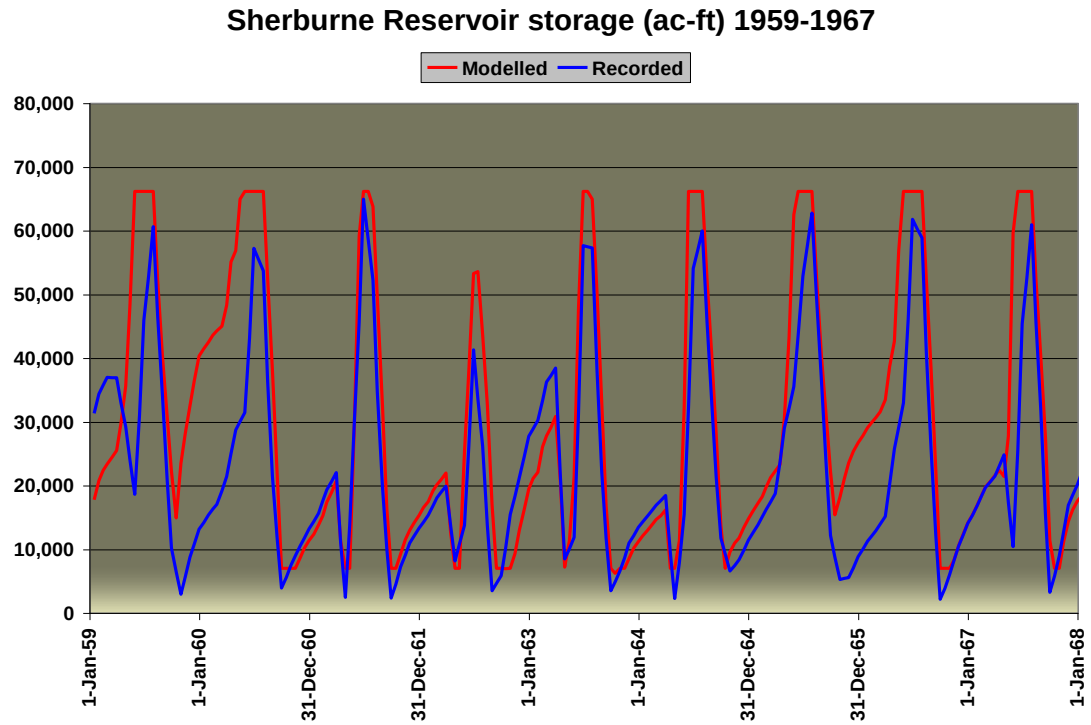
3-2.5


US St Mary Diversion Canal (ft3/sec) 1995-2003
Recorded
Modelled
800
700
600
500
400
300
200
100
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

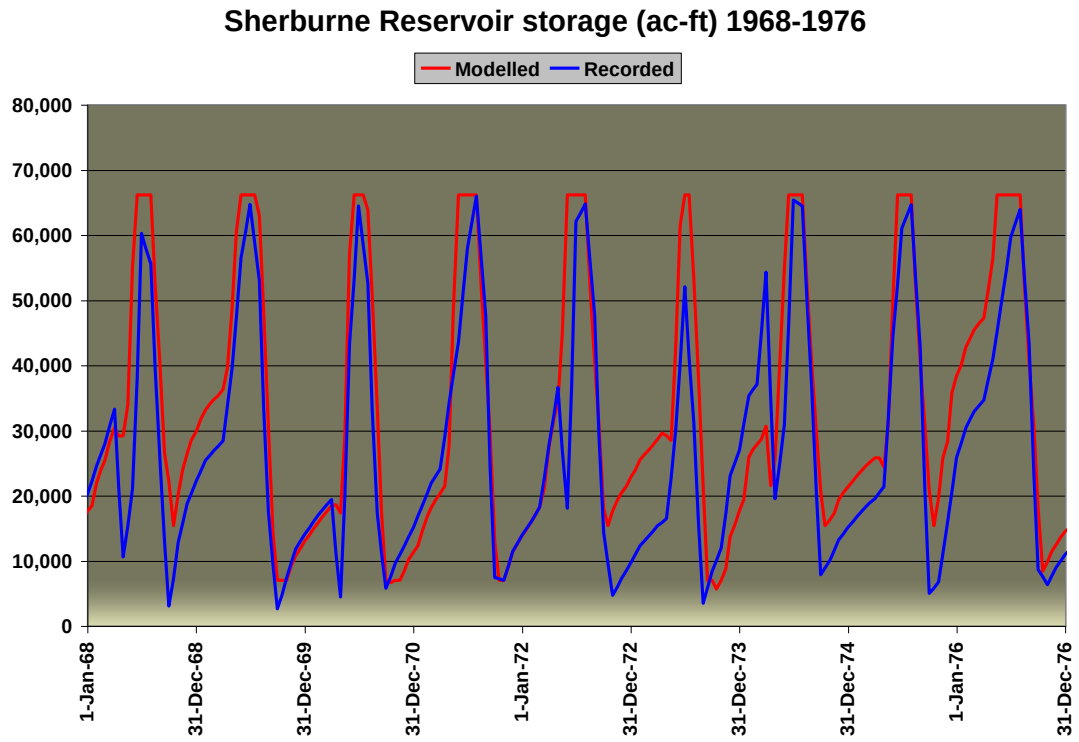
3-3 Sherburne Reservoir Storage:

3-3.1 (1959 – 1967)
3-3.2 (1968 – 1976)
3-3.3 (1977 – 1985)
3-3.4 (1986 – 1994)
3-3.5 (1995 – 2003)

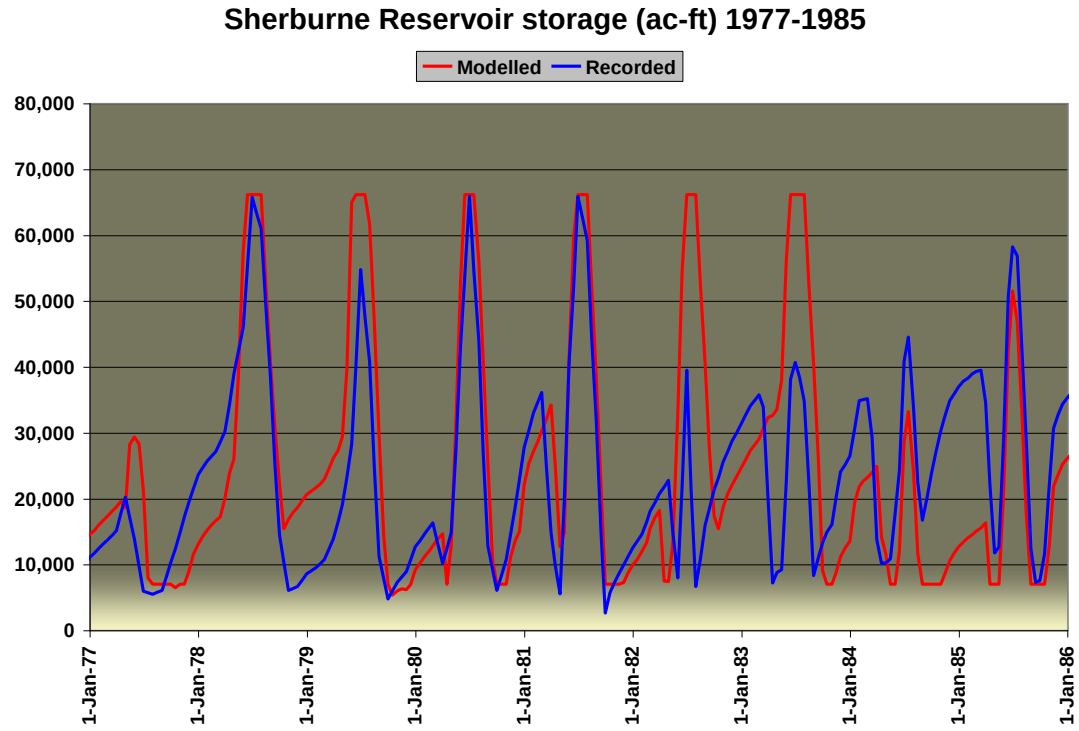
3-3.1



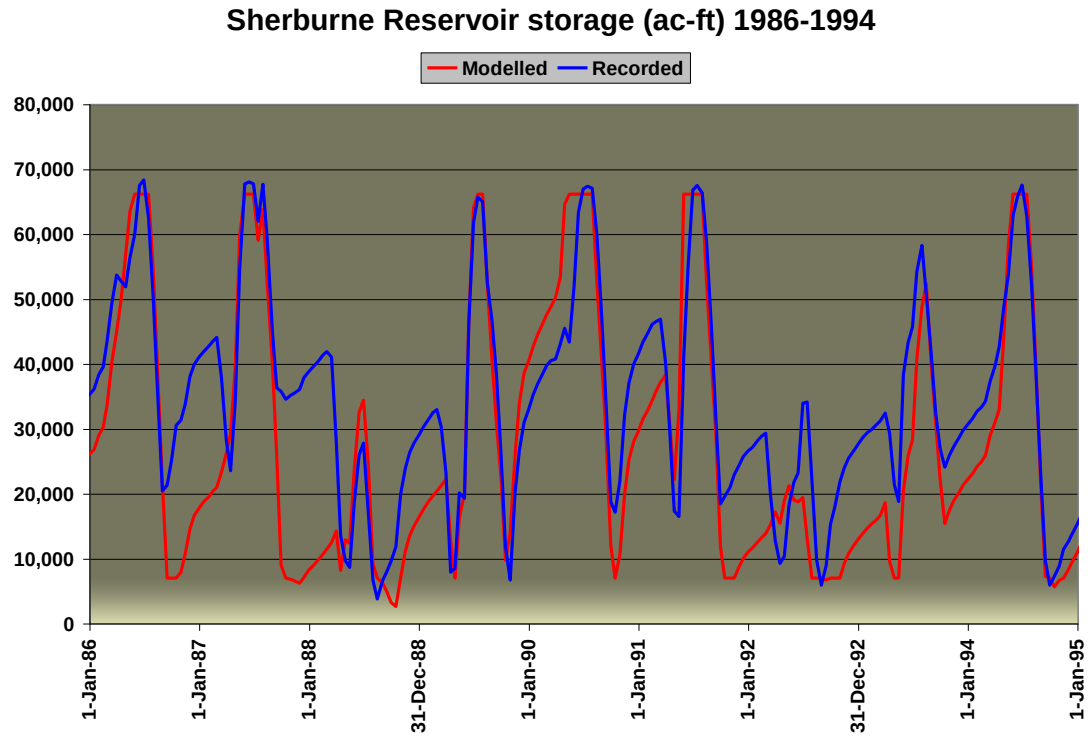
3-3.2


Sherburne Reservoir storage (ac-ft) 1968-1976
Modelled
Recorded
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

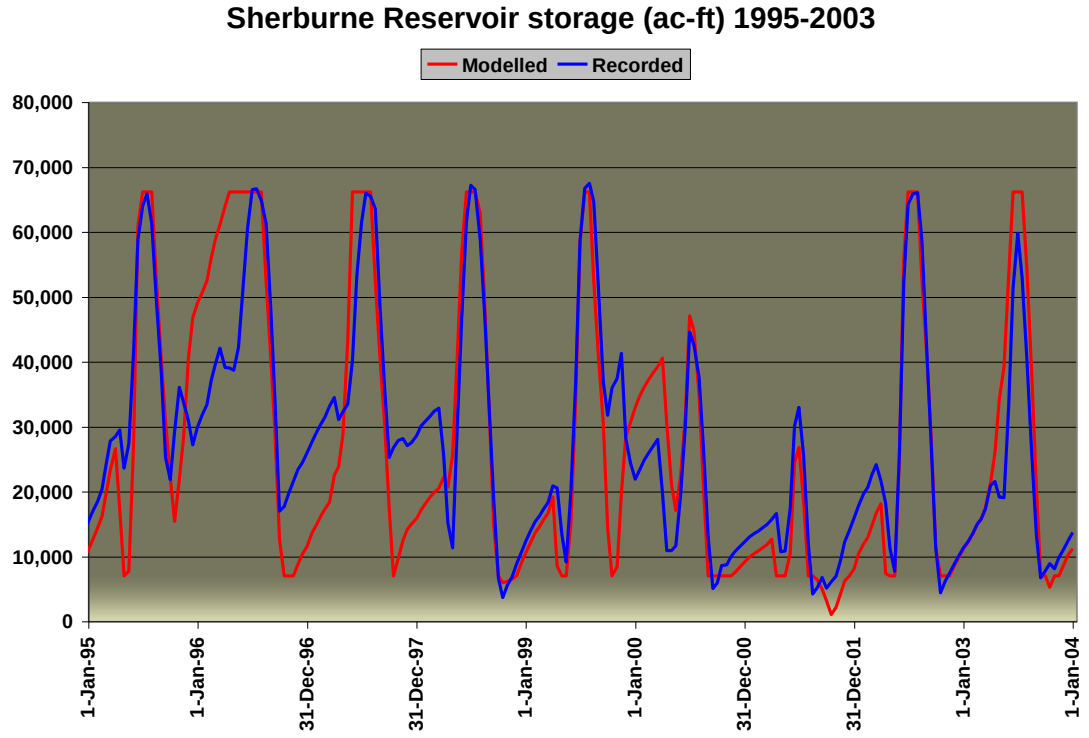
3-3.3


Sherburne Reservoir storage (ac-ft) 1977-1985
Modelled
Recorded
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

3-3.4


Sherburne Reservoir storage (ac-ft) 1986-1994
Modelled
Recorded
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

3-3.5


Sherburne Reservoir storage (ac-ft) 1995-2003
Modelled
Recorded
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

3-4 Sherburne Reservoir Releases:

3-4.1 (1959 – 1967)

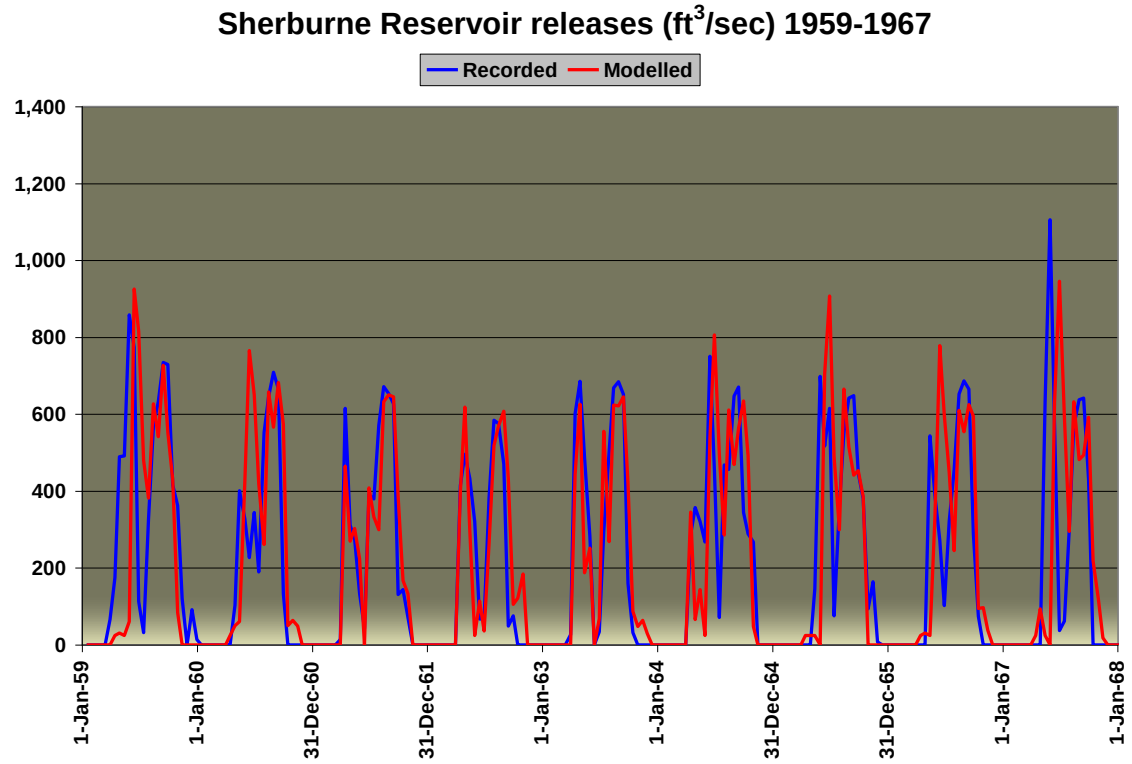
3-4.2 (1968 – 1976)

3-4.3 (1977 – 1985)

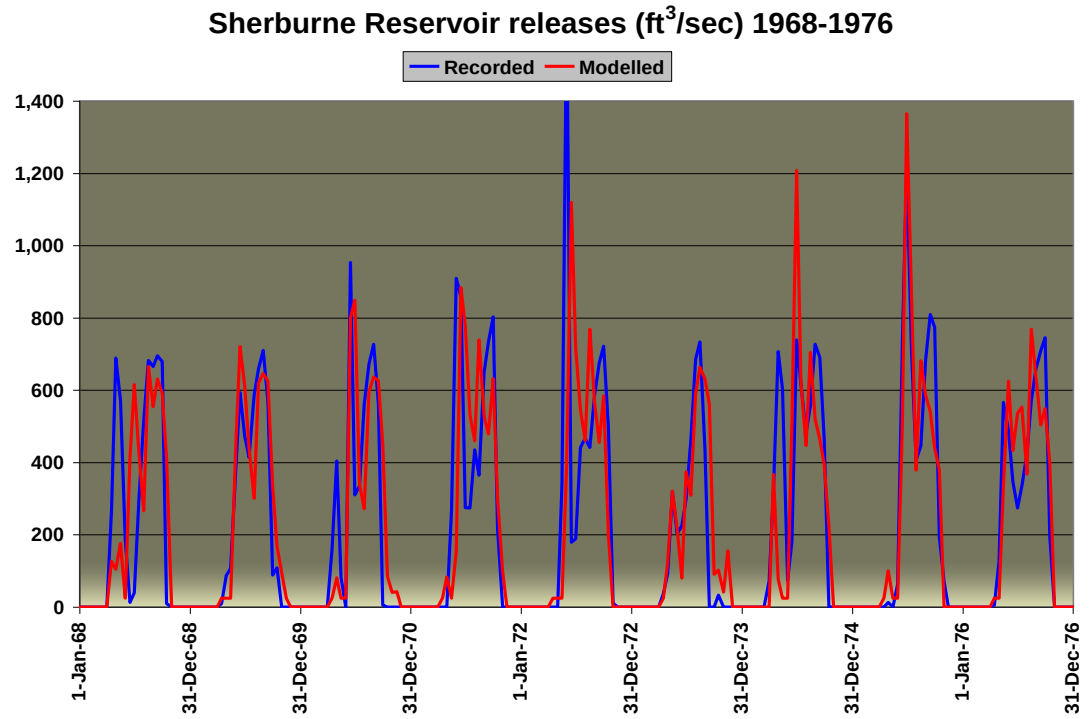
3-4.4 (1986 – 1994)

3-4.5 (1995 – 2003)

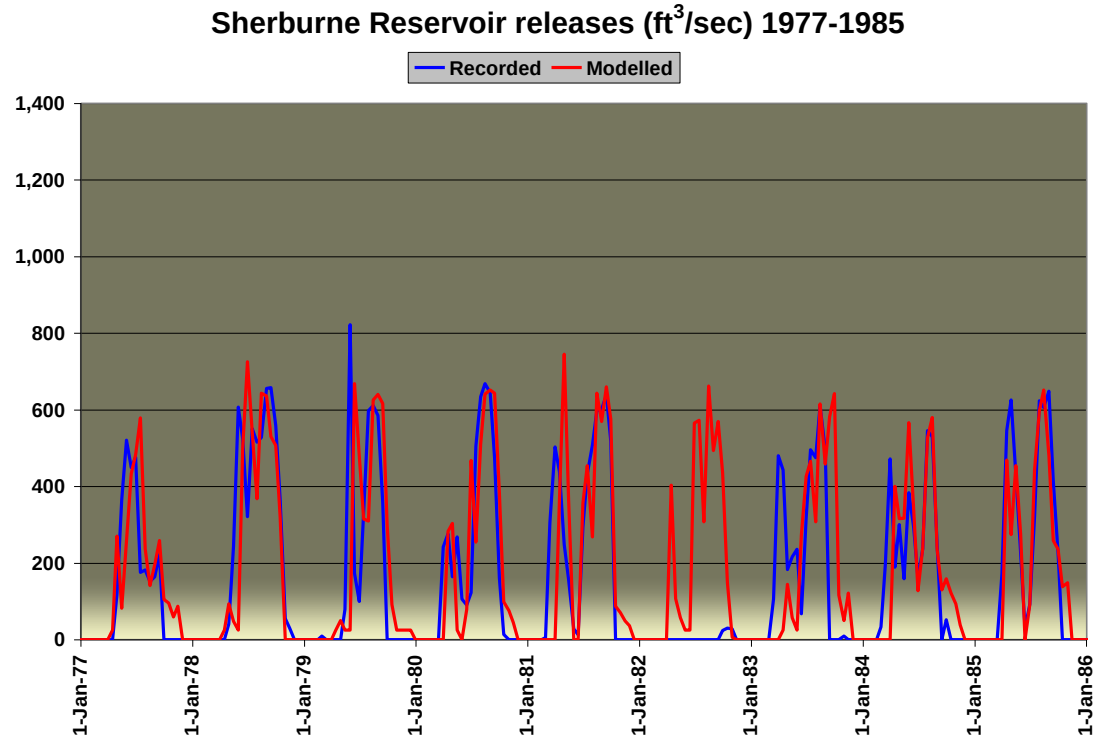
3-4.1



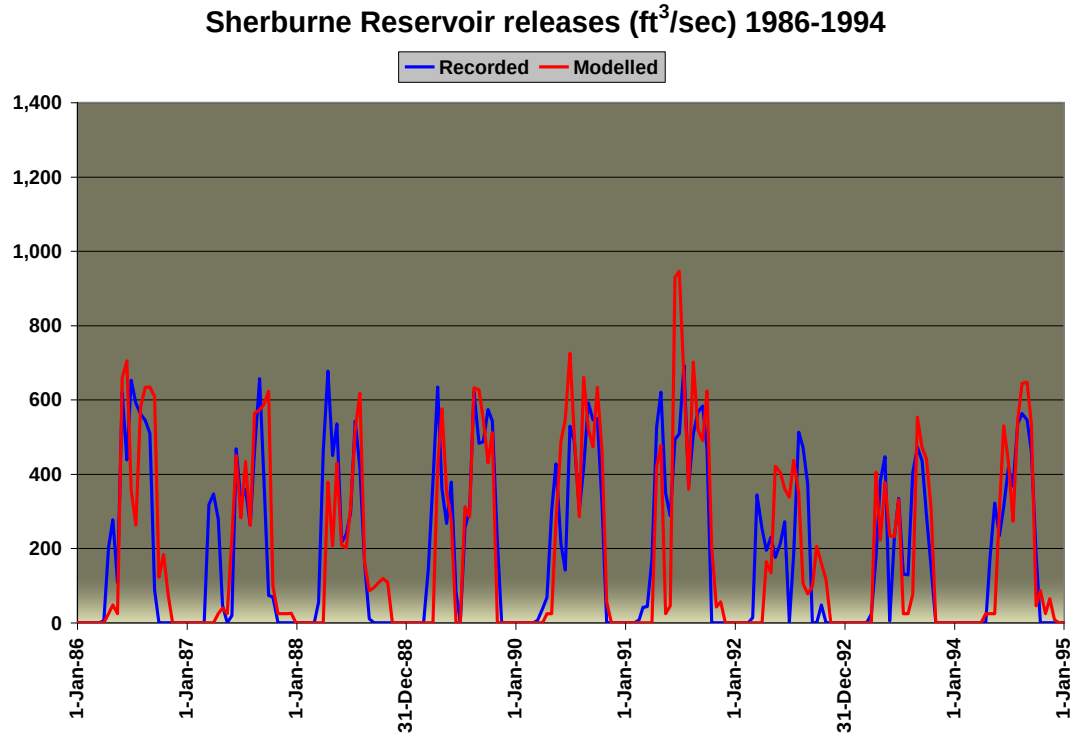
3-4.2


Sherburne Reservoir releases (ft3/sec) 1968-1976
Recorded
Modelled
1,400
1,200
1,000
800
600
400
200
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

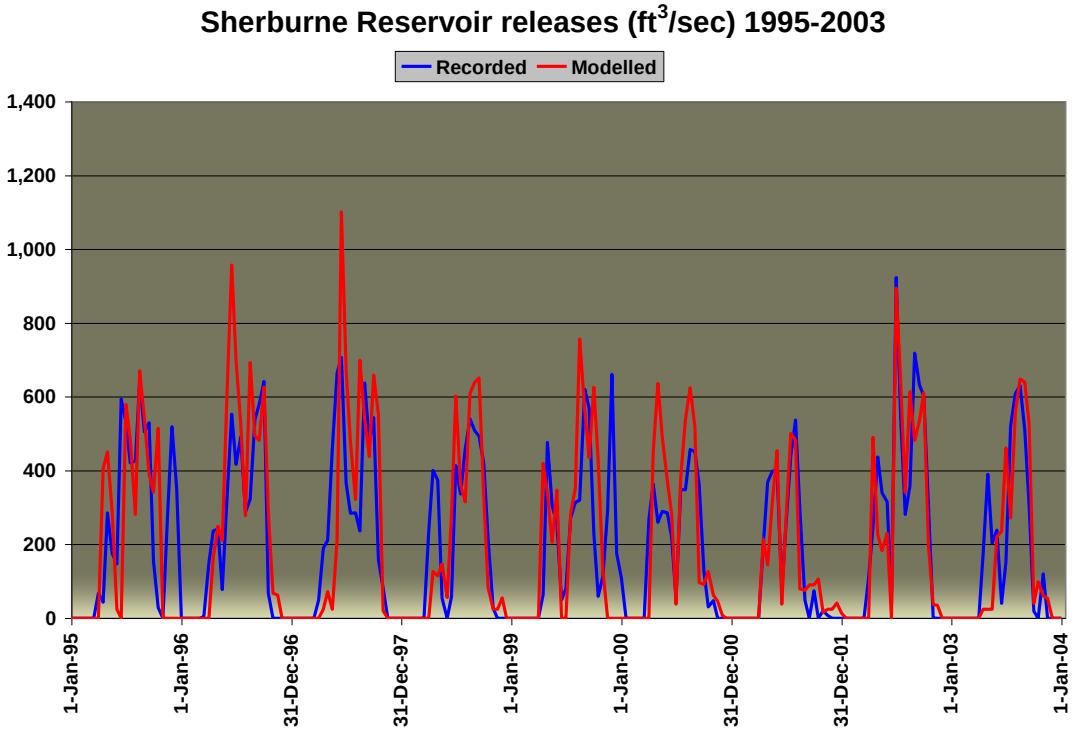
3-4.3


Sherburne Reservoir releases (ft3/sec) 1977-1985
Recorded
Modelled
1,400
1,200
1,000
800
600
400
200
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

3-4.4


Sherburne Reservoir releases (ft3/sec) 1986-1994
Recorded
Modelled
1,400
1,200
1,000
800
600
400
200
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

3-4.5

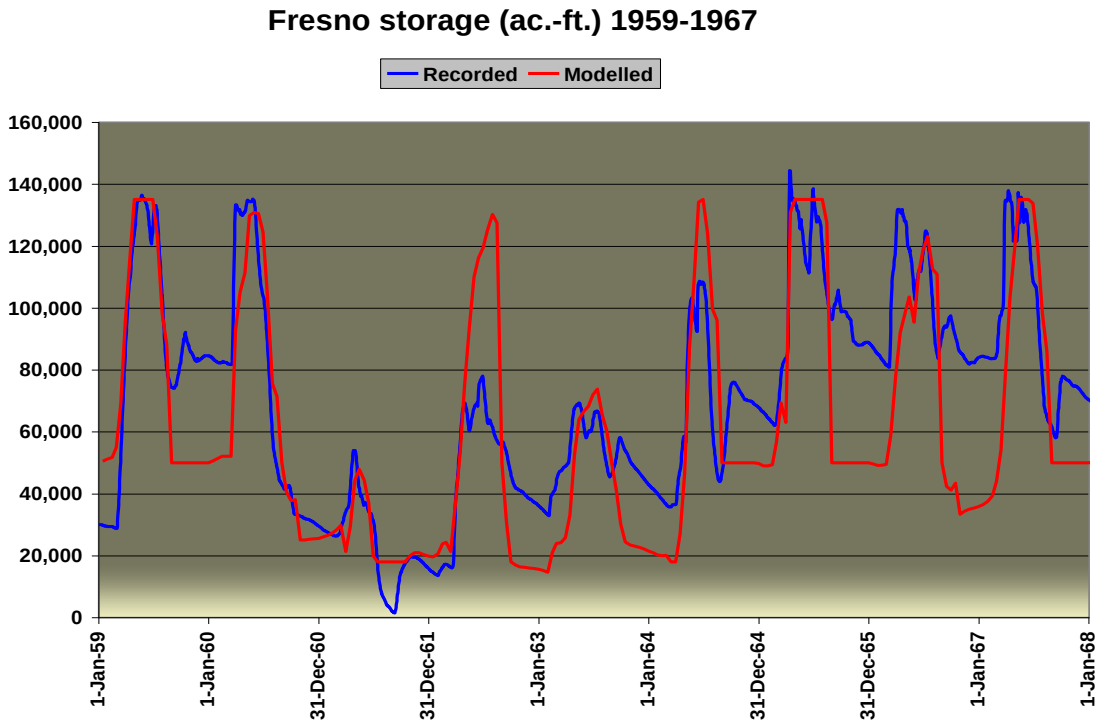

Sherburne Reservoir releases (ft3/sec) 1995-2003
Recorded
Modelled
1,400
1,200
1,000
800
600
400
200
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

Appendix 4 – Calibration Run Results: Milk River Downstream of the Eastern Crossing

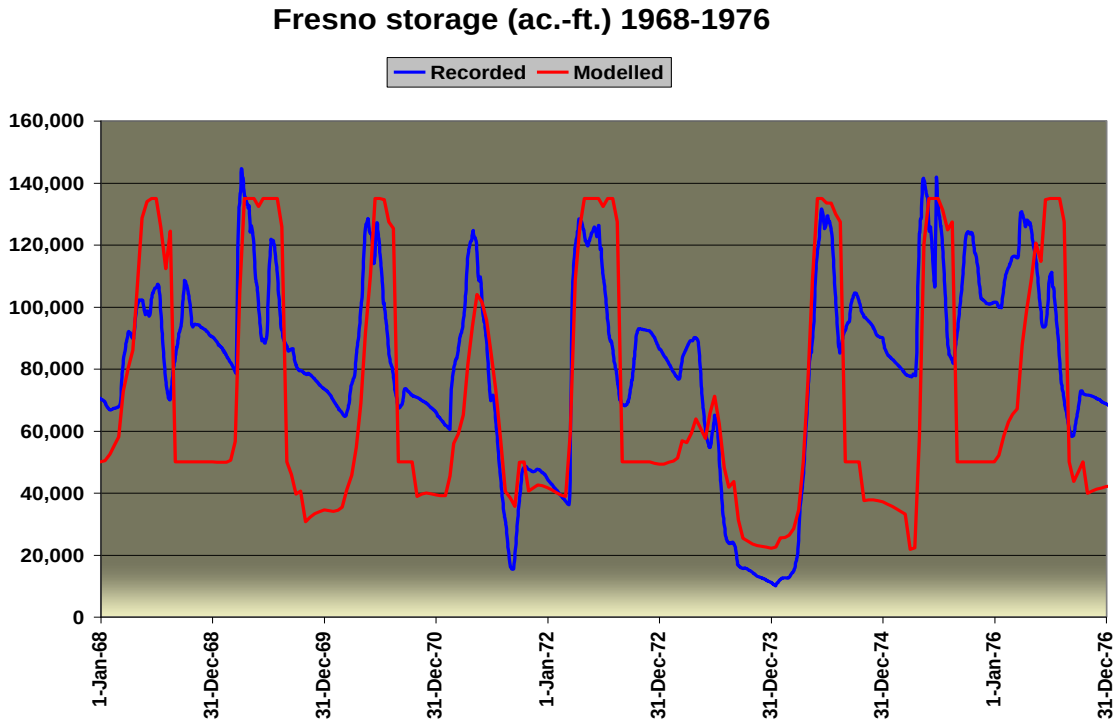
4-1 Fresno Reservoir Storage:

- **4-1.1 (1959 – 1967)**
- **4-1.2 (1968 – 1976)**
- **4-1.3 (1977 – 1985)**
- **4-1.4 (1986 – 1994)**
- **4-1.5 (1995 – 2003)**

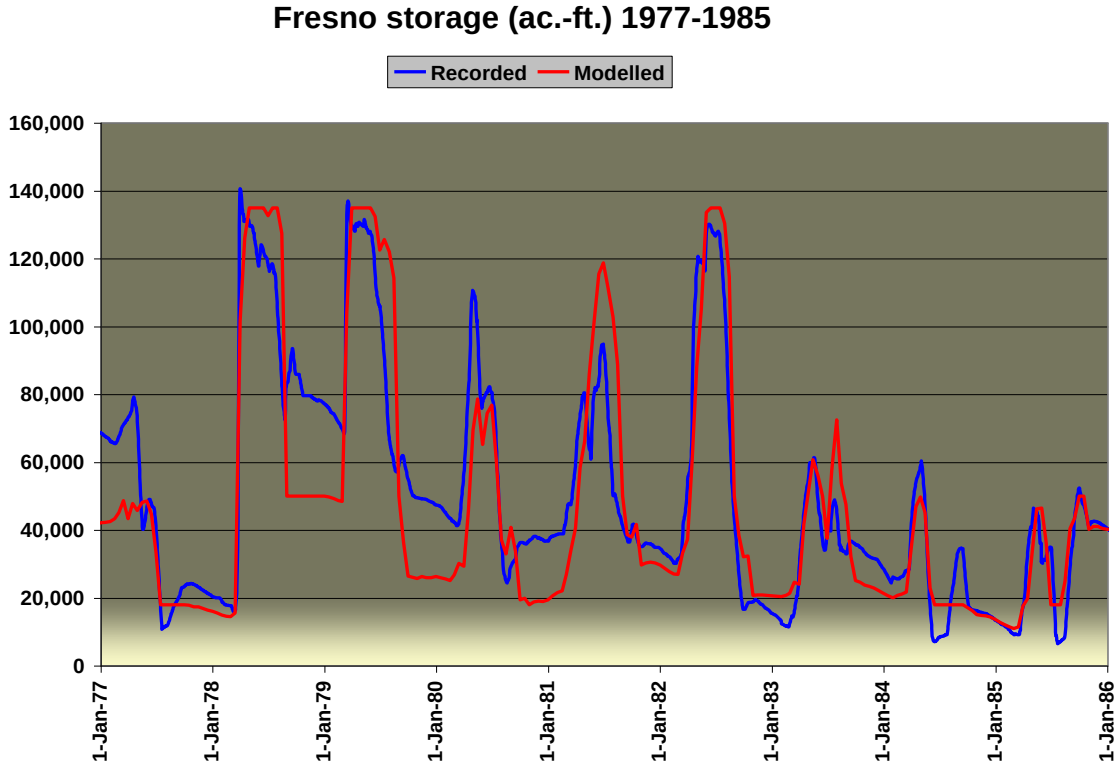
4-1.1



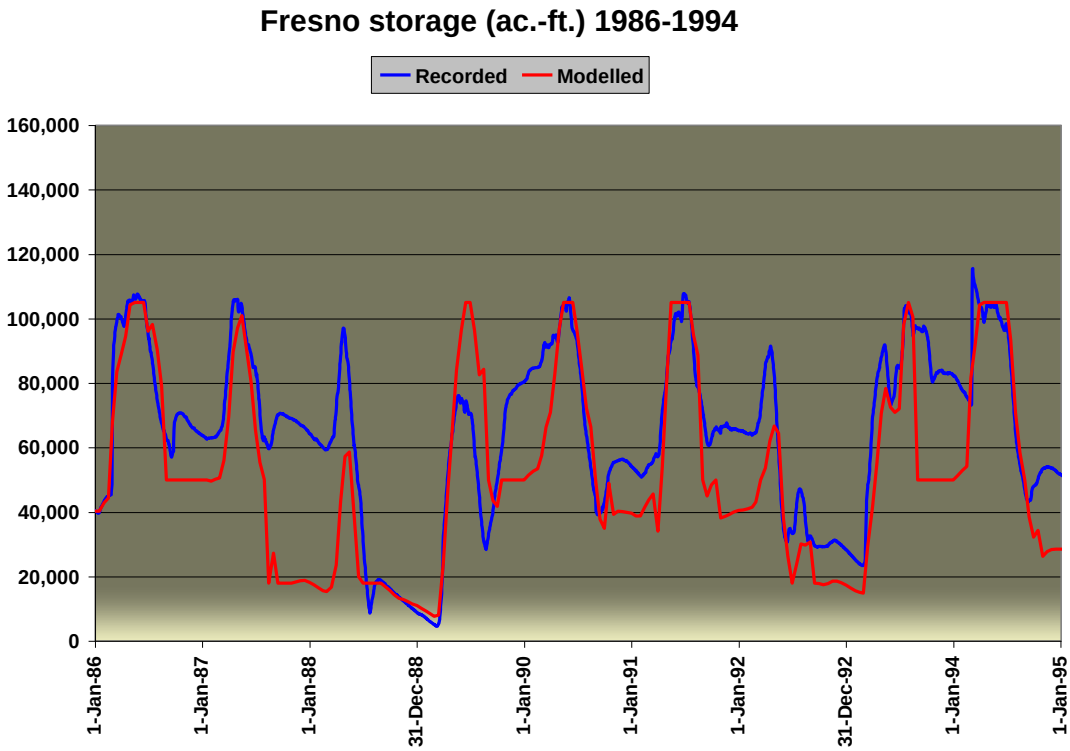
4-1.2


Fresno storage (ac.-ft.) 1968-1976
Recorded
Modelled
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

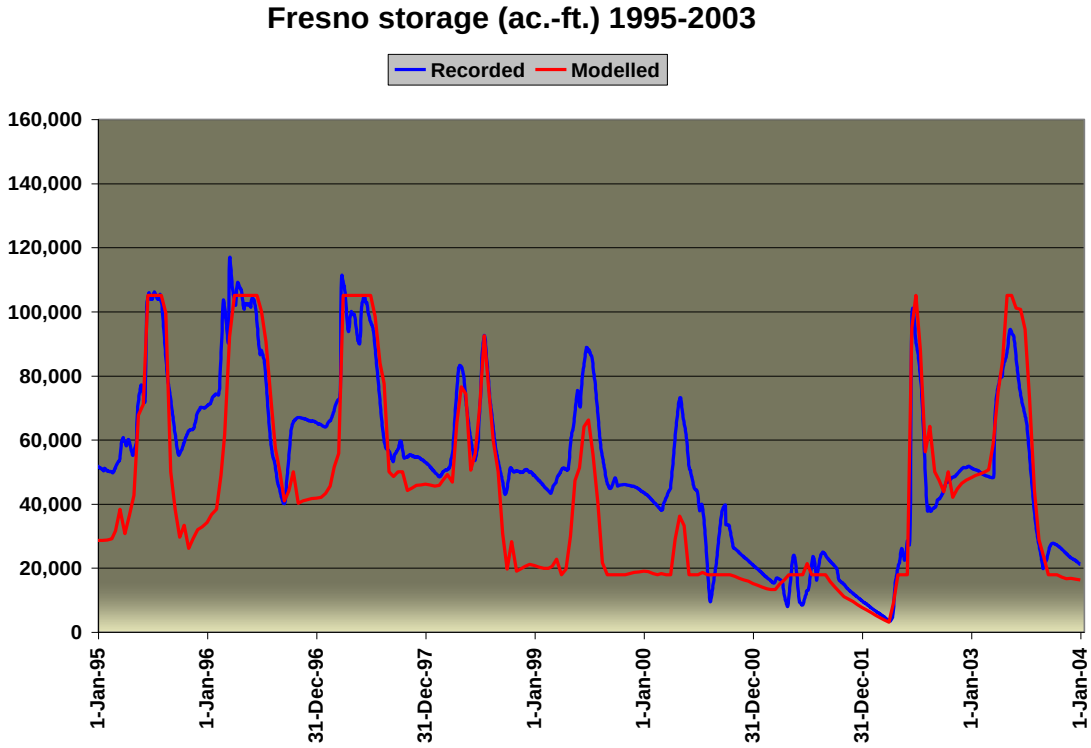
4-1.3


Fresno storage (ac.-ft.) 1977-1985
Recorded
Modelled
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

4-1.4


Fresno storage (ac.-ft.) 1986-1994
Recorded
Modelled
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

4-1.5


Fresno storage (ac.-ft.) 1995-2003
Recorded
Modelled
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

4-2 Nelson Reservoir Storage:

4-2.1 (1959 – 1967)

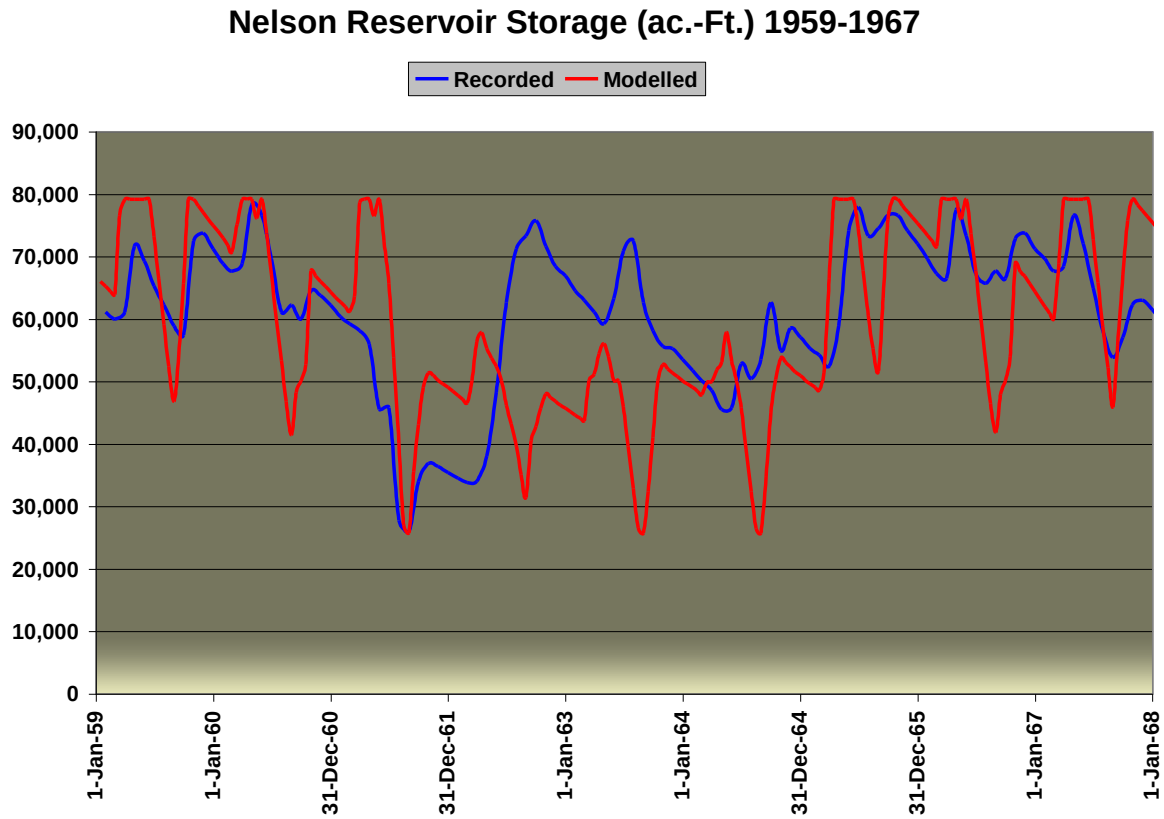
4-2.2 (1968 – 1976)

4-2.3 (1977 – 1985)

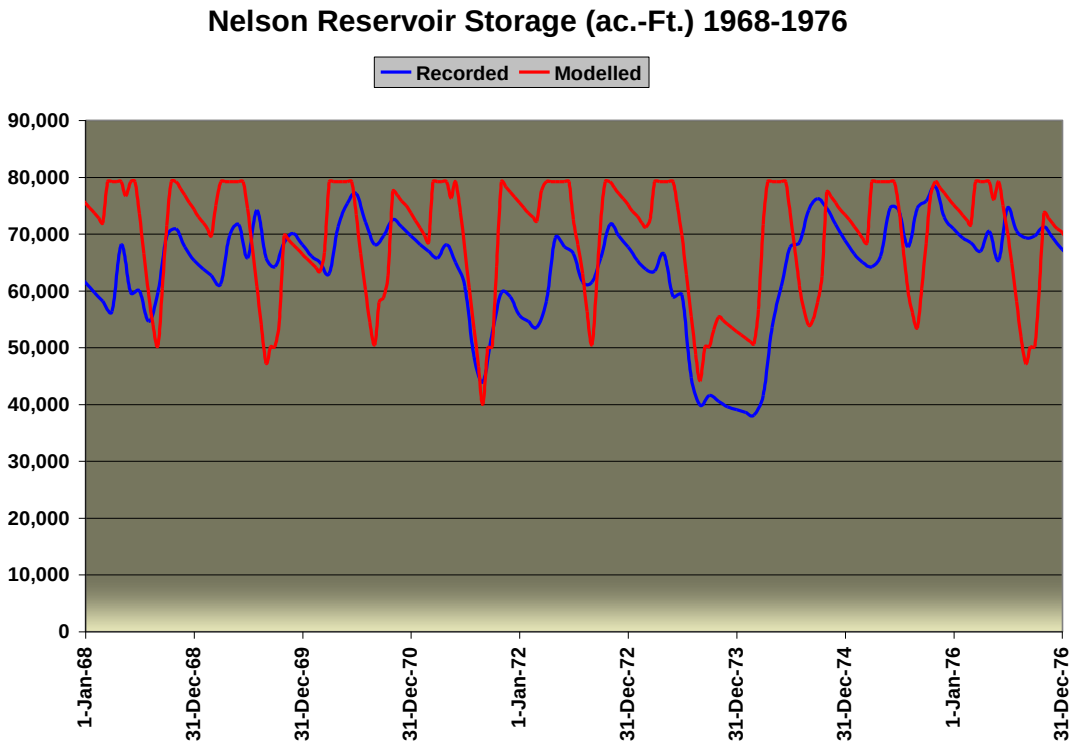
4-2.4 (1986 – 1994)

4-2.5 (1995 – 2003)

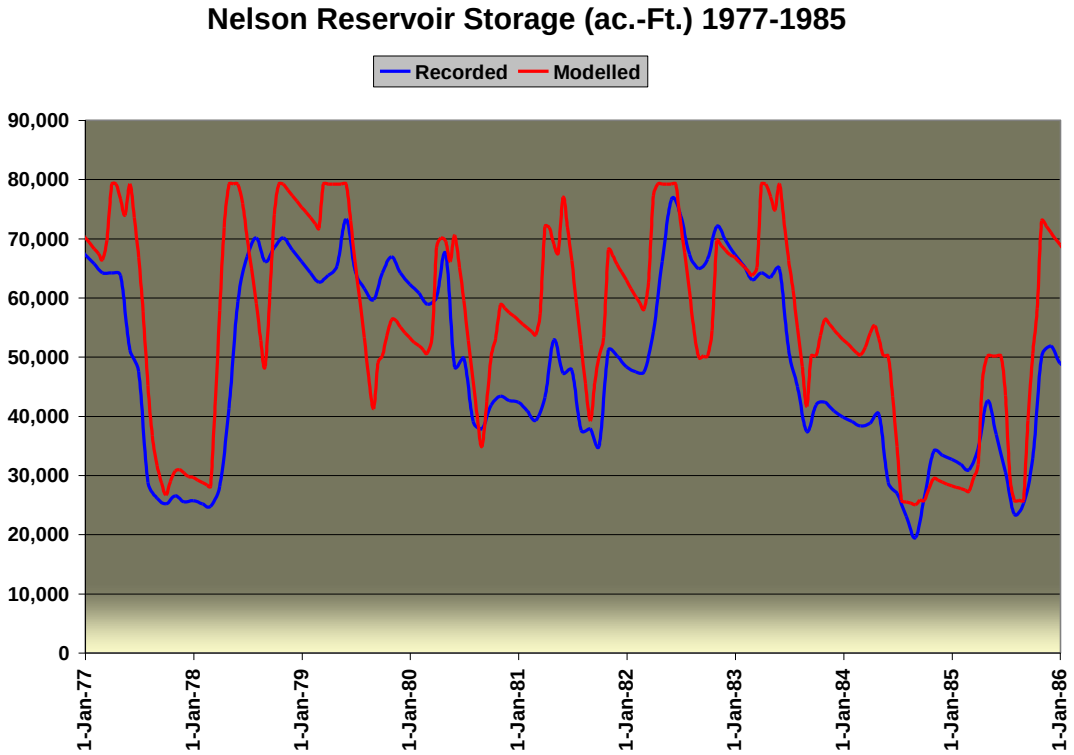
4-2.1



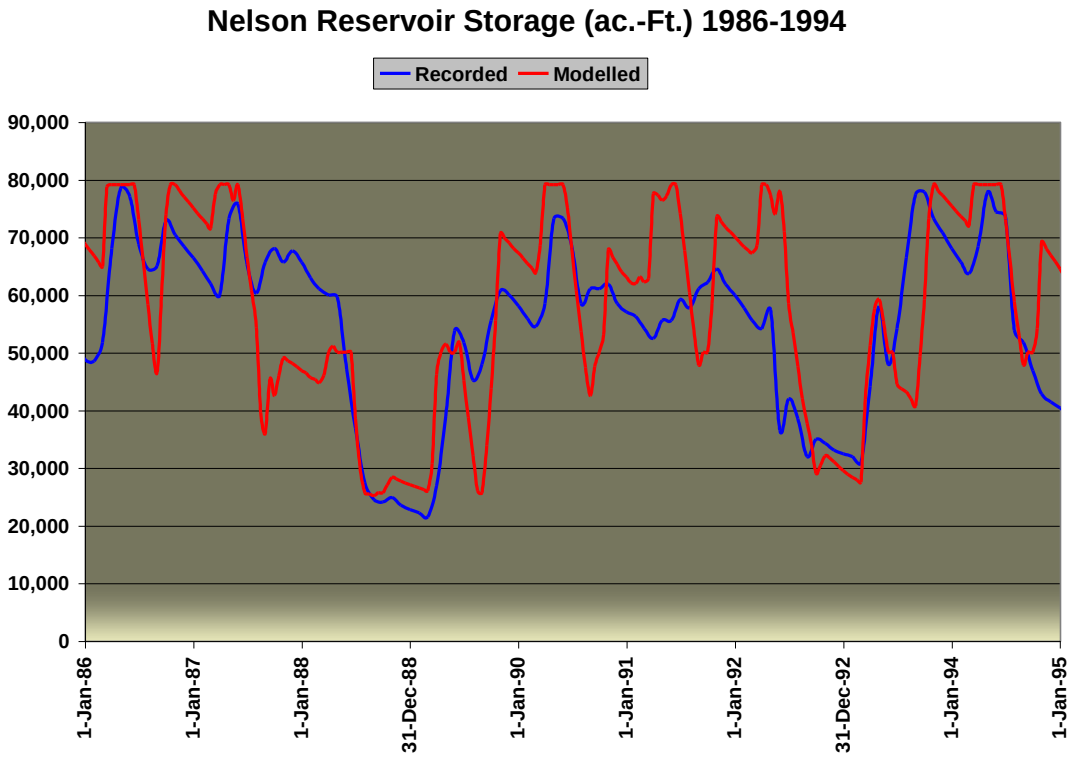
4-2.2


Nelson Reservoir Storage (ac.-Ft.) 1968-1976
Recorded
Modelled
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

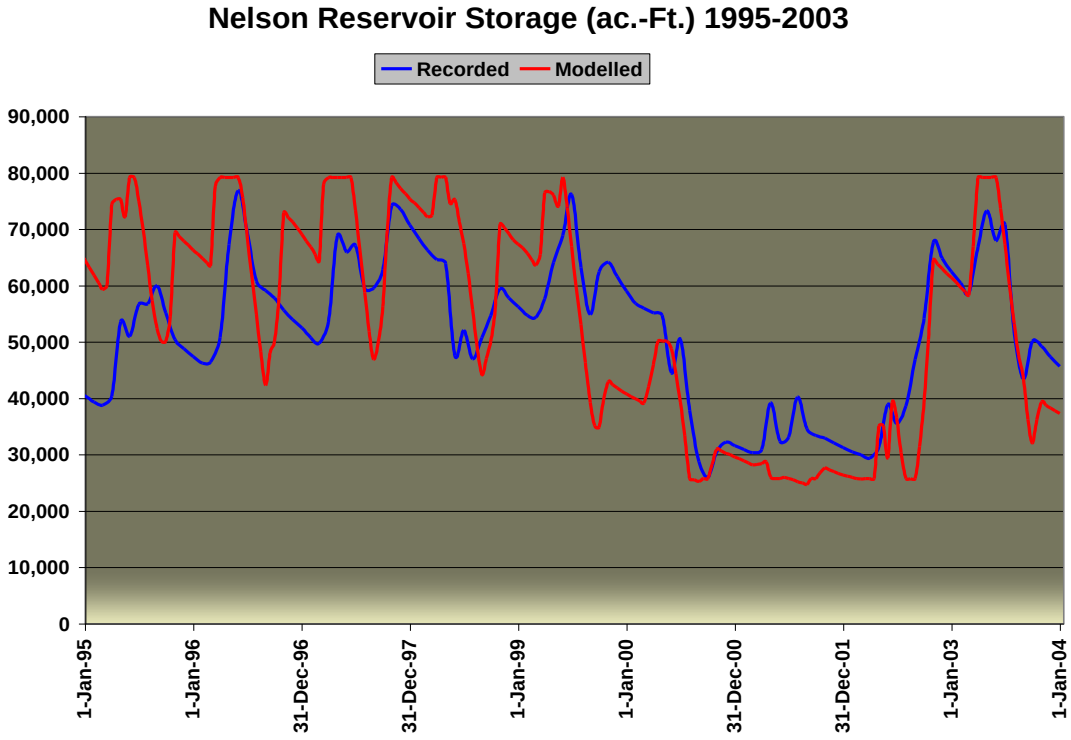
4-2.3


Nelson Reservoir Storage (ac.-Ft.) 1977-1985
Recorded
Modelled
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

4-2.4


Nelson Reservoir Storage (ac.-Ft.) 1986-1994
Recorded
Modelled
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

4-2.5


Nelson Reservoir Storage (ac.-Ft.) 1995-2003
Recorded
Modelled
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

4-3 Milk River at Havre:

4-3.1 (1959 – 1967)

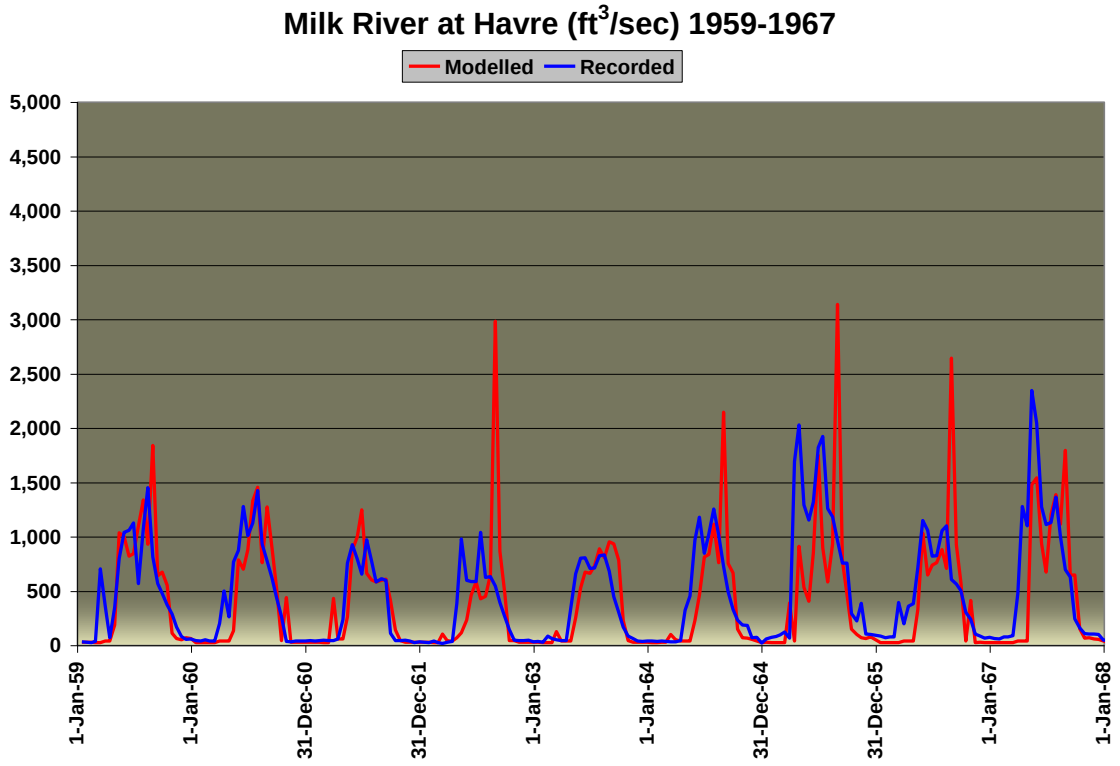
4-3.2 (1968 – 1976)

4-3.3 (1977 – 1985)

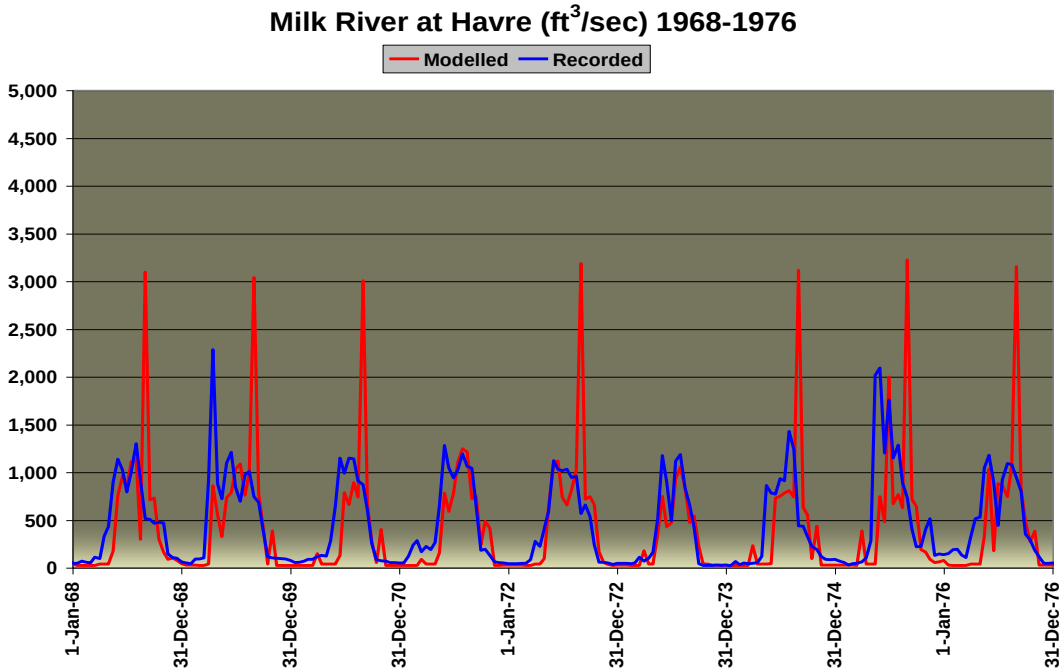
4-3.4 (1986 – 1994)

4-3.5 (1995 – 2003)

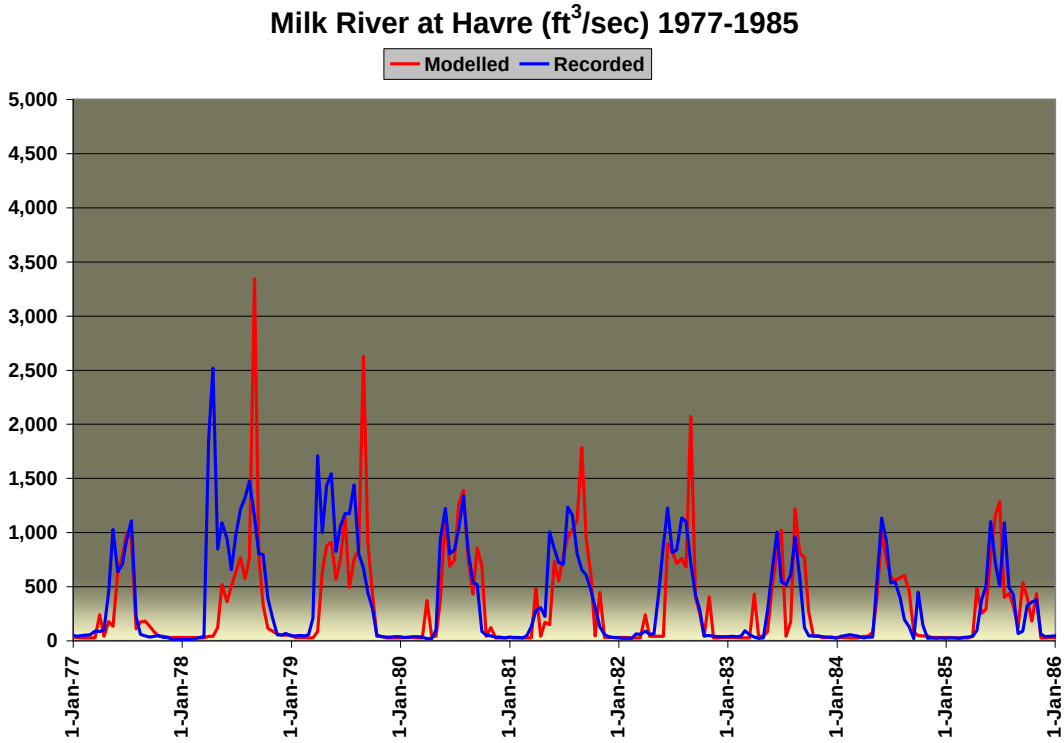
4-3.1



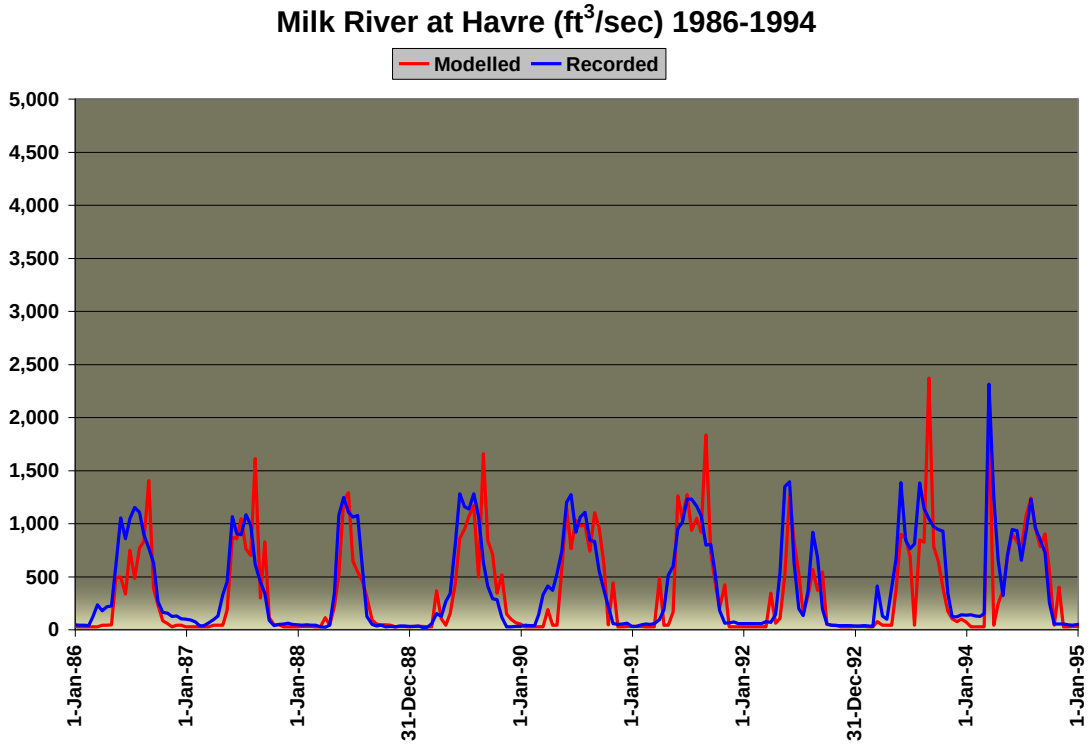
4-3.2


Milk River at Havre (ft3/sec) 1968-1976
Modelled
Recorded
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

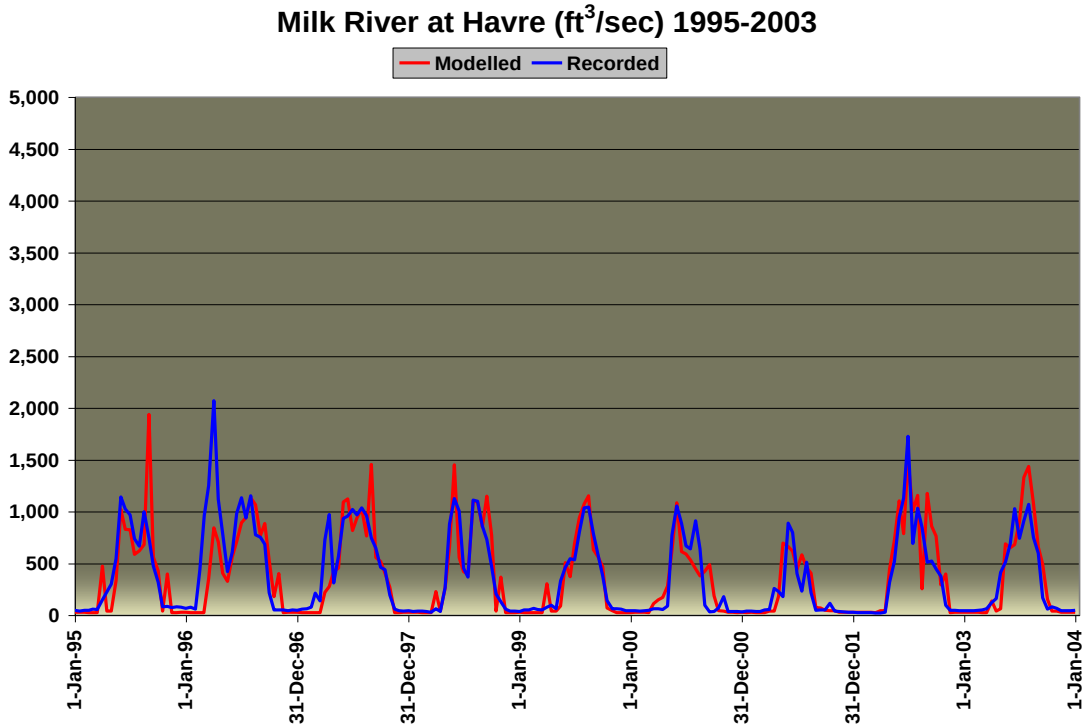
4-3.3


Milk River at Havre (ft3/sec) 1977-1985
Modelled
Recorded
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

4-3.4


Milk River at Havre (ft3/sec) 1986-1994
Modelled
Recorded
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

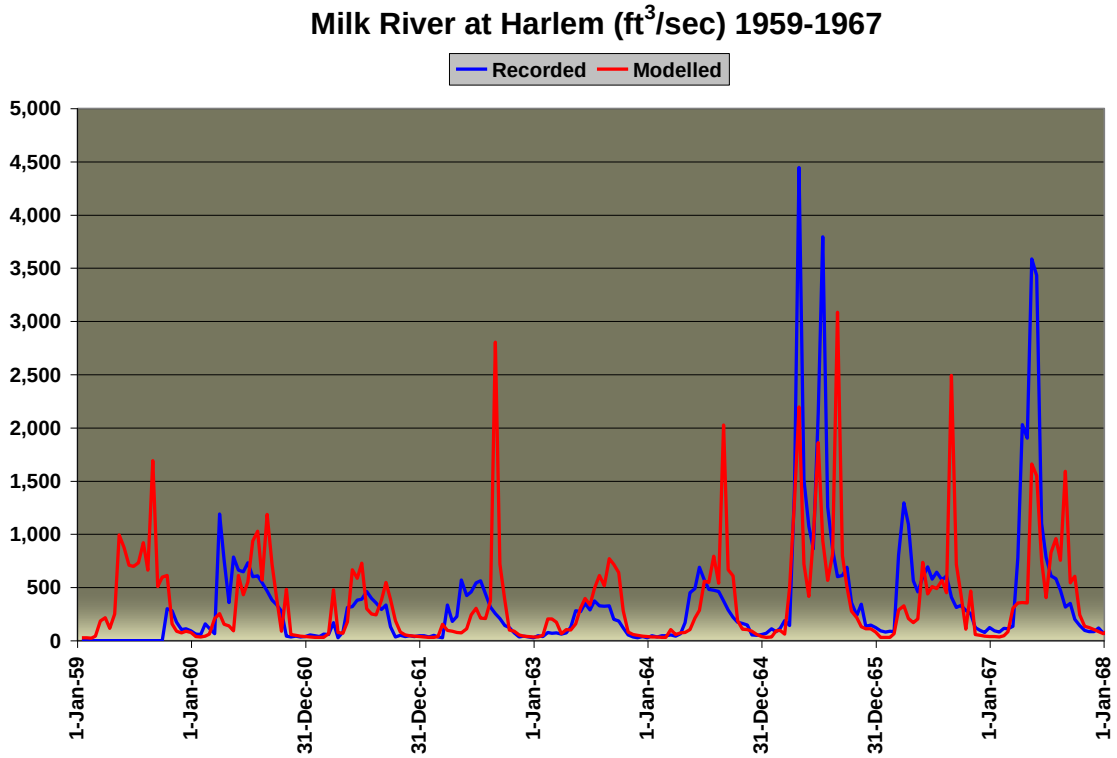
4-3.5


Milk River at Havre (ft3/sec) 1995-2003
Modelled
Recorded
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

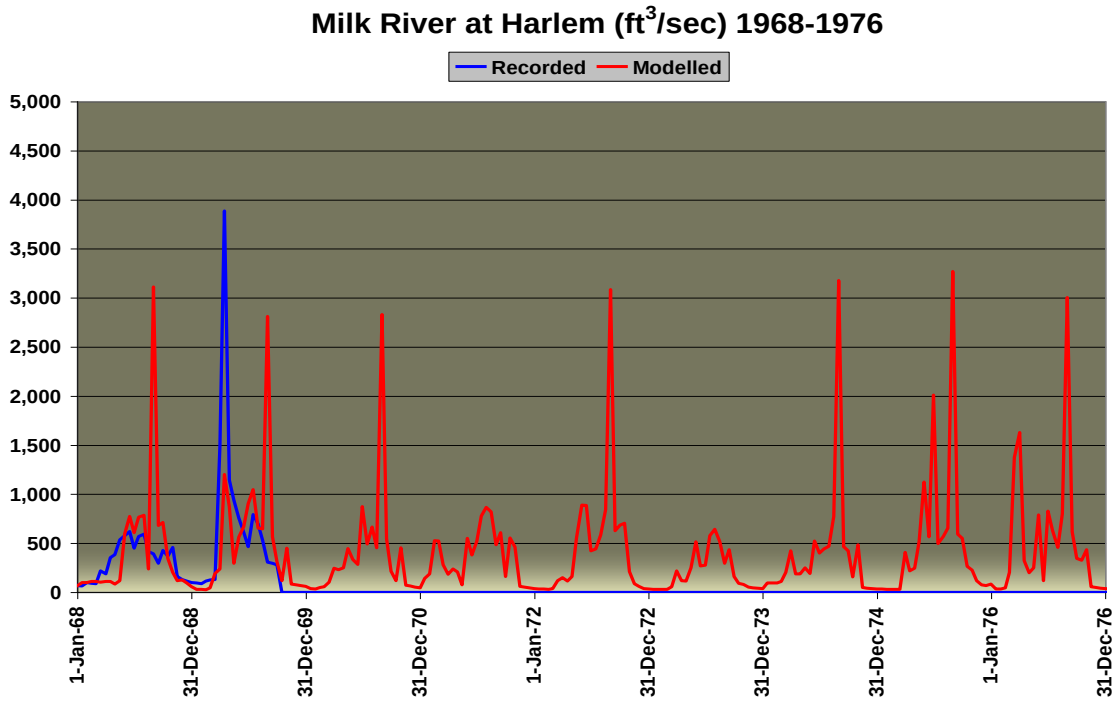
4-4 Milk River at Harlem

- **4-4.1 (1959 – 1967)**
- **4-4.2 (1968 – 1976)**
- **4-4.3 (1977 – 1985)**
- **4-4.4 (1986 – 1994)**
- **4-4.5 (1995 – 2003)**

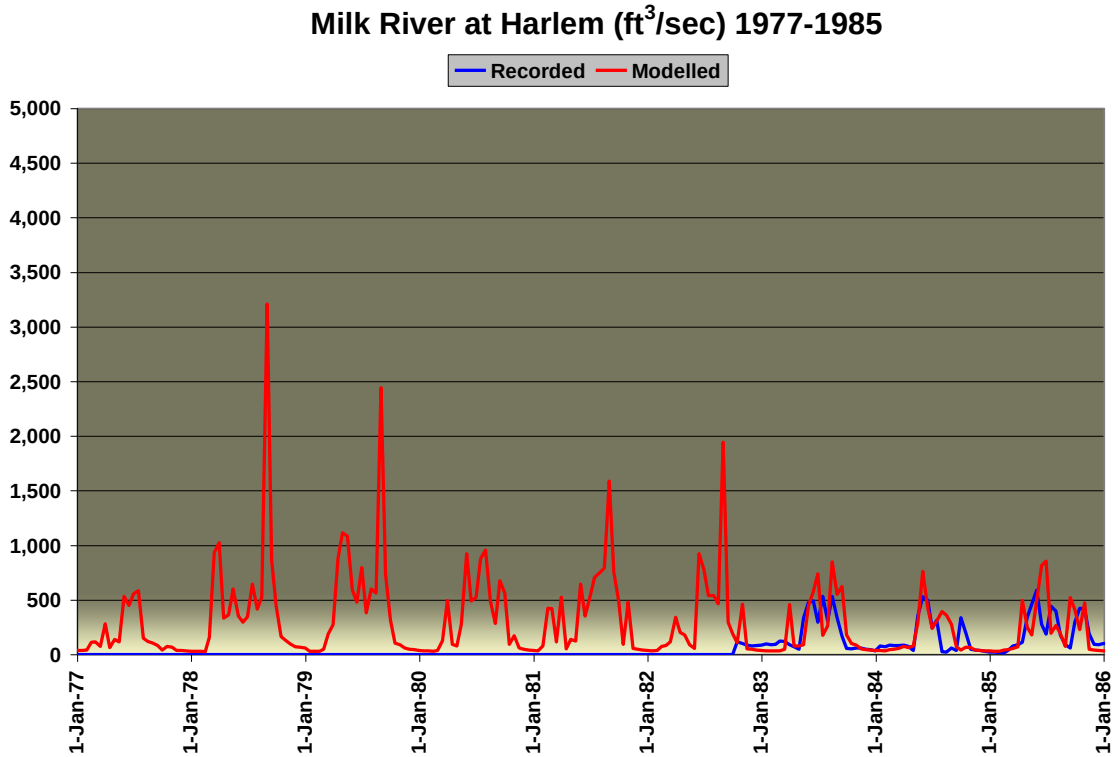
4-4.1



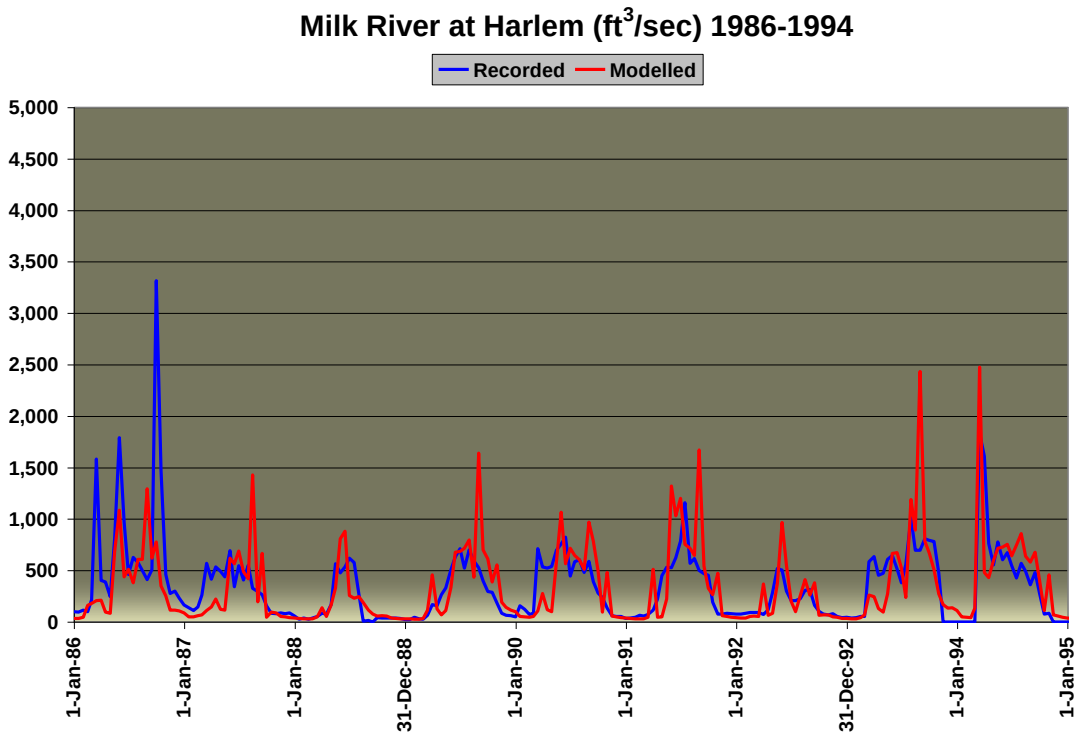
4-4.2


Milk River at Harlem (ft3/sec) 1968-1976
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

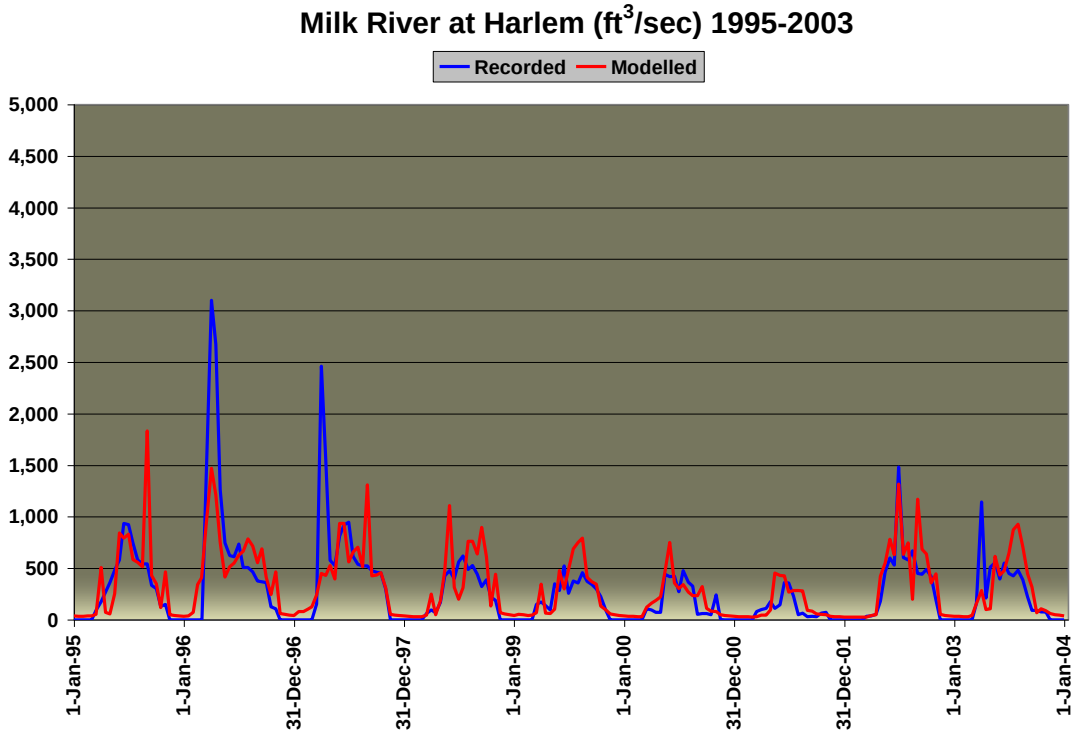
4-4.3


Milk River at Harlem (ft3/sec) 1977-1985
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

4-4.4


Milk River at Harlem (ft3/sec) 1986-1994
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

4-4.5


Milk River at Harlem (ft3/sec) 1995-2003
Recorded
Modelled
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1-Jan-95
1-Jan-96
31-Dec-96
31-Dec-97
1-Jan-99
1-Jan-00
31-Dec-00
31-Dec-01
1-Jan-03
1-Jan-04

4-5 Milk River at Nashua:

4-5.1 (1959 – 1967)

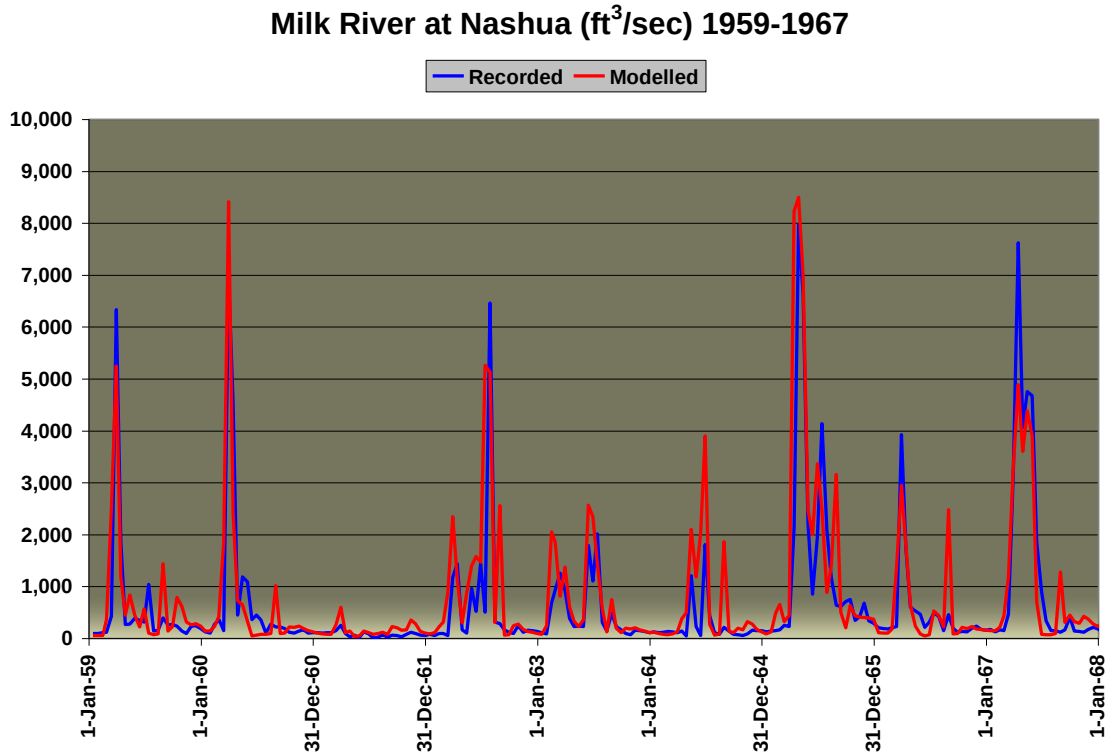
4-5.2 (1968 – 1976)

4-5.3 (1977 – 1985)

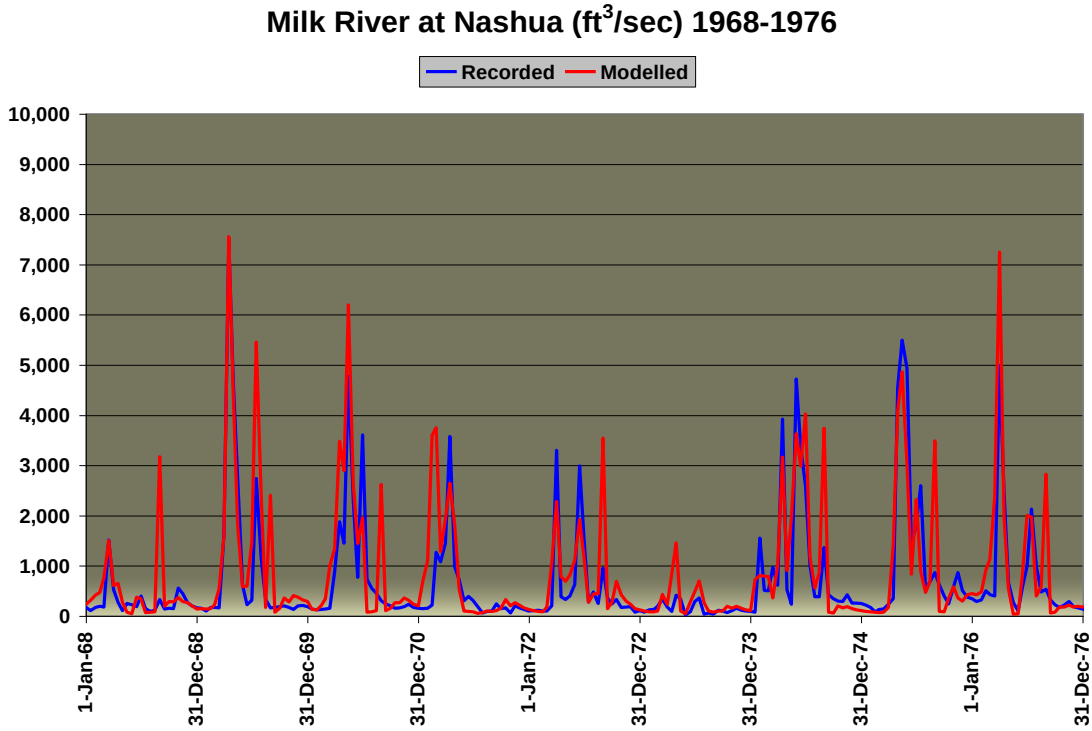
4-5.4 (1986 – 1994)

4-5.5 (1995 – 2003)

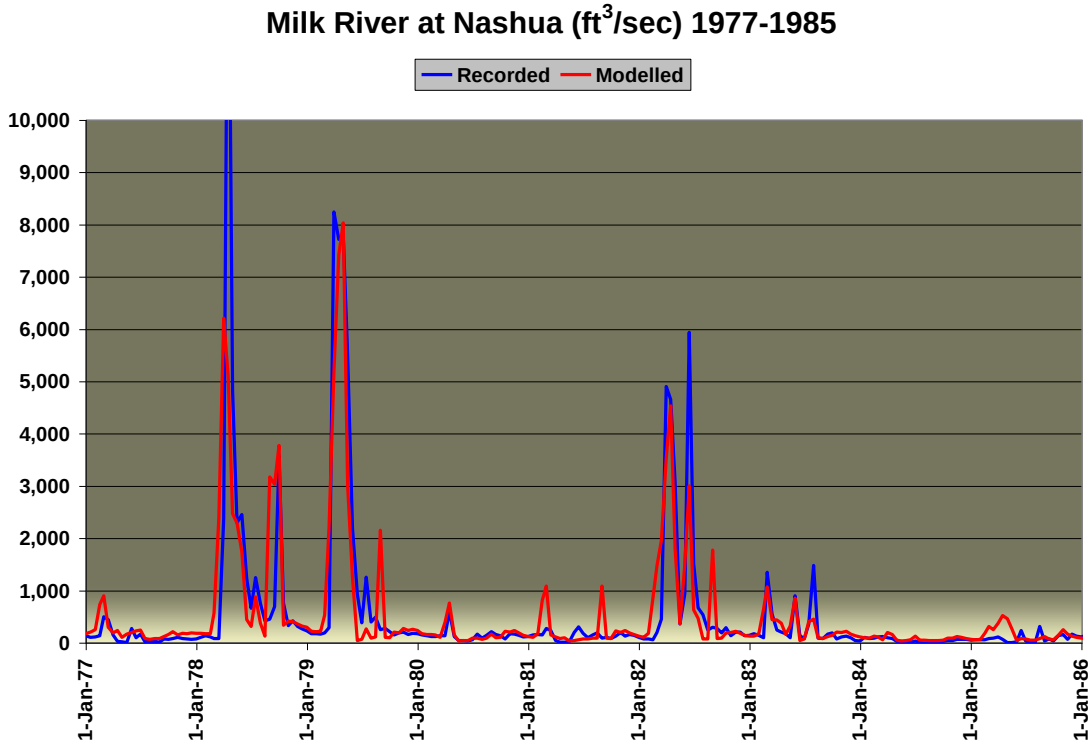
4-5.1



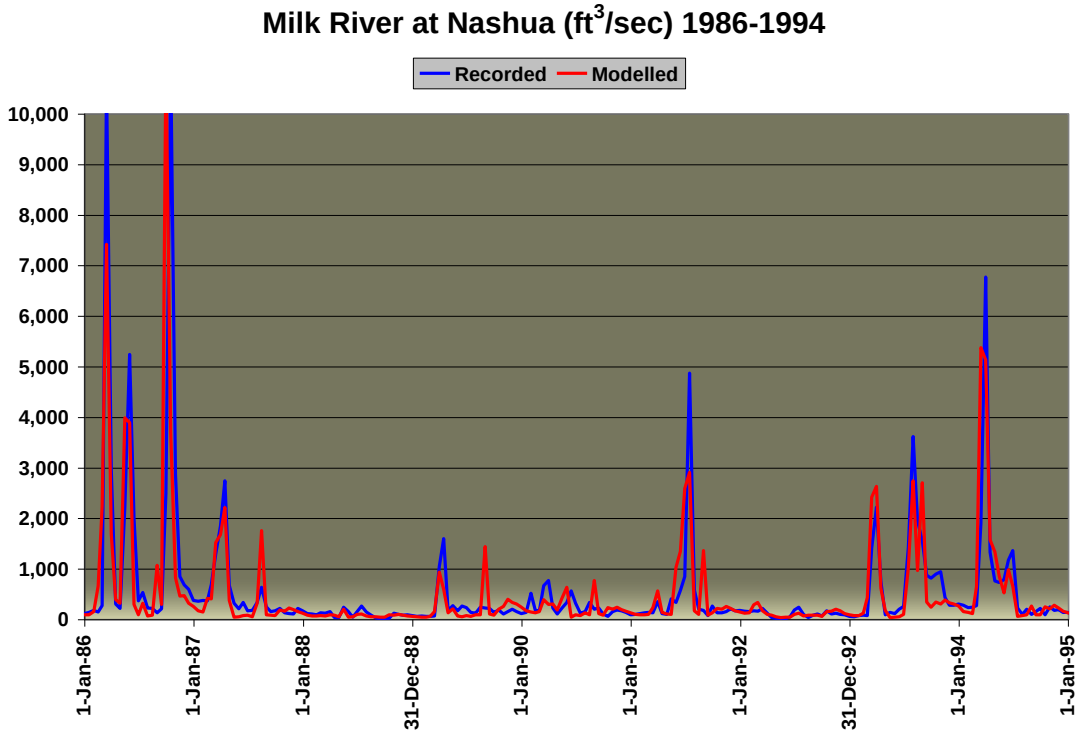
4-5.2


Milk River at Nashua (ft3/sec) 1968-1976
Recorded
Modelled
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan-68
31-Dec-68
31-Dec-69
31-Dec-70
1-Jan-72
31-Dec-72
31-Dec-73
31-Dec-74
1-Jan-76
31-Dec-76

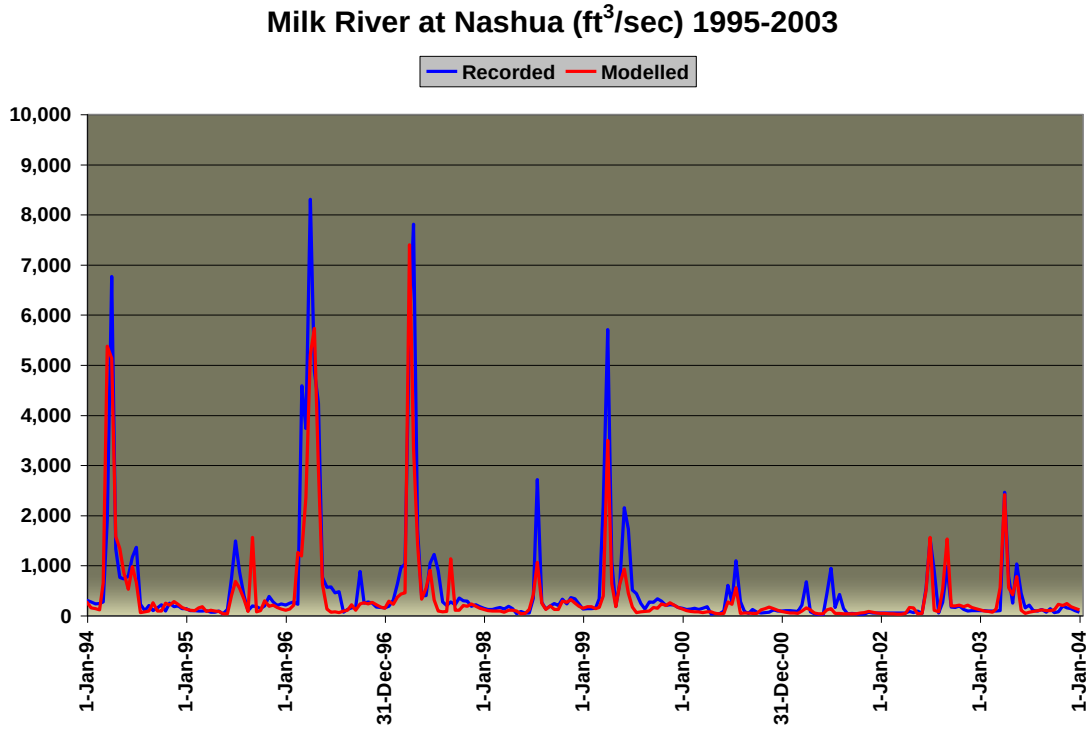
4-5.3


Milk River at Nashua (ft3/sec) 1977-1985
Recorded
Modelled
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan-77
1-Jan-78
1-Jan-79
1-Jan-80
1-Jan-81
1-Jan-82
1-Jan-83
1-Jan-84
1-Jan-85
1-Jan-86

4-5.4


Milk River at Nashua (ft3/sec) 1986-1994
Recorded
Modelled
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan-86
1-Jan-87
1-Jan-88
31-Dec-88
1-Jan-90
1-Jan-91
1-Jan-92
31-Dec-92
1-Jan-94
1-Jan-95

4-5.5


Milk River at Nashua (ft3/sec) 1995-2003
Recorded
Modelled
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1-Jan-94
1-Jan-95
1-Jan-96
31-Dec-96
1-Jan-98
1-Jan-99
1-Jan-00
31-Dec-00
1-Jan-02
1-Jan-03
1-Jan-04

Appendix 5 – Results Viewer

Results Viewer

This document is a pdf version of the MT-AB Model Results Viewer spreadsheet. This document was generated for the purpose of readability and publication.

There may be minor discrepancies in page layout as each excel tab was converted to pdf. The document also does not contain interactive components of the spreadsheet, in which the user can select an option, and results across four different performance measures will be displayed as compared to two base cases. All results are provided, by performance measure, in the last four sections of the document.

The document contains the following sections, which refers to each tab in the spreadsheet.

SELECTION: This section displays the "Selection" tab from the spreadsheet, with the Option 1.1.1.2 (2a) selected. In the spreadsheet, 100 different structural and administrative options can be selected from the drop-down menu. Once a structural or administrative option is selected, results for that option can be viewed by clicking on the "View Results" button.

OPTION RESULTS: This section provides the results for Option 1.1.1.2 or 2a. An overview of results is displayed on this spreadsheet tab, when a structural or administrative option is selected, which can be done for all 100 options modelled. The results displayed on this page, includes a comparison of the selected option against two base cases across four performance measures: (a) Annual percentage of entitlement accessed by Montana and Alberta, (b) Annual volume of entitlement accessed (acre-feet) by Montana and Alberta, (c) Montana irrigation performance summary and (d) Alberta irrigation performance summary.

STRUCTURAL OPTIONS: This section provides the list of all structural options modelled.

ADMINISTRATIVE OPTIONS: This section provides the list of all administrative options modelled.

DEFINITIONS: This section provides information on model assumptions for existing infrastructure and the rules of the 1921 order for water apportionment.

ENTITLEMENTS: This section contains model input data for the annual US and Canadian entitlements from 1959 to 2003, the average volume for that period, as well as the average entitlements during the 11 driest years and 22 driest years.

OPERATIONS: This section displays graphs and tables that show the original and modified reservoir operation curves. The original reservoir operation curve is used for Sherburne Reservoir for all options, except for several structural options and a few administrative options. The options that use the modified reservoir operation curve are specified in the descriptions in the Structural Options and Administrative Options sections.

ENTITLEMENT SUMMARY (%): This section provides the results for all 100 options, for the performance measure: annual percentage of entitlement accessed by Montana and Alberta.

ENTITLEMENT SUMMARY (VOL): This section provides of the results for all 100 options, for the performance measure: annual volume of entitlement accessed by Montana and Alberta.

MONTANA IRRIGATION PERFORMANCE SUMMARY: This section provides the results for all 100 options for the performance measure: Montana's irrigation performance.

ALBERTA IRRIGATION PERFORMANCE SUMMARY: This section provides the results for all 100 options for the performance measure: Alberta's irrigation performance.

Copies of the Microsoft Excel spreadsheet can be obtained from:

Montana Department of Natural Resources and Conservation
Water Resources Division
dnrc_publicinfo@mt.gov

Alberta Environment and Protected Areas
Transboundary Waters
AEP.TWS@gov.ab.ca

SELECTION

RESULTS VIEWER

Modelling of St. Mary - Milk River System, 2009 to 2011

Approximately 100 OPTIONS were modelled. To view the Results for an OPTION, first select the OPTION by Category and Sub-Category, then choose the "VIEW RESULTS" button.

1. STRUCTURAL OPTIONs | 2. ADMINISTRATIVE OPTIONs | VIEW RESULTS

Existing (2010) Infrastructure | Sherburne Operations | Canadian St Mary Operations | 1921 Order | ENTITLEMENTS

- 1.1 INDEPENDENT U.S. INFRASTRUCTURE
  - 1.1.1 Increased U.S. St Mary Canal Diversion Capacity Options
    - Option 1.1.1.1 (1a)
    - Option 1.1.1.2 (2a)
    - Option 1.1.1.3 (2a1)
    - Option 1.1.1.4 (2c)
    - Option 1.1.1.5 (2c1)
    - Option 1.1.1.6 (2d)
    - Option 1.1.1.7 (2e)
    - Option 1.1.1.8 (2f)
    - Option 1.1.1.9 (3)
  - 1.1.2 Regulated Storage On Lower St Mary Lake (LSML) Options
    - Option 1.1.2.1 (4c)
    - Option 1.1.2.2 (4a)
    - Option 1.1.2.3 (4a1)
    - Option 1.1.2.4 (4b)
    - Option 1.1.2.5 (4d)
    - Option 1.1.2.6 (4e)
    - Option 1.1.2.7 (9)
  - 1.1.3 Increased Storage On Lake Sherburne Reservoir Options
    - Option 1.1.3.1 (5a)
    - Option 1.1.3.2 (5b)
    - Option 1.1.3.3 (5c)
  - 1.1.4 Increased Storage on both Lower St Mary Lake and Lake Sherburne Reservoir
    - Option 1.1.4.1 (6a)
    - Option 1.1.4.2 (6a1)
    - Option 1.1.4.3 (6b)
    - Option 1.1.4.4 (6c)
    - Option 1.1.4.5 (6d)
  - 1.1.5 Maximum Water Supply and Increased Delivery and Irrigation Efficiency
    - Option 1.1.5.1 (1b)
    - Option 1.1.5.2 (2b)
    - Option 1.1.5.3 (21a)
    - Option 1.1.5.4 (21b)
    - Option 1.1.5.5 (21c)
    - Option 1.1.5.6 (21e)
    - Option 1.1.5.7 (21d)

RULES OF THE 1921 ORDER

St Mary River: $QNat_{IB}$ = Natural Flow at the International Boundary

	$QNat_{IB}$	Canadian Entitlement	U.S. Entitlement
April 1 to October 31	666 cfs or Less	75% of $QNat_{IB}$	25% of $QNat_{IB}$
	More than 666 cfs	500 + 50% of ($QNat_{IB}$ - 666)	166 + 50% of ($QNat_{IB}$ - 666)
November 1 to March 31	All Flows	50% of $QNat_{IB}$	50% of $QNat_{IB}$

Milk River: $QNat_{IB}$ = Natural Flow at the International Boundary, Eastern Crossing

	$QNat_{IB}$	Canadian Entitlement	U.S. Entitlement
April 1 to October 31	666 cfs or Less	25% of $QNat_{IB}$	75% of $QNat_{IB}$
	More than 666 cfs	166 + 50% of ($QNat_{IB}$ - 666)	500 + 50% of ($QNat_{IB}$ - 666)
November 1 to March 31	All Flows	50% of $QNat_{IB}$	50% of $QNat_{IB}$

2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal (2a)

2a

Results for OPTION 1.1.1.2 (2a)

BACK

Annual Percentage of Entitlement Accessed

		Montana		Alberta			
		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River Flow into Canada	Accessed from US Canal diversion	St Mary River Total Accessed	Milk River Accessed
	Avg. driest 11 years	94	137	104	0	104	27
	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	80	147	114	0	114	13
1.1.1.1 (1a)	Avg. driest 11 years	93	137	105	0	105	27
	Avg. driest 22 years	88	142	108	0	108	17
	Average 45 years	75	147	117	0	117	13
2.2.2.1 (10a)	Avg. driest 11 years	95	138	102	1	103	26
	Avg. driest 22 years	90	143	106	1	107	17
	Average 45 years	76	147	115	1	116	12

BASE CASE OPTIONS Presented for Comparison Purposes

Annual Volume of Entitlement Accessed (Acre-Feet)

		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural Flow at International Border - Flow into Canada)	Net Accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into	Accessed (From US St Mary canal	Total Accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
	Avg. driest 11 years	181,899	170,403	170,403	29,536	40,565	210,968	291,339	302,835	0	302,835	15,099	4,058	306,893
	Avg. driest 22 years	207,748	188,275	188,275	50,257	71,611	259,886	321,557	341,030	0	341,030	25,870	4,502	345,532
	Average 45 years	261,021	209,370	209,370	81,114	118,909	328,279	379,266	430,917	0	430,917	43,421	5,613	436,530
1.1.1.1 (1a)	Avg. driest 11 years	181,899	168,777	168,777	29,536	40,565	209,342	291,339	304,461	0	304,461	15,099	4,058	308,519
	Avg. driest 22 years	207,748	183,253	183,253	50,257	71,611	254,864	321,557	346,052	0	346,052	25,870	4,502	350,554
	Average 45 years	261,021	196,392	196,392	81,114	118,909	315,301	379,266	443,895	0	443,895	43,421	5,613	449,508
2.2.2.1 (10a)	Avg. driest 11 years	181,899	176,045	172,171	29,536	40,717	212,888	291,339	297,193	3,874	301,067	15,099	3,907	304,974
	Avg. driest 22 years	207,748	189,941	186,186	50,257	71,800	257,985	321,557	339,364	3,755	343,119	25,870	4,314	347,433
	Average 45 years	261,021	202,455	199,028	81,114	119,170	318,198	379,266	437,832	3,427	441,259	43,421	5,353	446,612

BASE CASE OPTIONS Presented for Comparison Purposes

2a

Results for OPTION 1.1.1.2 (2a)

BACK

Montana Irrigation Performance Summary

		Private Irrigaton Deficits		District Irrigation Deficits						Total Milk River		
		Upstream of Dodson	Downstream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
Average (inches)		1.86	1.13	2.16	1.27	3.07	2.76	4.37	4.65	3.18	137,042	430,382
Deficits >= 4 inches		7	5	8	4	10	9	16	20	11		
1.1.1.1 (1a)	Average	2.05	1.18	2.20	1.33	3.10	2.76	4.62	5.10	3.36	137,042	424,560
	Deficits >= 4 inches	8	5	8	4	12	9	19	21	13		
2.2.2.1 (10a)	Average	2.01	1.08	2.21	1.33	3.10	2.77	4.66	5.01	3.34	137,042	424,834
	Deficits >= 4 inches	8	4	8	4	11	9	20	19	13		

BASE CASE OPTIONS Presented for Comparison Purposes

Alberta Irrigation Performance Summary

		Southern Tributaries Irrigation											Milk River Irrigation		
		Private Irrigation Deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
		Southern Tributaries Basins	Blood Tribe Irrigation Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
Average (inches)		2.11	0.93	0.60	0.33	1.22	0.54	0.78	1.83	0.72	615,681	757,608	7.67	8,069	4,925
Deficits >= 4 inches		8	1	1	1	1	1	1	3				36		
1.1.1.1 (1a)	Average (inches)	2.11	0.93	0.60	0.33	1.20	0.53	0.78	1.83	0.71	615,681	757,904	7.67	8,069	4,925
	Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2.2.2.1 (10a)	Average (inches)	2.11	0.96	0.61	0.35	1.25	0.57	0.78	1.83	0.73	615,681	756,653	4.37	8,069	8,089
	Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
1.1.2.7 (9)	Average (inches)	2.11	0.98	0.63	0.37	1.32	0.60	0.80	1.83	0.75	615,681	755,369	7.67	8,069	4,925
	Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		

BASE CASE OPTIONS Presented for Comparison Purposes

STRUCTURAL OPTIONS

1.1 INDEPENDENT U.S. INFRASTRUCTURE	This series of Options examines the increase in access to entitlements and water utilization that can be realized through improvements to U.S. owned infrastructure. The improvements investigated include: increases in diversion canal capacities, increases in storage, and improvements in water delivery systems.
1.1.1 Increased U.S. St Mary Canal Diversion Capacity Options	
Option 1.1.1.1	2010 Infrastructure (1a)
Option 1.1.1.2	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal (2a)
Option 1.1.1.3	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown for Lake Sherburne Reservoir (2a1)
Option 1.1.1.4	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; original 137,000 ac-ft storage on Fresno Reservoir (2c)
Option 1.1.1.5	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; original 137,000 ac-ft storage on Fresno Reservoir; modified drawdown for Lake Sherburne Reservoir (2c1)
Option 1.1.1.6	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal with Canal maintained at canal capacity as long as possible. (2d)
Option 1.1.1.7	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; increased 160,000 ac-ft storage on Fresno Reservoir; modified drawdown curve for Lake Sherburne Reservoir (2e)
Option 1.1.1.8	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 80-year future siltation reduced 50,000 ac-ft storage on Fresno Reservoir; and modified drawdown curve for Lake Sherburne Reservoir (2f)
Option 1.1.1.9	2010 Infrastructure, but 1200 cfs U.S. St Mary Diversion Canal (3)
1.1.2 Regulated Storage On Lower St Mary Lake (LSML) Options	
Option 1.1.2.1	2010 Infrastructure, but new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML. (4c)
Option 1.1.2.2	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML. (4a)
Option 1.1.2.3	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML; modified Lake Sherburne Reservoir drawdown (4a1)
Option 1.1.2.4	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal with Canal maintained at capacity as long as possible; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML (4b)
Option 1.1.2.5	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML; original 137,000 ac-ft storage on Fresno Reservoir (4d)
Option 1.1.2.6	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML; increased 160,000 ac-ft storage in Fresno Reservoir (4e)
Option 1.1.2.7	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal maintained at capacity as long as possible; maximum storage required on Lower St Mary Lake for Montana to access 100% of entitlement (9)
1.1.3 Increased Storage On Lake Sherburne Reservoir Options	
Option 1.1.3.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 10,000 ac-ft storage on Lake Sherburne Reservoir (5a)

Option 1.1.3.2	As OPTION 1.1.3.1, but 20 cfs IFN below Lake Sherburne Reservoir (5b)
Option 1.1.3.3	As OPTION 1.1.3.2, but over winter storage (no fall target) on Lake Sherburne Reservoir (5c)
1.1.4 Increased Storage on both Lower St Mary Lake and Lake Sherburne Reservoir	
Option 1.1.4.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake; new 10,000 ac-ft storage on Lake Sherburne Reservoir. (6a)
Option 1.1.4.2	As OPTION 1.1.4.1, but modified Lake Sherburne Reservoir drawdown (6a1)
Option 1.1.4.3	As OPTION 1.1.4.1, but 20 cfs IFN below Lake Sherburne Reservoir drawdown (6b)
Option 1.1.4.4	As OPTION 1.1.4.3, but no fall target for Lake Sherburne Reservoir (6c)
Option 1.1.4.5	As OPTION 1.1.4.1, but 850 cfs U.S. St Mary Diversion Canal maintained at capacity for as long as possible (6d)
1.1.5 Maximum Water Supply and Increased Delivery and Irrigation Efficiency	
Option 1.1.5.1	2010 Infrastructure, but non-restrictive Milk River Project Irrigation Delivery Canal Capacities. (1b)
Option 1.1.5.2	As OPTION 1.1.5.1, but 850 cfs U.S. St Mary Diversion Canal (2b)
Option 1.1.5.3	As OPTION 1.1.5.2, but AB Milk River irrigation efficiencies (30% return flows) and irrigation standards (water application at 80% of Optimal crop water requirement) applied to all irrigation including in Montana. (21a)
Option 1.1.5.4	As OPTION 1.1.5.3, but new 8,800 ac-ft storage on Lower St Mary Lake (21b)
Option 1.1.5.5	As OPTION 1.1.5.4, but determine maximum acreage that can be irrigated in MT to AB irrigation standard (4” or greater irrigation deficit occurring no more than 1 in 10 years) (21c)
Option 1.1.5.6	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; determine maximum acreage that can be irrigated if MT district efficiencies increased from current 35% (65% return flow) to 50% (50% return flow) and non-district efficiency from 40% (60% return flow) to 60% (40 % return flow) (21e)
Option 1.1.5.7	As OPTION 1.1.5.6, but with the Current LOI (Letter Of Intent) (21d)
1.1.6 Off-Stream Storage in Montana	
Option 1.1.6.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown curve for Lake Sherburne Reservoir; 5,000 ac-ft off-stream storage along lower reaches of U.S. St Mary Diversion Canal (17a)
Option 1.1.6.2	As OPTION 1.1.6.1, but 10,000 ac-ft off-stream storage along lower reaches of U.S. St Mary Diversion Canal (17b)
Option 1.1.6.3	As OPTION 1.1.6.1, but 200,000 ac-ft off-stream storage along lower reaches of U.S. St Mary Diversion Canal (17c)
Option 1.1.6.4	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown curve for Lake Sherburne Reservoir; new 60,000 ac-ft off-stream storage in Ft Belknap reservation. Ft Belknap with 1st MT priority from Milk River right to divert 1st 125 cfs for existing Ft Belknap irrigation, and an additional 520 cfs diversion for new storage and 19,390 new acres of irrigation on the reservation (22)
1.2 INDEPENDENT CANADIAN INFRASTRUCTURE	This series of Options examines the increase in access to entitlements and water utilization that can be realized through construction of a Milk River Dam within the Canadian Milk River Basin.
1.2.1 Increased Canadian Storage on Milk River	
Option 1.2.1.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 122,000 ac-ft Canadian Storage on Milk River with 15 cfs winter IFN below reservoir (7a)

Option 1.2.1.2	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 188,000 ac-ft Canadian Storage on Milk River with 15 cfs winter IFN below reservoir (7b)
Option 1.2.1.3	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 237,000 ac-ft Canadian Storage on Milk River with 15 cfs winter IFN below reservoir (7c)
Option 1.2.1.4	As OPTION 1.2.1.3, but modified Lake Sherburne Reservoir drawdown curve (8d)
1.3 SHARED INFRASTRUCURE	This series of Options examines the increase in access to entitlements and water utilization that can be realized through joint improvements in infrastructure. The joint/shared improvements investigated include; the construction of shared storage on the Canadian Milk River; shared increased storage on Fresno Reservoir and St Mary Reservoir; shared use of the U.S. St Mary Diversion Canal.
1.3.1 Shared Storage on Canadian Milk River	
Option 1.3.1.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified Lake Sherburne Reservoir drawdown curve; 237,000 ac-ft storage on Canadian Milk River with capacity shared equally (118,500 ac-ft for AB and 118,500 ac-ft for MT); 15 cfs winter and 25 cfs summer IFN below reservoir; U.S. share of reservoir stores U.S. St Mary diversions and U.S. Milk River entitlements (8a)
Option 1.3.1.2	As OPTION 1.3.1.1, but U.S. share of reservoir stores U.S. St Mary diversions and U.S. share of Milk River natural flow above Fort Belknap's 645 cfs allocation. (8b)
Option 1.3.1.3	As OPTION 1.3.1.1, but storage on Canadian Milk River has capacity shared 75% AB and 25% MT (177,750 ac-ft for AB and 59,250 ac-ft for MT) (8c)
Option 1.3.1.4	As OPTION 1.3.1.1, but 1,000 cfs U.S. St Mary Diversion Canal (8e)
Option 1.3.1.5	As OPTION 1.3.1.1, but storage in Fresno reduced to 50,000 ac-ft (80 year future storage) (8f)
1.3.2 Shared (AB and MT) Increased Storage in Fresno Reservoir	
Option 1.3.2.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 137,000 ac-ft Fresno Reservoir with storage above current 83,000 ac-ft shared equally between AB and MT. AB surplus deliveries stored as a credit and AB may draw on stored credit from U.S. flows (Milk natural and St. Mary diversions) in Milk River. Winter drawdown to fall target at 100,000 ac-ft with any fall release to bring storage to target shared proportionately based on storage capacity owned by AB and MT (18a)
Option 1.3.2.2	As Option 1.3.2.1, but any Winter release required to draw Fresno down to 100,000 ac-ft Winter Storage is achieved entirely based on release of Montana stored water (18b)
1.3.3 Canada Participates in U.S. St Mary Canal to Divert Canadian Water	
Option 1.3.3.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown for Lake Sherburne Reservoir; under current LOI Canada utilizes U.S. Canal to divert Canadian St Mary water to irrigate 13,000 acres in Canadian Milk River basin (19a)
Option 1.3.3.2	As OPTION 1.3.3.1, but irrigation of 18,000 acres in Canadian Milk River basin (19b)
Option 1.3.3.3	As OPTION 1.3.3.1, but irrigation of existing 8,069 acres in Canadian Milk River basin (19f)
Option 1.3.3.4	As OPTION 1.3.3.1, but NO LOI (19c)

Option 1.3.3.5	As OPTION 1.3.3.2, but NO LOI (19d)
Option 1.3.3.6	As OPTION 1.3.3.3, but NO LOI (19e)
1.3.4 Canada Participates in U.S. St Mary Canal with Access to U.S. Diversions	
Option 1.3.4.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown for Lake Sherburne Reservoir; under current LOI Canada utilizes U.S. St Mary diversions to help meet Canadian irrigation requirements for existing 8,069 acres in Milk River basin (20f)
Option 1.3.4.2	As OPTION 1.3.4.1, but U.S. diversions utilized to help meet Canadian irrigation requirements for 13,000 acres in Milk River basin (20a)
Option 1.3.4.3	As OPTION 1.3.4.1, but U.S. diversions utilized to help meet Canadian irrigation requirements for 18,000 acres in Milk River basin (20b)
Option 1.3.4.4	As OPTION 1.3.4.1, but NO LOI (20e)
Option 1.3.4.5	As OPTION 1.3.4.2, but NO LOI (20c)
Option 1.3.4.6	As OPTION 1.3.4.3, but NO LOI (20d)

ADMINISTRATIVE OPTIONS

2.1 ENTITLEMENT MODIFICATIONS TO 1921 ORDER FOR NATURAL FLOWS > 666 CFS	This series of OPTIONs examines the increase in access to entitlements and water utilization that can be realized through Entitlement modifications to the 1921 Order for Natural Flows > 666 cfs.
2.1.1 Modification to Sharing of Flows above 666 cfs within 1921 Order	**1st Modification to 1921 Order:** St Mary River irrigation season – AB to receive 75% and MT 25% of first 666 cfs; AB to receive 25% and MT 75% of flow above 666 cfs but below 1332 cfs; flow above 1,332 cfs to be shared equally. Milk River irrigation season – MT to receive 75% and AB 25% of first 666 cfs; MT to receive 25% and AB 75% of flow above 666 cfs but below 1332 cfs; flow above 1,332 cfs to be shared equally. **2nd Modification to 1921 Order:** St Mary River irrigation season – AB to receive 75% and MT 25% of first 666 cfs; AB to receive 35% and MT 65% of flow above 666 cfs but below 1332 cfs; flow above 1,332 cfs to be shared equally. Milk River irrigation season – MT to receive 75% and AB 25% of first 666 cfs; MT to receive 20% and AB 80% of flow above 666 cfs. **3rd Modification to 1921 Order:** As 2nd Modification, but with the Provisos: St Mary River irrigation season – AB shall not receive less than its entitlement under the 1921 Order in any calendar year. Milk River irrigation season – MT shall not receive less than its entitlement under the 1921 Order in any calendar year.
Option 2.1.1.1	2010 Infrastructure, but 1st Modification to 1921 Order (23a)
Option 2.1.1.2	As OPTION 2.1.1.1, but 850 cfs U.S. St Mary Diversion Canal (23b)
Option 2.1.1.3	As OPTION 2.1.1.2, but 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML (23c)
Option 2.1.1.4	As OPTION 2.1.1.3, but 237,000 ac-ft Canadian Storage on Milk River with 15 cfs winter IFN below reservoir (23d)
Option 2.1.1.5	2010 Infrastructure, but model only Canadian Southern Tributaries system (St Mary, Waterton, and Belly River) with Canada receiving its modified share under the 1st Modification to 1921 Order (23e)
Option 2.1.1.6	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; 2nd Modification to 1921 Order (23f)
Option 2.1.1.7	2010 Infrastructure, but 3rd Modification to 1921 Order; modified drawdown for Lake Sherburne Reservoir. (MO2)
Option 2.1.1.8	As OPTION 2.1.1.7, but 850 cfs U.S. St Mary Diversion Canal. (MO3)
Option 2.1.1.9	As OPTION 2.1.1.7, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML (MO4)
Option 2.1.1.10	As OPTION 2.1.1.7, but 1,000 cfs U.S. St Mary Diversion Canal. (MO5)
Option 2.1.1.11	As OPTION 2.1.1.7, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake with 25 cfs IFN below LSML; 237,000 ac-ft Canadian Storage on Milk River with 15 cfs winter IFN below reservoir (MO6)
Option 2.1.1.12	As OPTION 2.1.1.7 but giving Canadian Milk River users access to up 4,000 Acre-Feet of Water from the US entitlement (MO2A)
Option 2.1.1.13	As OPTION 2.1.1.7 but giving Canadian Milk River users access to up 6,000 Acre-Feet of Water from the US entitlement (MO2B)
2.2 CHANGE IN ADMINISTRATIVE PROCEDURES	
2.2.1 Change in Balancing Period to Seasonal or Annual Water Year	**This series of Options examines the increase in access to current entitlements and water utilization that can be realized through modifications in the balancing period from bi-monthly to either Seasonal (April 1 to October 31) or Annual water year (November 1 to October 31), with the upstream jurisdiction at its discretion taking more or less of its daily entitlement, provided that the downstream jurisdiction entitlements are met on a seasonal or annual basis.**

ADMINISTRATIVE OPTIONS

Option 2.2.1.1	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; IFN on St Mary River in Canada = 35% of natural flow; Seasonal (April 1-October 31) independent balancing of entitlements on the St Mary River and Milk River; Canadian Milk River irrigators accessing the entire Milk River natural flow; modified drawdown for Lake Sherburne Reservoir. (16a)
Option 2.2.1.2	As OPTION 2.2.1.1, but Annual water year independent balancing of entitlements on the St Mary River and Milk River (16b)
Option 2.2.1.3	As OPTION 2.2.1.1, but Canadian Milk River irrigators accessing the entire Milk River natural flow and U.S. St Mary Diversion flow (16c)
Option 2.2.1.4	As OPTION 2.2.1.1, but Annual water year independent balancing of entitlements on the St Mary River and Milk River; Canadian Milk River irrigators accessing the entire Milk River natural flow and U.S. St Mary Diversion flow; 137,000 ac-ft Fresno live storage (16d)
Option 2.2.1.5	As OPTION 2.2.1.1, but Annual water year independent balancing of entitlements on the St Mary River and Milk River; Canadian Milk River irrigators accessing the entire Milk River natural flow and U.S. St Mary Diversion flow; 8,800 ac-ft additional storage on Lower St Mary Lake (16e)
Option 2.2.1.6	As OPTION 2.2.1.5, but 137,000 ac-ft Fresno live storage(16f)
Option 2.2.1.7	As OPTION 2.2.1.6, but 237,000 ac-ft live storage in Canadian Reservoir on Milk River (16g)
2.2.2 Deficit Trading – Letter of Intent	**In 2001 the Accredited Officers, at the request of Alberta and Montana, implemented a "Letter Of Intent" that allows Montana to accumulate a delivery deficit on the St Mary River of up to 8,000 ac-ft during the spring. Of this 8,000 ac-ft, 4,000 ac-ft must be paid back during the high flow season and 4,000 ac-ft can be balanced by trading it against a counterbalancing 4,000 ac-ft deficit that Alberta is allowed to accumulate on the Milk River. This series of Options examines the increase in access to current entitlements and water utilization that can be realized through an expansion of the allowable deficit.**
Option 2.2.2.1	2010 Infrastructure, but deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (10a)
Option 2.2.2.2	2010 Infrastructure, but larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (10b)
Option 2.2.2.3	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (11a)
Option 2.2.2.4	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (11b)
Option 2.2.2.5	2010 Infrastructure, but 1,200 cfs U.S. St Mary Diversion Canal; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (12a)
Option 2.2.2.6	2010 Infrastructure, but 1,200 cfs U.S. St Mary Diversion Canal; larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (12b)
Option 2.2.2.7	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (13a)
Option 2.2.2.8	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake; larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (13b)
Option 2.2.2.9	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 8,800 ac-ft storage on Lower St Mary Lake; modified drawdown curve for Lake Sherburne Reservoir; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (13a1)

Option 2.2.2.10	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 10,000 ac-ft of storage on Lake Sherburne Reservoir with no winter drawdown and 20 cfs IFN below Lake Sherburne Reservoir; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (14a)
Option 2.2.2.11	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 10,000 ac-ft of storage on Lake Sherburne Reservoir with no winter drawdown and 20 cfs IFN below Lake Sherburne Reservoir; larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (14b)
Option 2.2.2.12	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 10,000 ac-ft of storage on Lake Sherburne Reservoir with no winter drawdown and 20 cfs IFN below Lake Sherburne Reservoir; new 8,800 ac-ft storage on Lower St Mary Lake; deficit trading (8,000 ac-ft/4,000 ac-ft) under current (2010) Letter of Intent (15a)
Option 2.2.2.13	2010 Infrastructure, but 850 cfs U.S. St Mary Diversion Canal; new 10,000 ac-ft of storage on Lake Sherburne Reservoir with no winter drawdown and 20 cfs IFN below Lake Sherburne Reservoir; new 8,800 ac-ft storage on Lower St Mary Lake; larger deficit trading (20,000 ac-ft/10,000 ac-ft) under revised Letter of Intent (15b)
2.2.3 Capped Credit System based on Surplus Deliveries	Under the current procedures used to administer the 1921 Order; - the entitlements are to be computed on a daily basis with balancing on a semi-monthly (15th and end of month) basis, - Surplus deliveries within any balancing period are forfeited, and - Deficit deliveries during a semi-monthly balancing period are to be made up in the next balancing period. This series of Options examines the increase in access to current entitlements and water utilization that can be realized through a modification in the administrative procedures in which surplus deliveries accumulate as a credit to the upstream jurisdiction (to an upper cap) which the upstream jurisdiction can then draw on at a later date, by taking more than its entitlement providing certain specified conditions are met. Unless otherwise specified, all simulations are carried out for existing (2010) infrastructure and the following conditions: - All credits can be accumulated and must be used within a water year (November 1 to October 31) - Any residual/unused credits are zeroed on October 31 - In drawing on its credits, AB may draw up to a maximum of 4,000 acre-feet from U.S. St Mary diversions with the balance of credits having to be drawn from U.S. Milk River entitlements, - In drawing on its credits, MT must maintain the following flow in the St Mary River at the international boundary; When the natural flow is less than 570 cfs – the lesser of Canada's share or 200 cfs, When the natural flow is greater than 570 cfs - 35% of the natural flow.
Option 2.2.3.1	2010 Infrastructure; Credit accumulated by the U.S. on the St Mary is capped at a maximum of 32,000 ac-ft; Credit accumulated by Canada on the Milk is capped at a maximum of 16,000 ac-ft. (MT1a)
Option 2.2.3.2	As OPTION 2.2.3.1, but 850 cfs U.S. St Mary Diversion Canal; modified drawdown Lake Sherburne Reservoir (MT1b)
Option 2.2.3.3	As OPTION 2.2.3.2, but new 8,800 ac-ft storage on Lower St Mary Lake (MT1c)
Option 2.2.3.4	As OPTION 2.2.3.2, but 237,000 ac-ft Canadian Milk River Reservoir (MT1d)
Option 2.2.3.5	As OPTION 2.2.3.2, but new 8,800 ac-ft storage on Lower St Mary Lake; 237,000 ac-ft Canadian Milk River Reservoir (MT1e)

ADMINISTRATIVE OPTIONS

Option 2.2.3.6	Full version of the JIT model, 2010 Infrastructure, but IFNs of 15/25 cfs below Sherburne Lake Reservoir and 50 cfs below U.S. St Mary Diversion Canal; Uses a two credit system with Montana first diverting entitlements, followed by storage and lastly credits. MT can accumulate two credits on the St Mary River: Winter Credit accumulates during October 15 to March 31, is capped at a 16,000 ac-ft, and may be used during March 16 to May 31; Spring Credit accumulates during June 1 to July 15, is capped at 16,000 ac-ft, and may be used during June 1 to October 15. AB can accumulate one credit on the Milk River during October 15 to May 31, is capped at 16,000 ac-ft, and may be used any time up to October 15. Any unused credits are zeroed. The credit system is replaced by a modified LOI during years with low (Natural flow and Storage in the Canadian St Mary and Ridge Reservoirs). In drawing on its credits, MT must maintain 45% of natural flow in the St Mary River at the international boundary (CrSysLOICap1)
Option 2.2.3.7	As OPTION 2.2.3.6 but with 850 cfs US St Mary diversion canal (CrSysLOICap2)

DEFINITIONS

Existing (2010) Infrastructure

Unless otherwise specified, all simulations are modelled with existing (2010) infrastructure which includes the following:

U.S. ST MARY DIVERSION CANAL: Capacity = 650 cfs
LOWER ST MARY LAKE: Live Storage = 0 ac-ft
LAKE SHERBURNE RESERVOIR: Live Storage = 66,147 ac-ft; Drawdown begins October 1st; Fall Target Level = 27,000 ac-ft
FRESNO RESERVOIR: Live Storage = 83,000 ac-ft (projected 2015 capacity); Fall Target Level = 46,000 ac-ft
INSTREAM FLOW REQUIREMENT below Lake Sherburne Reservoir = 0.0 cfs
IRRIGATED ACREAGES:
- Canadian Milk River basin = 8,069 acres
- U.S. Milk River Basin = 137,042 acres
- Canadian Southern Tributaries = 615,681 acres

RULES OF THE 1921 ORDER

St Mary River: $QNat_{IB}$ = Natural Flow at the International Boundary

	$QNat_{IB}$	Canadian Entitlement	U.S. Entitlement
April 1 to October 31	666 cfs or Less	75% of $QNat_{IB}$	25% of $QNat_{IB}$
	More than 666 cfs	500 + 50% of ($QNat_{IB}$ - 666)	166 + 50% of ($QNat_{IB}$ - 666)
November 1 to March 31	All Flows	50% of $QNat_{IB}$	50% of $QNat_{IB}$

Milk River: $QNat_{IB}$ = Natural Flow at the International Boundary, Eastern Crossing

	$QNat_{IB}$	Canadian Entitlement	U.S. Entitlement
April 1 to October 31	666 cfs or Less	25% of $QNat_{IB}$	75% of $QNat_{IB}$
	More than 666 cfs	166 + 50% of ($QNat_{IB}$ - 666)	500 + 50% of ($QNat_{IB}$ - 666)
November 1 to March 31	All Flows	50% of $QNat_{IB}$	50% of $QNat_{IB}$

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1959	Prior Appropriation Share	68,863	68,181	137,044	207,322	22,716	230,038	
	50/50 Share	271,310	28,954	300,264	271,310	28,954	300,264	
	Total	340,173	97,135	437,308	478,632	51,670	530,302	967,609
1960	Prior Appropriation Share	57,146	47,886	105,032	171,881	15,961	187,842	
	50/50 Share	156,241	27,366	183,607	156,241	27,366	183,607	
	Total	213,387	75,252	288,639	328,122	43,327	371,449	660,088
1961	Prior Appropriation Share	59,653	27,387	87,040	179,376	9,129	188,505	
	50/50 Share	194,903	8,658	203,561	194,903	8,658	203,561	
	Total	254,557	36,045	290,602	374,280	17,787	392,067	682,668
1962	Prior Appropriation Share	61,998	35,974	97,972	186,521	11,990	198,511	
	50/50 Share	164,632	14,557	179,189	164,632	14,557	179,189	
	Total	226,630	50,531	277,161	351,153	26,547	377,700	654,861
1963	Prior Appropriation Share	53,949	21,065	75,014	162,235	7,022	169,257	
	50/50 Share	180,999	10,147	191,146	180,999	10,147	191,146	
	Total	234,947	31,212	266,159	343,234	17,169	360,403	626,562
1964	Prior Appropriation Share	61,230	77,770	139,000	184,218	25,896	210,114	
	50/50 Share	285,675	19,853	305,528	285,675	19,853	305,528	
	Total	346,905	97,623	444,528	469,892	45,749	515,641	960,169
1965	Prior Appropriation Share	65,084	106,372	171,456	195,864	35,393	231,257	
	50/50 Share	257,894	58,176	316,070	257,894	58,176	316,070	
	Total	322,979	164,548	487,527	453,758	93,569	547,327	1,034,854
1966	Prior Appropriation Share	61,972	67,979	129,951	186,444	22,640	209,084	
	50/50 Share	196,066	22,266	218,332	196,066	22,266	218,332	
	Total	258,038	90,245	348,283	382,509	44,906	427,415	775,698

BACK

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1967	Prior Appropriation Share	54,079	97,949	152,028	162,653	32,574	195,227	
	50/50 Share	269,770	72,221	341,991	269,770	72,221	341,991	
	Total	323,849	170,170	494,019	432,423	104,795	537,218	1,031,237
1968	Prior Appropriation Share	65,448	72,615	138,063	196,956	24,205	221,161	
	50/50 Share	206,507	24,724	231,231	206,507	24,724	231,231	
	Total	271,956	97,339	369,295	403,463	48,929	452,392	821,687
1969	Prior Appropriation Share	59,127	79,175	138,302	177,852	26,363	204,215	
	50/50 Share	184,602	52,929	237,531	184,602	52,929	237,531	
	Total	243,729	132,104	375,833	362,454	79,292	441,746	817,579
1970	Prior Appropriation Share	52,122	68,486	120,608	156,754	22,810	179,564	
	50/50 Share	219,474	12,863	232,337	219,474	12,863	232,337	
	Total	271,595	29,425 81,349	352,944	376,227	35,673	411,900	764,845
1971	Prior Appropriation Share	60,264	73,164	133,428	181,292	24,379	205,671	
	50/50 Share	258,004	19,300	277,304	258,004	19,300	277,304	
	Total	318,268	92,464	410,732	439,297	43,679	482,976	893,708
1972	Prior Appropriation Share	66,639	90,661	157,300	200,504	30,203	230,707	
	50/50 Share	282,585	38,865	321,450	282,585	38,865	321,450	
	Total	349,224	129,526	478,750	483,089	69,068	552,157	1,030,906
1973	Prior Appropriation Share	50,277	22,781	73,058	151,165	7,594	158,759	
	50/50 Share	141,868	10,781	152,649	141,868	10,781	152,649	
	Total	192,146	33,562	225,708	293,034	18,375	311,409	537,116
1974	Prior Appropriation Share	57,463	67,466	124,929	172,917	22,487	195,403	
	50/50 Share	263,885	13,364	277,249	263,885	13,364	277,249	
	Total	321,348	80,830	402,178	436,801	35,851	472,652	874,829

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1975	Prior Appropriation Share	60,762	113,496	174,258	182,840	37,749	220,589	
	50/50 Share	340,348	65,853	406,201	340,348	65,853	406,201	
	Total	401,110	179,349	580,459	523,189	103,602	626,791	1,207,250
1976	Prior Appropriation Share	61,457	61,826	123,283	184,980	20,609	205,589	
	50/50 Share	197,722	24,400	222,122	197,722	24,400	222,122	
	Total	259,179	86,226	345,405	382,703	45,009	427,712	773,116
1977	Prior Appropriation Share	58,494	22,059	80,553	175,954	7,353	183,307	
	50/50 Share	73,293	7,113	80,406	73,293	7,113	80,406	
	Total	131,787	29,172	160,959	249,247	14,466	263,713	424,673
1978	Prior Appropriation Share	65,116	98,643	163,759	195,985	32,861	228,846	
	50/50 Share	208,752	54,393	263,145	208,752	54,393	263,145	
	Total	273,868	153,036	426,904	404,738	87,254	491,992	918,895
1979	Prior Appropriation Share	53,848	76,245	130,093	161,934	25,369	187,303	
	50/50 Share	164,172	57,445	221,617	164,172	57,445	221,617	
	Total	218,021	133,690	351,711	326,107	82,814	408,921	760,631
1980	Prior Appropriation Share	61,216	57,551	118,767	184,174	19,165	203,339	
	50/50 Share	187,279	10,225	197,504	187,279	10,225	197,504	
	Total	248,494	67,776	316,270	371,453	29,390	400,843	717,113
1981	Prior Appropriation Share	55,093	62,994	118,087	165,752	20,970	186,722	
	50/50 Share	200,151	16,883	217,034	200,151	16,883	217,034	
	Total	255,244	79,877	335,121	365,903	37,853	403,756	738,877
1982	Prior Appropriation Share	55,392	75,632	131,024	166,592	25,174	191,766	
	50/50 Share	195,104	22,941	218,045	195,104	22,941	218,045	
	Total	250,496	98,573	349,069	361,696	48,115	409,811	758,880

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1983	Prior Appropriation Share	53,674	29,015	82,689	161,465	9,672	171,137	
	50/50 Share	131,195	6,055	137,250	131,195	6,055	137,250	
	Total	184,869	35,070	219,939	292,660	15,727	308,387	528,326
1984	Prior Appropriation Share	56,966	15,118	72,084	171,258	5,039	176,297	
	50/50 Share	131,921	5,407	137,328	131,921	5,407	137,328	
	Total	188,887	20,525	209,412	303,179	10,446	313,625	523,037
1985	Prior Appropriation Share	65,850	34,608	100,458	198,144	11,536	209,680	
	50/50 Share	180,968	5,674	186,642	180,968	5,674	186,642	
	Total	246,818	40,282	287,100	379,112	17,210	396,322	683,422
1986	Prior Appropriation Share	63,989	38,660	102,649	192,440	12,887	205,327	
	50/50 Share	165,721	38,273	203,994	165,721	38,273	203,994	
	Total	229,710	76,933	306,643	358,161	51,160	409,321	715,964
1987	Prior Appropriation Share	58,468	29,637	88,105	175,988	5,831	181,819	
	50/50 Share	148,296	7,577	155,873	148,296	3,946	152,242	
	Total	206,764	37,214	243,978	324,284	9,777	334,061	578,039
1988	Prior Appropriation Share	54,828	17,493	72,321	164,928	5,831	170,759	
	50/50 Share	119,010	3,946	122,956	119,010	3,946	122,956	
	Total	173,838	21,439	195,277	283,938	9,777	293,715	488,992
1989	Prior Appropriation Share	65,960	50,083	116,043	198,520	16,684	215,204	
	50/50 Share	251,470	18,770	270,240	251,470	18,770	270,240	
	Total	317,430	68,853	386,283	449,990	35,454	485,444	871,727
1990	Prior Appropriation Share	65,105	54,703	119,808	195,967	18,216	214,183	
	50/50 Share	228,972	19,784	248,756	228,972	19,784	248,756	
	Total	294,077	74,487	368,564	424,939	38,000	462,939	831,503

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1991	Prior Appropriation Share	58,368	75,241	133,609	175,631	25,062	200,693	
	50/50 Share	281,041	11,593	292,634	281,041	11,593	292,634	
	Total	339,409	86,834	426,243	456,673	36,655	493,328	919,571
1992	Prior Appropriation Share	60,681	18,091	78,772	182,489	6,030	188,519	
	50/50 Share	99,198	7,578	106,776	99,198	7,578	106,776	
	Total	159,879	25,669	185,548	281,686	13,608	295,294	480,842
1993	Prior Appropriation Share	64,658	74,123	138,781	194,556	24,697	219,253	
	50/50 Share	155,433	21,348	176,781	155,433	21,348	176,781	
	Total	220,090	95,471	315,561	349,989	46,045	396,034	711,595
1994	Prior Appropriation Share	52,556	52,468	105,024	158,113	17,489	175,602	
	50/50 Share	143,411	38,848	182,259	143,411	38,848	182,259	
	Total	195,967	91,316	287,283	301,523	56,337	357,860	645,143
1995	Prior Appropriation Share	60,920	101,318	162,238	183,287	33,717	217,004	
	50/50 Share	332,758	33,378	366,136	332,758	33,378	366,136	
	Total	393,678	134,696	528,374	516,045	67,095	583,140	1,111,514
1996	Prior Appropriation Share	62,252	62,196	124,448	187,284	20,723	208,007	
	50/50 Share	244,035	57,428	301,463	244,035	57,428	301,463	
	Total	306,287	119,624	425,911	431,319	78,151	509,470	935,381
1997	Prior Appropriation Share	65,614	66,048	131,662	197,452	22,007	219,459	
	50/50 Share	278,601	36,127	314,728	278,601	36,127	314,728	
	Total	344,214	102,175	446,389	476,052	58,134	534,186	980,576
1998	Prior Appropriation Share	51,410	60,152	111,562	154,647	20,023	174,670	
	50/50 Share	174,332	8,716	183,048	174,332	8,716	183,048	
	Total	225,743	68,868	294,611	328,980	28,739	357,719	652,330

Annual U.S. and Canadian Entitlements from St Mary and Milk Rivers

Year	Entitlement Type	Montana			Alberta			Total
		St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	St Mary River (acre-feet)	Milk River (acre-feet)	Total (acre-feet)	(acre-feet)
1999	Prior Appropriation Share	61,288	40,561	101,849	184,460	13,520	197,980	
	50/50 Share	223,897	7,743	231,640	223,897	7,743	231,640	
	Total	285,186	48,304	333,490	408,357	21,263	429,620	763,110
2000	Prior Appropriation Share	56,849	16,237	73,086	170,962	5,412	176,374	
	50/50 Share	129,678	5,320	134,998	129,678	5,320	134,998	
	Total	186,527	21,557	208,084	300,641	10,732	311,373	519,457
2001	Prior Appropriation Share	44,126	10,205	54,331	132,683	3,402	136,085	
	50/50 Share	99,218	2,867	102,085	99,218	2,867	102,085	
	Total	143,344	13,072	156,416	231,902	6,269	238,171	394,587
2002	Prior Appropriation Share	57,481	71,436	128,917	172,858	23,766	196,624	
	50/50 Share	307,244	52,882	360,126	307,244	52,882	360,126	
	Total	364,725	124,318	489,043	480,103	76,648	556,751	1,045,794
2003	Prior Appropriation Share	53,594	36,789	90,383	161,200	141,377	302,577	
	50/50 Share	141,377	19,616	160,993	140,784	19,616	160,400	
	Total	194,972	56,405	251,377	301,984	160,993	462,977	714,354
Average (1959-2003)	Prior Appropriation Share	59,141	56,612	115,753	177,922	21,634	199,556	
	50/50 Share	201,534	24,516	226,049	201,520	24,435	225,955	
	Total	260,674	81,128	341,802	379,443	46,069	425,512	767,314
Average (11 driest yrs)	Prior Appropriation Share	54,719	21,681	76,400	164,575	18,597	183,172	
	50/50 Share	126,914	7,855	134,769	126,860	7,525	134,385	
	Total	181,633	29,536	211,169	291,435	26,122	317,557	528,726
Average (22 driest yrs)	Prior Appropriation Share	56,858	36,633	93,491	171,024	17,890	188,914	
	50/50 Share	150,647	13,632	164,278	150,620	13,467	164,086	
	Total	207,504	50,265	257,769	321,644	31,357	353,000	610,769

OPERATIONS

		Top of Dam	Target Elev.	Target Volume	Added Zone	Minimum level	Minimum volume
Date	Day	(Ft)	(Ft)	(AF)	(Ft)	(Ft)	(AF)
01-Jan	1	4790.00	4763.72	30,524	4762.72	4731.70	3,100
01-Mar	60	4790.00	4771.50	40,037	4770.50	4731.70	3,100
04-Jul	185	4790.00	4788.00	66200	4787.00	4731.70	3,100
01-Sep	227	4790.00	4788.00	66200	4772.40	4731.70	3,100
01-Oct	274	4790.00	4788.00	66200	4765.30	4731.70	3,100
01-Nov	305	4790.00	4759.69	26,018	4758.69	4731.70	3,100
31-Dec	365	4790.00	4763.72	30,524	4762.72	4731.70	3,100

ORIGINAL DRAWDOWN

Above green line - Spill;
Between green and orange lines - Release up to Canal Capacity to meet Demands or Specified Canal Diversions;
Below orange line - No Release.

MODIFIED DRAWDOWN

Above green line - Spill;
Between green and red lines - Release to accommodate canal diversion in excess of 650 cfs (850, 000, or 1200 cfs);

Between red and orange lines - Release up to 650 cfs to meet Demands or Specified Canal Diversions;
Below orange line - No Release.

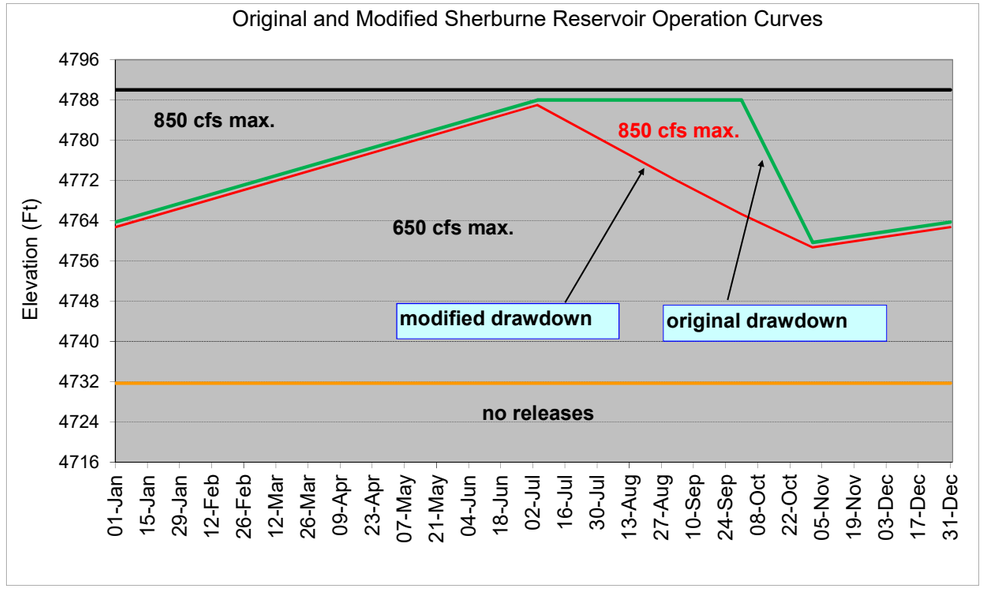
U.S. ST MARY CANAL OPERATION

Unless otherwise specified, canal operations for all OPTIONs are as follows:
While ensuring that any IFN requirements are met,
1) Divert as much as possible of U.S. Entitlements which cannot be captured and stored in Lake Sherburne Reservoir, up to canal capacity;
2) If the Diversion rate resulting from U.S. Entitlements which cannot be captured and stored in Lake Sherburne is less than 650 cfs, release from Lake Sherburne Reservoir, as required, to maintain a diversion rate equal to the lesser of 650 cfs or Montana water demands.

Units in feet

Date	Day	Top of Dar	FSL	Senior Licences and IFN	Minimum
1-Jan	1	3620.73	3608.92	3541.47	3510.50
1-Mar	60	3620.73	3608.92	3541.47	3510.50
1-Apr	91	3620.73	3613.52	3541.47	3510.50
1-May	121	3620.73	3619.10	3541.47	3510.50
1-Jun	152	3620.73	3619.10	3541.47	3510.50
1-Aug	213	3620.73	3619.10	3541.47	3510.50
1-Sep	244	3620.73	3619.10	3541.47	3510.50
1-Oct	274	3620.73	3608.92	3541.47	3510.50
#####	365	3620.73	3608.92	3541.47	3510.50

Fall releases so that storage is about 26,000 AF by November 1 and by about 40,000 AF by March 1st due to local inflows
Target fill date by July 4th
No releases when reservoir reaches 3,100 AF (Larry Dolan)



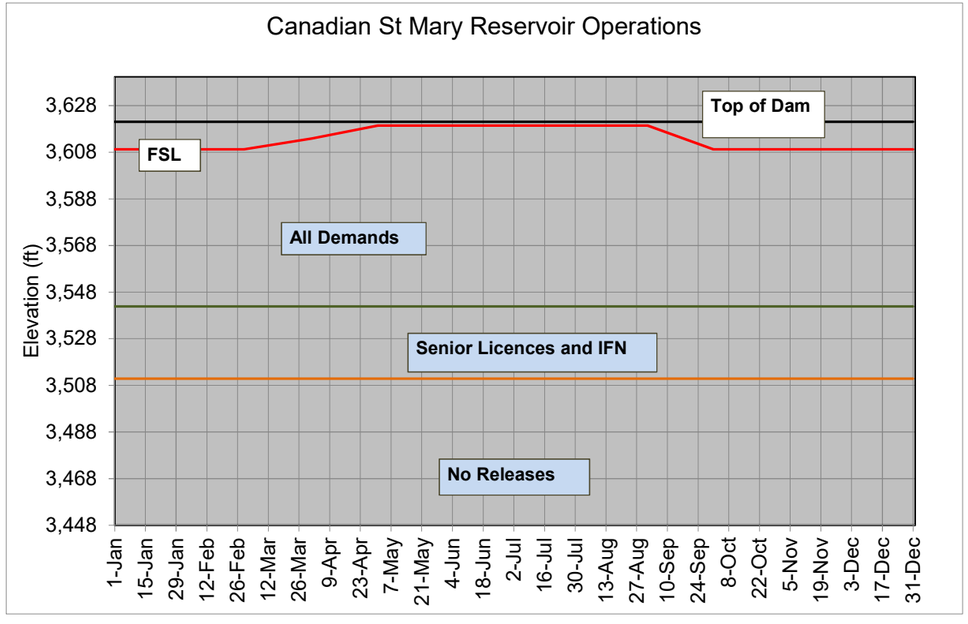


Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	93	137	105	0	105	27
1a	Avg. driest 22 years	88	142	108	0	108	17
	Average 45 years	75	147	117	0	117	13
	Avg. driest 11 years	93	137	104	0	104	27
1b	Avg. driest 22 years	89	142	107	0	107	17
	Average 45 years	76	147	117	0	117	13
	Avg. driest 11 years	94	137	104	0	104	27
2a	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	80	147	114	0	114	13
	Avg. driest 11 years	94	137	104	0	104	27
2a1	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	82	147	112	0	112	13
	Avg. driest 11 years	94	137	104	0	104	27
2b	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	81	147	113	0	113	13
	Avg. driest 11 years	94	137	104	0	104	27
2c	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	82	147	113	0	113	13
	Avg. driest 11 years	94	137	104	0	104	27
2c1	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	83	147	112	0	112	13
	Avg. driest 11 years	94	137	104	0	104	27
2d	Avg. driest 22 years	94	142	104	0	104	17
	Average 45 years	88	147	108	0	108	13
	Avg. driest 11 years	94	137	104	0	104	27
2e	Avg. driest 22 years	93	142	105	0	105	17
	Average 45 years	83	147	111	0	111	13
	Avg. driest 11 years	94	137	104	0	104	27
2f	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	81	147	113	0	113	13
	Avg. driest 11 years	94	137	104	0	104	27
3	Avg. driest 22 years	93	142	105	0	105	17
	Average 45 years	86	147	110	0	110	13
	Avg. driest 11 years	97	137	102	0	102	27
4a	Avg. driest 22 years	94	142	104	0	104	17
	Average 45 years	82	147	112	0	112	13
	Avg. driest 11 years	98	137	101	0	101	27
4a1	Avg. driest 22 years	95	142	103	0	103	17
	Average 45 years	85	147	110	0	110	13

Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	98	137	101	0	101	27
4b	Avg. driest 22 years	98	142	102	0	102	17
	Average 45 years	92	147	105	0	105	13
	Avg. driest 11 years	96	137	102	0	102	27
4c	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	77	147	116	0	116	13
	Avg. driest 11 years	98	137	101	0	101	27
4d	Avg. driest 22 years	96	142	103	0	103	17
	Average 45 years	86	147	110	0	110	13
	Avg. driest 11 years	98	137	101	0	101	27
4e	Avg. driest 22 years	96	142	102	0	102	17
	Average 45 years	86	147	110	0	110	13
	Avg. driest 11 years	93	137	104	0	104	27
5a	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	81	147	113	0	113	13
	Avg. driest 11 years	93	137	104	0	104	27
5b	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	81	147	113	0	113	13
	Avg. driest 11 years	93	137	104	0	104	27
5c	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	82	147	113	0	113	13
	Avg. driest 11 years	97	137	102	0	102	27
6a	Avg. driest 22 years	95	142	104	0	104	17
	Average 45 years	83	147	112	0	112	13
	Avg. driest 11 years	98	137	101	0	101	27
6a1	Avg. driest 22 years	96	142	102	0	102	17
	Average 45 years	87	147	109	0	109	13
	Avg. driest 11 years	95	137	103	0	103	27
6b	Avg. driest 22 years	90	142	106	0	106	17
	Average 45 years	78	147	115	0	115	13
	Avg. driest 11 years	91	137	105	0	105	27
6c	Avg. driest 22 years	89	142	107	0	107	17
	Average 45 years	79	147	115	0	115	13
	Avg. driest 11 years	98	137	101	0	101	27
6d	Avg. driest 22 years	98	142	101	0	101	17
	Average 45 years	93	147	105	0	105	13
	Avg. driest 11 years	94	111	104	0	104	78
7a	Avg. driest 22 years	92	107	105	0	105	87
	Average 45 years	82	109	113	0	113	83

Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	94	112	104	0	104	77
7b	Avg. driest 22 years	92	107	105	0	105	86
	Average 45 years	82	105	112	0	112	90
	Avg. driest 11 years	94	113	104	0	104	75
7c	Avg. driest 22 years	92	108	105	0	105	85
	Average 45 years	82	105	112	0	112	91
	Avg. driest 11 years	94	110	104	0	104	80
8a	Avg. driest 22 years	93	108	104	0	104	84
	Average 45 years	85	112	110	0	110	78
	Avg. driest 11 years	94	110	104	0	104	80
8b	Avg. driest 22 years	93	108	104	0	104	84
	Average 45 years	85	112	110	0	110	78
	Avg. driest 11 years	94	111	104	0	104	78
8c	Avg. driest 22 years	93	108	105	0	105	84
	Average 45 years	85	108	111	0	111	85
	Avg. driest 11 years	94	111	104	0	104	78
8d	Avg. driest 22 years	92	108	105	0	105	84
	Average 45 years	83	106	111	0	111	89
	Avg. driest 11 years	94	111	104	0	104	78
8e	Avg. driest 22 years	94	108	104	0	104	84
	Average 45 years	87	113	109	0	109	76
	Avg. driest 11 years	94	111	104	0	104	79
8f	Avg. driest 22 years	93	108	104	0	104	84
	Average 45 years	85	113	110	0	110	77
	Avg. driest 11 years	100	137	100	0	100	27
9	Avg. driest 22 years	100	142	100	0	100	17
	Average 45 years	100	147	100	0	100	13
	Avg. driest 11 years	95	138	102	1	103	26
10a	Avg. driest 22 years	90	143	106	1	107	17
	Average 45 years	76	147	115	1	116	12
	Avg. driest 11 years	93	138	103	1	105	26
10a WCO	Avg. driest 22 years	88	143	107	1	108	17
	Average 45 years	75	147	116	1	117	12
	Avg. driest 11 years	97	138	99	3	102	26
10b	Avg. driest 22 years	92	143	103	3	105	17
	Average 45 years	78	147	113	2	115	13
	Avg. driest 11 years	96	138	101	1	102	26
11a	Avg. driest 22 years	93	143	103	1	104	17
	Average 45 years	83	147	110	1	111	12

Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	99	138	98	3	101	26
11b	Avg. driest 22 years	95	143	101	3	103	17
	Average 45 years	84	147	109	2	111	13
	Avg. driest 11 years	96	138	101	1	102	26
12a	Avg. driest 22 years	95	143	102	1	103	17
	Average 45 years	87	147	108	1	109	12
	Avg. driest 11 years	100	138	97	3	100	26
12b	Avg. driest 22 years	98	143	99	3	101	17
	Average 45 years	90	147	105	2	107	12
	Avg. driest 11 years	99	138	99	1	101	26
13a	Avg. driest 22 years	95	143	102	1	103	17
	Average 45 years	84	147	110	1	111	12
	Avg. driest 11 years	100	129	98	1	100	26
13a1	Avg. driest 22 years	97	140	101	1	102	17
	Average 45 years	86	146	109	1	110	12
	Avg. driest 11 years	102	138	96	3	99	26
13b	Avg. driest 22 years	98	143	98	3	101	17
	Average 45 years	86	147	108	2	110	12
	Avg. driest 11 years	95	138	102	1	103	26
14a	Avg. driest 22 years	93	143	103	1	104	17
	Average 45 years	83	147	111	1	112	12
	Avg. driest 11 years	98	138	98	3	101	26
14b	Avg. driest 22 years	96	143	100	3	103	17
	Average 45 years	85	147	108	2	110	13
	Avg. driest 11 years	93	138	103	1	104	26
15a	Avg. driest 22 years	91	143	105	1	106	17
	Average 45 years	80	147	113	1	114	12
	Avg. driest 11 years	96	138	100	3	103	26
15b	Avg. driest 22 years	93	143	102	3	104	17
	Average 45 years	82	147	110	2	112	13
	Avg. driest 11 years	93	130	104	0	104	41
16a	Avg. driest 22 years	92	137	105	0	105	28
	Average 45 years	87	143	109	0	109	19
	Avg. driest 11 years	101	128	100	0	100	45
16b	Avg. driest 22 years	99	137	101	0	101	29
	Average 45 years	94	143	104	0	104	20
	Avg. driest 11 years	94	131	104	0	104	40
16c	Avg. driest 22 years	93	134	105	0	105	34
	Average 45 years	89	141	107	0	107	23

Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	98	109	100	2	101	82
16d	Avg. driest 22 years	96	124	100	2	102	52
	Average 45 years	92	137	104	1	105	31
	Avg. driest 11 years	99	110	101	0	101	81
16e	Avg. driest 22 years	100	125	100	0	100	52
	Average 45 years	95	137	104	0	104	31
	Avg. driest 11 years	97	110	102	0	102	81
16f	Avg. driest 22 years	99	125	100	0	100	52
	Average 45 years	95	137	103	0	103	31
	Avg. driest 11 years	100	112	100	0	100	76
16g	Avg. driest 22 years	100	104	100	0	100	92
	Average 45 years	97	103	102	0	102	94
	Avg. driest 11 years	94	137	104	0	104	27
17a	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	82	147	112	0	112	13
	Avg. driest 11 years	94	137	104	0	104	27
17b	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	82	147	113	0	113	13
	Avg. driest 11 years	92	137	105	0	105	27
17c	Avg. driest 22 years	89	142	107	0	107	17
	Average 45 years	78	147	115	0	115	13
	Avg. driest 11 years	94	107	104	0	104	87
18a	Avg. driest 22 years	92	116	105	0	105	68
	Average 45 years	83	127	111	0	111	50
	Avg. driest 11 years	94	110	104	0	104	81
18b	Avg. driest 22 years	92	117	105	0	105	66
	Average 45 years	83	127	111	0	111	50
	Avg. driest 11 years	96	138	96	6	102	25
19a	Avg. driest 22 years	93	142	100	5	104	18
	Average 45 years	83	146	108	3	112	15
	Avg. driest 11 years	96	138	94	9	102	25
19b	Avg. driest 22 years	93	141	98	7	105	20
	Average 45 years	83	144	107	5	112	17
	Avg. driest 11 years	94	138	98	6	104	25
19c	Avg. driest 22 years	91	142	101	5	106	19
	Average 45 years	81	145	110	3	113	15
	Avg. driest 11 years	94	138	95	9	104	25
19d	Avg. driest 22 years	91	141	99	7	106	21
	Average 45 years	81	144	108	5	113	18

Table 1B1		Entitlement Access Summary					
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	94	139	101	3	104	25
19e	Avg. driest 22 years	92	143	103	2	105	16
	Average 45 years	82	147	111	2	113	12
	Avg. driest 11 years	96	138	99	3	102	25
19f	Avg. driest 22 years	93	143	102	2	104	16
	Average 45 years	84	147	110	2	111	12
	Avg. driest 11 years	89	137	101	6	107	28
20a	Avg. driest 22 years	88	141	103	5	108	20
	Average 45 years	80	145	110	3	114	16
	Avg. driest 11 years	84	137	101	9	110	28
20b	Avg. driest 22 years	84	140	103	7	110	23
	Average 45 years	78	144	110	5	115	19
	Avg. driest 11 years	84	137	104	6	110	28
20c	Avg. driest 22 years	84	141	105	5	110	20
	Average 45 years	77	145	112	3	115	16
	Avg. driest 11 years	80	136	104	9	113	29
20d	Avg. driest 22 years	81	140	105	7	112	23
	Average 45 years	75	144	112	5	117	19
	Avg. driest 11 years	89	138	104	3	107	26
20e	Avg. driest 22 years	88	143	105	3	108	17
	Average 45 years	80	147	112	2	114	12
	Avg. driest 11 years	92	138	101	4	105	25
20f	Avg. driest 22 years	90	143	103	3	106	16
	Average 45 years	82	147	110	2	113	12
	Avg. driest 11 years	93	137	104	0	104	27
21a	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	81	147	113	0	113	13
	Avg. driest 11 years	98	106	101	0	101	88
21b	Avg. driest 22 years	95	104	103	0	103	92
	Average 45 years	84	104	111	0	111	93
	Avg. driest 11 years	98	106	101	0	101	88
21c	Avg. driest 22 years	96	104	103	0	103	92
	Average 45 years	85	104	110	0	110	93
	Avg. driest 11 years	93	139	102	1	103	24
21d	Avg. driest 22 years	91	143	104	1	105	16
	Average 45 years	81	147	112	1	112	12
	Avg. driest 11 years	93	137	104	0	104	27
21e	Avg. driest 22 years	91	142	106	0	106	17
	Average 45 years	80	147	113	0	113	13

Table 1B1		Entitlement Access Summary					
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	94	137	104	0	104	27
22	Avg. driest 22 years	92	142	105	0	105	17
	Average 45 years	83	147	112	0	112	13
	Avg. driest 11 years	102	138	99	0	99	26
23a	Avg. driest 22 years	95	143	103	0	103	17
	Average 45 years	80	147	114	0	114	12
	Avg. driest 11 years	106	138	96	0	96	26
23b	Avg. driest 22 years	102	143	99	0	99	17
	Average 45 years	89	147	108	0	108	12
	Avg. driest 11 years	110	138	94	0	94	26
23c	Avg. driest 22 years	105	143	97	0	97	17
	Average 45 years	91	147	106	0	106	12
	Avg. driest 11 years	111	112	93	0	93	77
23d	Avg. driest 22 years	106	107	96	0	96	87
	Average 45 years	93	103	105	0	105	94
	Avg. driest 11 years	100		100		100	
23e	Avg. driest 22 years	100		100		100	
	Average 45 years	100		100		100	
	Avg. driest 11 years	102	137	99	0	99	27
23f	Avg. driest 22 years	98	142	101	0	101	17
	Average 45 years	86	147	109	0	109	13
	Avg. driest 11 years	98	137	101	0	101	27
MO2	Avg. driest 22 years	94	142	104	0	104	17
	Average 45 years	80	147	114	0	114	13
	Avg. driest 11 years	96	138	101	1	102	25
MO2A	Avg. driest 22 years	92	143	104	1	105	16
	Average 45 years	78	147	114	1	115	12
	Avg. driest 11 years	95	138	101	2	103	25
MO2B	Avg. driest 22 years	91	143	104	2	106	16
	Average 45 years	78	147	114	1	115	12
	Avg. driest 11 years	100	137	100	0	100	27
MO3	Avg. driest 22 years	98	142	101	0	101	17
	Average 45 years	87	147	109	0	109	13
	Avg. driest 11 years	100	137	100	0	100	27
MO4	Avg. driest 22 years	97	142	102	0	102	17
	Average 45 years	86	147	110	0	110	13
	Avg. driest 11 years	100	137	100	0	100	27
MO5	Avg. driest 22 years	98	142	101	0	101	17
	Average 45 years	89	147	107	0	107	13

Table 1B1	Entitlement Access Summary						
		Annual Percentage of Entitlement Accessed (%)					
		Montana		Alberta			
Option		St Mary River Net Accessed (Natural flow at international border - flow into Canada - Canada's accessed from US canal)	Milk River Accessed	St Mary River flow into Canada	Accessed from US canal diversion	St Mary Total Accessed	Milk River Accessed
	Avg. driest 11 years	100	112	100	0	100	77
MO6	Avg. driest 22 years	98	107	101	0	101	87
	Average 45 years	87	104	109	0	109	93
	Avg. driest 11 years	97	121	100	1	102	59
MT1a	Avg. driest 22 years	94	133	103	1	104	36
	Average 45 years	82	141	112	1	112	23
	Avg. driest 11 years	99	121	100	1	101	59
MT1b	Avg. driest 22 years	97	133	101	1	102	36
	Average 45 years	89	141	107	1	108	23
	Avg. driest 11 years	103	125	97	1	98	52
MT1c	Avg. driest 22 years	101	135	98	1	99	32
	Average 45 years	91	142	105	1	106	22
	Avg. driest 11 years	100	106	100	0	100	235
MT1d	Avg. driest 22 years	99	104	101	0	101	148
	Average 45 years	90	104	107	0	107	89
	Avg. driest 11 years	104	106	97	0	97	235
MT1e	Avg. driest 22 years	102	104	98	0	98	148
	Average 45 years	92	104	105	0	105	89
	Avg. driest 11 years	95	125	103	1	103	51
CrSysLOICap1	Avg. driest 22 years	91	135	105	1	106	33
	Average 45 years	79	141	114	0	114	22
	Avg. driest 11 years	95	125	102	1	103	51
CrSysLOICap2	Avg. driest 22 years	94	135	103	1	104	33
	Average 45 years	87	141	109	0	109	22

Table 1B2		Entitlement Access Summary												
		Annual Volume of Entitlement Accessed (AF)												
		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
Option														
	Avg. driest 11 years	181899	168777	168777	29536	40565	209342	291339	304461	0	304461	15099	4058	308519
1a	Avg. driest 22 years	207748	183253	183253	50257	71611	254864	321557	346052	0	346052	25870	4502	350554
	Average 45 years	261021	196392	196392	81114	118909	315301	379266	443895	0	443895	43421	5613	449508
	Avg. driest 11 years	181899	170024	170024	29536	40565	210589	291339	303214	0	303214	15099	4058	307272
1b	Avg. driest 22 years	207748	184555	184555	50257	71611	256167	321557	344749	0	344749	25870	4502	349252
	Average 45 years	261021	197888	197888	81114	118909	316797	379266	442399	0	442399	43421	5613	448012
	Avg. driest 11 years	181899	170403	170403	29536	40565	210968	291339	302835	0	302835	15099	4058	306893
2a	Avg. driest 22 years	207748	188275	188275	50257	71611	259886	321557	341030	0	341030	25870	4502	345532
	Average 45 years	261021	209370	209370	81114	118909	328279	379266	430917	0	430917	43421	5613	436530
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
2a1	Avg. driest 22 years	207748	190564	190564	50257	71611	262175	321557	338741	0	338741	25870	4502	343243
	Average 45 years	261021	213859	213859	81114	118909	332768	379266	426428	0	426428	43421	5613	432041
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
2b	Avg. driest 22 years	207748	189551	189551	50257	71611	261162	321557	339754	0	339754	25870	4502	344256
	Average 45 years	261021	210786	210786	81114	118909	329695	379266	429501	0	429501	43421	5613	435115
	Avg. driest 11 years	181899	170700	170700	29536	40565	211265	291339	302537	0	302537	15099	4058	306596
2c	Avg. driest 22 years	207748	190236	190236	50257	71611	261847	321557	339068	0	339068	25870	4502	343571
	Average 45 years	261021	213247	213247	81114	118909	332156	379266	427040	0	427040	43421	5613	432653
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
2c1	Avg. driest 22 years	207748	191351	191351	50257	71611	262962	321557	337954	0	337954	25870	4502	342456
	Average 45 years	261021	216846	216846	81114	118909	335755	379266	423441	0	423441	43421	5613	429055
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
2d	Avg. driest 22 years	207748	194303	194303	50257	71611	265914	321557	335002	0	335002	25870	4502	339504
	Average 45 years	261021	229059	229059	81114	118909	347968	379266	411228	0	411228	43421	5613	416841
	Avg. driest 11 years	181899	171215	171215	29536	40563	211778	291339	302023	0	302023	15099	4060	306083
2e	Avg. driest 22 years	207748	192526	192526	50257	71610	264136	321557	336778	0	336778	25870	4503	341282
	Average 45 years	261021	217781	217781	81114	118908	336690	379266	422506	0	422506	43421	5614	428119
	Avg. driest 11 years	181899	171124	171124	29536	40565	211689	291339	302114	0	302114	15099	4058	306172
2f	Avg. driest 22 years	207748	190361	190361	50257	71611	261972	321557	338944	0	338944	25870	4502	343446
	Average 45 years	261021	212063	212063	81114	118909	330972	379266	428223	0	428223	43421	5613	433837
	Avg. driest 11 years	181899	171308	171308	29536	40565	211873	291339	301930	0	301930	15099	4058	305988
3	Avg. driest 22 years	207748	192729	192729	50257	71611	264340	321557	336576	0	336576	25870	4502	341078
	Average 45 years	261021	223681	223681	81114	118909	342590	379266	416606	0	416606	43421	5613	422219
	Avg. driest 11 years	181899	176102	176102	29536	40565	216667	291339	297136	0	297136	15099	4058	301194
4a	Avg. driest 22 years	207748	194914	194914	50257	71611	266526	321557	334390	0	334390	25870	4502	338893
	Average 45 years	261021	214677	214677	81114	118909	333586	379266	425610	0	425610	43421	5613	431223
	Avg. driest 11 years	181899	178777	178777	29536	40565	219342	291339	294460	0	294460	15099	4058	298518
4a1	Avg. driest 22 years	207748	198119	198119	50257	71611	269730	321557	331185	0	331185	25870	4502	335688
	Average 45 years	261021	221355	221355	81114	118909	340264	379266	418932	0	418932	43421	5613	424545
	Avg. driest 11 years	181899	179086	179086	29536	40565	219651	291339	294152	0	294152	15099	4058	298210
4b	Avg. driest 22 years	207748	202860	202860	50257	71611	274471	321557	326445	0	326445	25870	4502	330947
	Average 45 years	261021	240713	240713	81114	118909	359622	379266	399574	0	399574	43421	5613	405187
	Avg. driest 11 years	181899	174665	174665	29536	40565	215230	291339	298572	0	298572	15099	4058	302631
4c	Avg. driest 22 years	207748	190460	190460	50257	71611	262071	321557	338844	0	338844	25870	4502	343347
	Average 45 years	261021	201875	201875	81114	118909	320784	379266	438412	0	438412	43421	5613	444025
	Avg. driest 11 years	181899	179086	179086	29536	40565	219651	291339	294152	0	294152	15099	4058	298210
4d	Avg. driest 22 years	207748	199426	199426	50257	71611	271037	321557	329879	0	329879	25870	4502	334381
	Average 45 years	261021	223774	223774	81114	118909	342683	379266	416513	0	416513	43421	5613	422127

		Annual Volume of Entitlement Accessed (AF)												
		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
Option														
	Avg. driest 11 years	181899	179086	179086	29536	40565	219651	291339	294152	0	294152	15099	4058	298210
4e	Avg. driest 22 years	207748	200459	200459	50257	71611	272070	321557	328846	0	328846	25870	4502	333348
	Average 45 years	261021	224711	224711	81114	118909	343620	379266	415576	0	415576	43421	5613	421189
	Avg. driest 11 years	181899	170010	170010	29536	40565	210575	291339	303228	0	303228	15099	4058	307286
5a	Avg. driest 22 years	207748	189403	189403	50257	71611	261014	321557	339902	0	339902	25870	4502	344404
	Average 45 years	261021	211838	211838	81114	118909	330747	379266	428449	0	428449	43421	5613	434062
	Avg. driest 11 years	181899	169972	169972	29536	40565	210537	291339	303266	0	303266	15099	4058	307324
5b	Avg. driest 22 years	207748	189441	189441	50257	71611	261052	321557	339864	0	339864	25870	4502	344366
	Average 45 years	261021	212183	212183	81114	118909	331092	379266	428104	0	428104	43421	5613	433717
	Avg. driest 11 years	181899	169729	169729	29536	40565	210294	291339	303509	0	303509	15099	4058	307567
5c	Avg. driest 22 years	207748	190194	190194	50257	71611	261805	321557	339110	0	339110	25870	4502	343613
	Average 45 years	261021	213557	213557	81114	118909	332466	379266	426730	0	426730	43421	5613	432343
	Avg. driest 11 years	181899	176297	176297	29536	40565	216862	291339	296941	0	296941	15099	4058	300999
6a	Avg. driest 22 years	207748	196362	196362	50257	71611	267973	321557	332943	0	332943	25870	4502	337445
	Average 45 years	261021	216975	216975	81114	118909	335884	379266	423312	0	423312	43421	5613	428925
	Avg. driest 11 years	181899	178961	178961	29536	40565	219526	291339	294277	0	294277	15099	4058	298335
6a1	Avg. driest 22 years	207748	199922	199922	50257	71611	271533	321557	329382	0	329382	25870	4502	333885
	Average 45 years	261021	225845	225845	81114	118909	344754	379266	414442	0	414442	43421	5613	420055
	Avg. driest 11 years	181899	173552	173552	29536	40565	214117	291339	299685	0	299685	15099	4058	303744
6b	Avg. driest 22 years	207748	186945	186945	50257	71611	258556	321557	342360	0	342360	25870	4502	346862
	Average 45 years	261021	203523	203523	81114	118909	322432	379266	436764	0	436764	43421	5613	442377
	Avg. driest 11 years	181899	166221	166221	29536	40565	206786	291339	307017	0	307017	15099	4058	311075
6c	Avg. driest 22 years	207748	185709	185709	50257	71611	257320	321557	343596	0	343596	25870	4502	348098
	Average 45 years	261021	205697	205697	81114	118909	324606	379266	434590	0	434590	43421	5613	440203
	Avg. driest 11 years	181899	179086	179086	29536	40563	219649	291339	294152	0	294152	15099	4060	298212
6d	Avg. driest 22 years	207748	203008	203008	50257	71610	274618	321557	326296	0	326296	25870	4503	330800
	Average 45 years	261021	243435	243435	81114	118908	362343	379266	396852	0	396852	43421	5614	402466
	Avg. driest 11 years	181899	171215	171215	29536	32809	204024	291339	302023	0	302023	15099	11816	313839
7a	Avg. driest 22 years	207748	190322	190322	50257	53669	243991	321557	338982	0	338982	25870	22449	361432
	Average 45 years	261021	213591	213591	81114	88592	302183	379266	426696	0	426696	43421	35930	462626
	Avg. driest 11 years	181899	171215	171215	29536	33061	204276	291339	302023	0	302023	15099	11570	313593
7b	Avg. driest 22 years	207748	190359	190359	50257	53800	244159	321557	338946	0	338946	25870	22319	361265
	Average 45 years	261021	213616	213616	81114	85236	298851	379266	426671	0	426671	43421	39287	465959
	Avg. driest 11 years	181899	171215	171215	29536	33291	204505	291339	302023	0	302023	15099	11342	313365
7c	Avg. driest 22 years	207748	190359	190359	50257	54054	244413	321557	338946	0	338946	25870	22068	361014
	Average 45 years	261021	213616	213616	81114	84997	298613	379266	426671	0	426671	43421	39525	466197
	Avg. driest 11 years	181899	171215	171215	29536	32604	203819	291339	302023	0	302023	15099	12032	314055
8a	Avg. driest 22 years	207748	193546	193546	50257	54340	247886	321557	335759	0	335759	25870	21787	357546
	Average 45 years	261021	221431	221431	81114	90832	312263	379266	418856	0	418856	43421	33704	452560
	Avg. driest 11 years	181899	171215	171215	29536	32597	203812	291339	302023	0	302023	15099	12039	314062
8b	Avg. driest 22 years	207748	193645	193645	50257	54337	247982	321557	335659	0	335659	25870	21790	357450
	Average 45 years	261021	222807	222807	81114	90830	313637	379266	417480	0	417480	43421	33705	451185
	Avg. driest 11 years	181899	171215	171215	29536	32909	204124	291339	302023	0	302023	15099	11726	313749
8c	Avg. driest 22 years	207748	193274	193274	50257	54456	247730	321557	336031	0	336031	25870	21671	357702
	Average 45 years	261021	220942	220942	81114	87565	308507	379266	419345	0	419345	43421	36970	456315
	Avg. driest 11 years	181899	171215	171215	29536	32811	204026	291339	302023	0	302023	15099	11825	313848
8d	Avg. driest 22 years	207748	191509	191509	50257	54516	246024	321557	337796	0	337796	25870	21611	359407
	Average 45 years	261021	217654	217654	81114	86041	303694	379266	422633	0	422633	43421	38495	461128
	Avg. driest 11 years	181899	171272	171272	29536	32806	204078	291339	301966	0	301966	15099	11830	313796
8e	Avg. driest 22 years	207748	194549	194549	50257	54411	248960	321557	334756	0	334756	25870	21716	356472
	Average 45 years	261021	227760	227760	81114	91501	319261	379266	412527	0	412527	43421	33034	445562

Annual Volume of Entitlement Accessed (AF)

Option		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
	Avg. driest 11 years	181899	171215	171215	29536	32697	203911	291339	302023	0	302023	15099	11939	313962
8f	Avg. driest 22 years	207748	193433	193433	50257	54343	247776	321557	335871	0	335871	25870	21784	357655
	Average 45 years	261021	221463	221463	81114	91317	312780	379266	418824	0	418824	43421	33218	452042
	Avg. driest 11 years	181899	181899	181899	29536	40565	222464	291339	291339	0	291339	15099	4058	295397
9	Avg. driest 22 years	207748	207748	207748	50257	71611	279359	321557	321557	0	321557	25870	4502	326059
	Average 45 years	261021	261021	261021	81114	118909	379930	379266	379266	0	379266	43421	5613	384879
	Avg. driest 11 years	181899	176045	172171	29536	40717	212888	291339	297193	3874	301067	15099	3907	304974
10a	Avg. driest 22 years	207748	189941	186186	50257	71800	257985	321557	339364	3755	343119	25870	4314	347433
	Average 45 years	261021	202455	199028	81114	119170	318198	379266	437832	3427	441259	43421	5353	446612
	Avg. driest 11 years	181899	172543	168668	29536	40683	209351	291339	300695	3874	304570	15099	3941	308511
10a WCO	Avg. driest 22 years	207748	186713	182957	50257	71773	254730	321557	342592	3755	346347	25870	4341	350688
	Average 45 years	261021	200119	196692	81114	119156	315848	379266	440168	3427	443595	43421	5366	448962
	Avg. driest 11 years	181899	186042	177012	29536	40669	217681	291339	287196	9030	296226	15099	3954	300180
10b	Avg. driest 22 years	207748	199530	191034	50257	71728	262762	321557	329774	8496	338271	25870	4386	342656
	Average 45 years	261021	211874	204779	81114	119038	323817	379266	428413	7095	435509	43421	5484	440993
	Avg. driest 11 years	181899	179020	175146	29536	40683	215829	291339	294218	3874	298092	15099	3941	302033
11a	Avg. driest 22 years	207748	197648	193893	50257	71803	265695	321557	331657	3755	335412	25870	4311	339724
	Average 45 years	261021	221199	217765	81114	119184	336948	379266	419088	3434	422522	43421	5339	427861
	Avg. driest 11 years	181899	188475	179444	29536	40669	220114	291339	284764	9030	293794	15099	3954	297748
11b	Avg. driest 22 years	207748	206043	197527	50257	71748	269275	321557	323262	8516	331778	25870	4366	336143
	Average 45 years	261021	226010	218885	81114	119074	337959	379266	414278	7125	421402	43421	5448	426851
	Avg. driest 11 years	181899	179216	175342	29536	40717	216059	291339	294022	3874	297896	15099	3907	301803
12a	Avg. driest 22 years	207748	200627	196871	50257	71835	268707	321557	328678	3755	332433	25870	4279	336712
	Average 45 years	261021	231144	227710	81114	119195	346905	379266	409143	3434	412578	43421	5327	417905
	Avg. driest 11 years	181899	190843	181813	29536	40669	222482	291339	282395	9030	291425	15099	3954	295379
12b	Avg. driest 22 years	207748	211631	203115	50257	71773	274888	321557	317674	8516	326190	25870	4340	330531
	Average 45 years	261021	241420	234252	81114	119147	353399	379266	398868	7167	406035	43421	5376	411411
	Avg. driest 11 years	181899	183830	179944	29536	40729	220673	291339	289408	3887	293295	15099	3895	297189
13a	Avg. driest 22 years	207748	202000	198238	50257	71826	270064	321557	327305	3761	331066	25870	4288	335355
	Average 45 years	261021	221469	218039	81114	119188	337226	379266	418818	3430	422248	43421	5335	427583
	Avg. driest 11 years	181899	186691	182805	29536	38196	221001	291339	286547	3887	290433	15099	3895	294328
13a1	Avg. driest 22 years	207748	205201	201440	50257	70559	271999	321557	324104	3761	327865	25870	4288	332153
	Average 45 years	261021	227798	224360	81114	118576	342936	379266	412490	3437	415927	43421	5328	421255
	Avg. driest 11 years	181899	194896	185854	29536	40682	226535	291339	278342	9042	287385	15099	3942	291326
13b	Avg. driest 22 years	207748	213008	204486	50257	71777	276263	321557	316297	8522	324819	25870	4337	329156
	Average 45 years	261021	231844	224708	81114	119097	343805	379266	408443	7137	415579	43421	5425	421005
	Avg. driest 11 years	181899	176444	172570	29536	40717	213287	291339	296794	3874	300668	15099	3907	304575
14a	Avg. driest 22 years	207748	197264	193509	50257	71820	265329	321557	332040	3755	335796	25870	4294	340090
	Average 45 years	261021	220483	217056	81114	119179	336235	379266	419804	3427	423232	43421	5343	428575
	Avg. driest 11 years	181899	187119	178077	29536	40682	218758	291339	286119	9042	295161	15099	3942	299103
14b	Avg. driest 22 years	207748	207267	198745	50257	71754	270499	321557	322038	8522	330560	25870	4360	334919
	Average 45 years	261021	229807	222684	81114	119073	341757	379266	410480	7124	417604	43421	5449	423053
	Avg. driest 11 years	181899	173525	169650	29536	40683	210333	291339	299713	3874	303588	15099	3941	307529
15a	Avg. driest 22 years	207748	192521	188766	50257	71786	260553	321557	336783	3755	340539	25870	4327	344866
	Average 45 years	261021	212675	209250	81114	119161	328410	379266	427612	3425	431038	43421	5362	436399
	Avg. driest 11 years	181899	183000	173970	29536	40635	214605	291339	290238	9030	299268	15099	3988	303256
15b	Avg. driest 22 years	207748	202726	194216	50257	71725	265941	321557	326579	8510	335089	25870	4389	339478
	Average 45 years	261021	221876	214765	81114	119048	333813	379266	418412	7111	425522	43421	5474	430997
	Avg. driest 11 years	181899	170050	170050	29536	38436	208485	291339	303188	0	303188	15099	6190	309379
16a	Avg. driest 22 years	207748	190354	190354	50257	68957	259310	321557	338951	0	338951	25870	7159	346110
	Average 45 years	261021	226838	226838	81114	116144	342983	379266	413449	0	413449	43421	8378	421827

		Annual Volume of Entitlement Accessed (AF)												
		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
Option														
	Avg. driest 11 years	181899	183307	183307	29536	37888	221196	291339	289931	0	289931	15099	6738	296669
16b	Avg. driest 22 years	207748	205981	205981	50257	68683	274664	321557	323323	0	323323	25870	7432	330756
	Average 45 years	261021	245001	245001	81114	116011	361012	379266	395286	0	395286	43421	8512	403798
	Avg. driest 11 years	181899	170925	170925	29536	38649	209574	291339	302313	0	302313	15099	5975	308288
16c	Avg. driest 22 years	207748	192306	192306	50257	67420	259726	321557	336999	0	336999	25870	8695	345694
	Average 45 years	261021	233567	233567	81114	114380	347947	379266	406720	0	406720	43421	10144	416864
	Avg. driest 11 years	181899	183328	177750	29536	32250	209999	291339	289910	5578	295489	15099	12375	307864
16d	Avg. driest 22 years	207748	206253	200162	50257	62562	262724	321557	323051	6091	329143	25870	13553	342696
	Average 45 years	261021	245252	240278	81114	111019	351297	379266	395036	4973	400009	43421	13505	413514
	Avg. driest 11 years	181899	179354	179354	29536	32404	211758	291339	293884	0	293884	15099	12220	306104
16e	Avg. driest 22 years	207748	207751	207751	50257	62617	270369	321557	321553	0	321553	25870	13498	335051
	Average 45 years	261021	247476	247476	81114	111034	358510	379266	392811	0	392811	43421	13489	406300
	Avg. driest 11 years	181899	176671	176671	29536	32409	209080	291339	296567	0	296567	15099	12215	308782
16f	Avg. driest 22 years	207748	206347	206347	50257	62621	268968	321557	322958	0	322958	25870	13494	336452
	Average 45 years	261021	248388	248388	81114	111039	359427	379266	391899	0	391899	43421	13485	405383
	Avg. driest 11 years	181899	182416	182416	29536	33077	215493	291339	290823	0	290823	15099	11545	302368
16g	Avg. driest 22 years	207748	208007	208007	50257	52279	260286	321557	321298	0	321298	25870	23834	345132
	Average 45 years	261021	254109	254109	81114	83682	337791	379266	386178	0	386178	43421	40843	427021
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
17a	Avg. driest 22 years	207748	190213	190213	50257	71611	261824	321557	339091	0	339091	25870	4502	343594
	Average 45 years	261021	214028	214028	81114	118909	332936	379266	426259	0	426259	43421	5613	431873
	Avg. driest 11 years	181899	171030	171030	29536	40565	211595	291339	302208	0	302208	15099	4058	306266
17b	Avg. driest 22 years	207748	189988	189988	50257	71611	261599	321557	339317	0	339317	25870	4502	343819
	Average 45 years	261021	213500	213500	81114	118909	332409	379266	426787	0	426787	43421	5613	432400
	Avg. driest 11 years	181899	167138	167138	29536	40565	207703	291339	306100	0	306100	15099	4058	310158
17c	Avg. driest 22 years	207748	184877	184877	50257	71611	256488	321557	344428	0	344428	25870	4502	348930
	Average 45 years	261021	204426	204426	81114	118909	323335	379266	435861	0	435861	43421	5613	441475
	Avg. driest 11 years	181899	171215	171215	29536	31508	202723	291339	302023	0	302023	15099	13117	315140
18a	Avg. driest 22 years	207748	191450	191450	50257	58445	249894	321557	337855	0	337855	25870	17673	355528
	Average 45 years	261021	217528	217528	81114	102943	320471	379266	422759	0	422759	43421	21581	444340
	Avg. driest 11 years	181899	171215	171215	29536	32377	203592	291339	302023	0	302023	15099	12256	314279
18b	Avg. driest 22 years	207748	191495	191495	50257	58947	250442	321557	337810	0	337810	25870	17173	354983
	Average 45 years	261021	217607	217607	81114	102981	320588	379266	422680	0	422680	43421	21543	444223
	Avg. driest 11 years	181899	192340	175086	29536	40842	215928	291339	280898	17253	298152	15099	3780	301932
19a	Avg. driest 22 years	207748	208834	193615	50257	71396	265012	321557	320471	15219	335690	25870	4717	340406
	Average 45 years	261021	229942	217213	81114	118087	335299	379266	410345	12730	423075	43421	6436	429510
	Avg. driest 11 years	181899	199963	174641	29536	40824	215465	291339	273275	25322	298597	15099	3799	302396
19b	Avg. driest 22 years	207748	215294	192903	50257	70948	263851	321557	314011	22391	336402	25870	5165	341567
	Average 45 years	261021	235019	215914	81114	117106	333021	379266	405269	19104	424373	43421	7416	431789
	Avg. driest 11 years	181899	188022	170877	29536	40787	211664	291339	285216	17145	302361	15099	3837	306198
19c	Avg. driest 22 years	207748	204289	189580	50257	71212	260791	321557	325016	14709	339725	25870	4903	344628
	Average 45 years	261021	224769	212644	81114	117809	330454	379266	415519	12124	427643	43421	6714	434357
	Avg. driest 11 years	181899	195944	170440	29536	40782	211222	291339	277294	25504	302798	15099	3841	306639
19d	Avg. driest 22 years	207748	210954	188966	50257	70773	259739	321557	318351	21988	340338	25870	5341	345679
	Average 45 years	261021	229870	211381	81114	116817	328197	379266	410417	18489	428907	43421	7706	436612
	Avg. driest 11 years	181899	180076	171127	29536	40916	212042	291339	293162	8950	302112	15099	3708	305820
19e	Avg. driest 22 years	207748	197950	190223	50257	71929	262151	321557	331354	7727	339082	25870	4185	343267
	Average 45 years	261021	219777	213586	81114	119251	332837	379266	420510	6191	426701	43421	5272	431973
	Avg. driest 11 years	181899	184187	175337	29536	40854	216191	291339	289051	8850	297902	15099	3770	301671
19f	Avg. driest 22 years	207748	202009	194099	50257	71999	266098	321557	327296	7909	335205	25870	4115	339320
	Average 45 years	261021	224499	218005	81114	119448	337453	379266	415788	6494	422283	43421	5074	427357

		Annual Volume of Entitlement Accessed (AF)												
		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
Option														
	Avg. driest 11 years	181899	179021	161293	29536	40457	201750	291339	294217	17728	311945	15099	4166	316111
20a	Avg. driest 22 years	207748	197725	182520	50257	70864	253383	321557	331580	15205	346785	25870	5250	352035
	Average 45 years	261021	221699	209381	81114	117538	326919	379266	418589	12317	430906	43421	6985	437891
	Avg. driest 11 years	181899	179056	153163	29536	40323	193486	291339	294183	25893	320075	15099	4302	324377
20b	Avg. driest 22 years	207748	197757	175355	50257	70282	245636	321557	331548	22402	353950	25870	5833	359783
	Average 45 years	261021	221800	203212	81114	116425	319637	379266	418487	18587	437075	43421	8098	445173
	Avg. driest 11 years	181899	171215	153506	29536	40456	193962	291339	302024	17709	319732	15099	4167	323899
20c	Avg. driest 22 years	207748	190557	175364	50257	70861	246225	321557	338747	15193	353941	25870	5253	359194
	Average 45 years	261021	214574	202268	81114	117531	319799	379266	425713	12306	438019	43421	6992	445011
	Avg. driest 11 years	181899	171215	145337	29536	40307	185645	291339	302024	25877	327901	15099	4317	332218
20d	Avg. driest 22 years	207748	190585	168191	50257	70274	238465	321557	338720	22395	361114	25870	5840	366955
	Average 45 years	261021	214967	196383	81114	116421	312804	379266	425320	18584	443904	43421	8102	452006
	Avg. driest 11 years	181899	171215	161793	29536	40698	202491	291339	302024	9422	311445	15099	3926	315371
20e	Avg. driest 22 years	207748	190530	182463	50257	71737	254200	321557	338774	8067	346842	25870	4377	351219
	Average 45 years	261021	214269	207918	81114	119117	327036	379266	426018	6351	432369	43421	5406	437774
	Avg. driest 11 years	181899	179020	167229	29536	40884	208113	291339	294218	11792	306010	15099	3739	309749
20f	Avg. driest 22 years	207748	197687	187650	50257	71973	259623	321557	331618	10037	341654	25870	4141	345795
	Average 45 years	261021	221298	213557	81114	119416	332973	379266	418989	7740	426730	43421	5107	431837
	Avg. driest 11 years	181899	169266	169266	29536	40565	209831	291339	303972	0	303972	15099	4058	308030
21a	Avg. driest 22 years	207748	189002	189002	50257	71611	260613	321557	340303	0	340303	25870	4502	344805
	Average 45 years	261021	211643	211643	81114	118909	330552	379266	428644	0	428644	43421	5613	434257
	Avg. driest 11 years	181899	177906	177906	29536	31401	209307	291339	295332	0	295332	15099	13242	308574
21b	Avg. driest 22 years	207748	197468	197468	50257	52415	249883	321557	331837	0	331837	25870	23715	355552
	Average 45 years	261021	219405	219405	81114	84047	303452	379266	420882	0	420882	43421	40475	461357
	Avg. driest 11 years	181899	178922	178922	29536	31401	210323	291339	294317	0	294317	15099	13242	307559
21c	Avg. driest 22 years	207748	198694	198694	50257	52415	251109	321557	330611	0	330611	25870	23715	354326
	Average 45 years	261021	221397	221397	81114	84047	305445	379266	418890	0	418890	43421	40475	459364
	Avg. driest 11 years	181899	173509	169621	29536	40981	210602	291339	295841	3888	299729	15099	3642	303371
21d	Avg. driest 22 years	207748	192178	188416	50257	72060	260475	321557	333365	3762	337127	25870	4054	341181
	Average 45 years	261021	213891	210453	81114	119369	329822	379266	422958	3438	426396	43421	5153	431550
	Avg. driest 11 years	181899	170037	170037	29536	40565	210602	291339	303201	0	303201	15099	4058	307259
21e	Avg. driest 22 years	207748	188389	188389	50257	71611	260000	321557	340916	0	340916	25870	4502	345418
	Average 45 years	261021	210047	210047	81114	118909	328956	379266	430240	0	430240	43421	5613	435853
	Avg. driest 11 years	181899	171215	171215	29536	40565	211780	291339	302023	0	302023	15099	4058	306081
22	Avg. driest 22 years	207748	190958	190958	50257	71611	262569	321557	338347	0	338347	25870	4502	342849
	Average 45 years	261021	216558	216558	81114	118909	335467	379266	423729	0	423729	43421	5613	429342
	Avg. driest 11 years	181899	185142	185142	29536	40772	225913	291339	288096	0	288096	15099	3854	291949
23a	Avg. driest 22 years	207748	197709	197709	50257	71845	269554	321557	331596	0	331596	25870	4270	335866
	Average 45 years	261021	207831	207831	81114	119164	326995	379266	432456	0	432456	43421	5360	437815
	Avg. driest 11 years	181899	193523	193523	29536	40772	234295	291339	279715	0	279715	15099	3854	283568
23b	Avg. driest 22 years	207748	211879	211879	50257	71845	283723	321557	317426	0	317426	25870	4270	321696
	Average 45 years	261021	232305	232305	81114	119164	351469	379266	407982	0	407982	43421	5360	413342
	Avg. driest 11 years	181899	199693	199693	29536	40772	240464	291339	273545	0	273545	15099	3854	277398
23c	Avg. driest 22 years	207748	217612	217612	50257	71845	289457	321557	311693	0	311693	25870	4270	315963
	Average 45 years	261021	236929	236929	81114	119164	356093	379266	403358	0	403358	43421	5360	408718
	Avg. driest 11 years	181899	202437	202437	29536	33020	235457	291339	270801	0	270801	15099	11595	282396
23d	Avg. driest 22 years	207748	220709	220709	50257	53551	274261	321557	308595	0	308595	25870	22563	331158
	Average 45 years	261021	242230	242230	81114	83686	325916	379266	398057	0	398057	43421	40836	438894
	Avg. driest 11 years			181899							291339			
23e	Avg. driest 22 years			207748							321557			
	Average 45 years			261021							379266			

		Annual Volume of Entitlement Accessed (AF)												
		Montana						Alberta						
		St Mary River			Milk River		Total Accessed	St Mary River				Milk River		Total Accessed
		Entitlement	Accessed (Natural flow at International Border - flow into Canada)	Net accessed	Entitlement	Accessed		Entitlement	Accessed (St Mary River flow into Canada)	Accessed (From US St Mary canal diversion)	Total accessed	Entitlement	Accessed	
		1	2	3 (2-8)	4	5	(3+5)	6	7	8	9 (7+8)	10	11	(9+11)
Option														
	Avg. driest 11 years	181899	184880	184880	29536	40565	225445	291339	288357	0	288357	15099	4058	292416
23f	Avg. driest 22 years	207748	203687	203687	50257	71611	275298	321557	325618	0	325618	25870	4502	330120
	Average 45 years	261021	225510	225510	81114	118909	344419	379266	414777	0	414777	43421	5613	420391
	Avg. driest 11 years	181899	178977	178977	29536	40565	219542	291339	294261	0	294261	15099	4058	298319
MO2	Avg. driest 22 years	207748	194323	194323	50257	71611	265935	321557	334982	0	334982	25870	4502	339484
	Average 45 years	261021	208277	208277	81114	118909	327187	379266	432009	0	432009	43421	5613	437623
	Avg. driest 11 years	181899	178978	174978	29536	40846	215823	291339	294260	4000	298260	15099	3779	302039
MO2A	Avg. driest 22 years	207748	194382	190564	50257	71864	262428	321557	334923	3818	338741	25870	4252	342992
	Average 45 years	261021	208033	204532	81114	119205	323737	379266	432254	3501	435755	43421	5319	441074
	Avg. driest 11 years	181899	178976	172987	29536	40885	213871	291339	294262	5989	300251	15099	3740	303991
MO2B	Avg. driest 22 years	207748	194371	188684	50257	71936	260620	321557	334934	5687	340620	25870	4180	344800
	Average 45 years	261021	208153	203158	81114	119289	322447	379266	432134	4995	437129	43421	5235	442364
	Avg. driest 11 years	181899	181631	181631	29536	40565	222197	291339	291606	0	291606	15099	4058	295665
MO3	Avg. driest 22 years	207748	203042	203042	50257	71611	274654	321557	326262	0	326262	25870	4502	330764
	Average 45 years	261021	227155	227155	81114	118909	346064	379266	413132	0	413132	43421	5613	418745
	Avg. driest 11 years	181899	181912	181912	29536	40565	222478	291339	291325	0	291325	15099	4058	295384
MO4	Avg. driest 22 years	207748	202517	202517	50257	71611	274128	321557	326788	0	326788	25870	4502	331290
	Average 45 years	261021	223703	223703	81114	118909	342612	379266	416584	0	416584	43421	5613	422198
	Avg. driest 11 years	181899	181947	181947	29536	40565	222512	291339	291291	0	291291	15099	4058	295349
MO5	Avg. driest 22 years	207748	204432	204432	50257	71611	276043	321557	324873	0	324873	25870	4502	329375
	Average 45 years	261021	233230	233230	81114	118909	352140	379266	407057	0	407057	43421	5613	412670
	Avg. driest 11 years	181899	182219	182219	29536	33090	215309	291339	291018	0	291018	15099	11553	302571
MO6	Avg. driest 22 years	207748	203694	203694	50257	53527	257221	321557	325610	0	325610	25870	22602	348213
	Average 45 years	261021	227504	227504	81114	84226	311730	379266	412783	0	412783	43421	40298	453080
	Avg. driest 11 years	181899	180765	177210	29536	35707	212917	291339	292473	3554	296027	15099	8917	304944
MT1a	Avg. driest 22 years	207748	198609	195401	50257	66892	262293	321557	330696	3208	333904	25870	9222	343125
	Average 45 years	261021	216655	214469	81114	114394	328863	379266	423632	2186	425818	43421	10129	435947
	Avg. driest 11 years	181899	183177	179623	29536	35707	215330	291339	290060	3554	293614	15099	8917	302531
MT1b	Avg. driest 22 years	207748	205205	201996	50257	66894	268890	321557	324099	3209	327309	25870	9221	336529
	Average 45 years	261021	234259	232072	81114	114395	346467	379266	406028	2187	408215	43421	10128	418343
	Avg. driest 11 years	181899	191169	187220	29536	36830	224051	291339	282068	3949	286018	15099	7792	293810
MT1c	Avg. driest 22 years	207748	213316	209729	50257	67761	277490	321557	315989	3587	319576	25870	8352	327928
	Average 45 years	261021	240697	238065	81114	115072	353137	379266	399590	2632	402222	43421	9450	411672
	Avg. driest 11 years	181899	182625	182625	29536	31362	213987	291339	290613	0	290613	15099	35415	326028
MT1d	Avg. driest 22 years	207748	204768	204768	50257	52405	257173	321557	324537	0	324537	25870	38312	362849
	Average 45 years	261021	235296	235296	81114	84047	319343	379266	404991	0	404991	43421	38664	443655
	Avg. driest 11 years	181899	189542	189542	29536	31362	220903	291339	283696	0	283696	15099	35416	319112
MT1e	Avg. driest 22 years	207748	212711	212711	50257	52405	265116	321557	316594	0	316594	25870	38313	354907
	Average 45 years	261021	241292	241292	81114	84047	325339	379266	398995	0	398995	43421	38664	437659
	Avg. driest 11 years	181899	174485	172211	29536	36932	209143	291339	298753	2274	301027	15099	7690	308717
CrSysLOICap1	Avg. driest 22 years	207748	191187	188842	50257	67665	256507	321557	338118	2345	340463	25870	8448	348910
	Average 45 years	261021	208995	207204	81114	114761	321966	379266	431292	1790	433083	43421	9760	442843
	Avg. driest 11 years	181899	175437	173163	29536	36932	210096	291339	297800	2274	300074	15099	7690	307764
CrSysLOICap2	Avg. driest 22 years	207748	198142	195797	50257	67665	263462	321557	331163	2345	333508	25870	8448	341955
	Average 45 years	261021	227787	225997	81114	114761	340758	379266	412500	1790	414290	43421	9760	424050

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
1a										(acres)	(acre-feet)
Average (inches)	2.1	1.2	2.2	1.3	3.1	2.8	4.6	5.1	3.4	137,042	424,560
Deficits >= 4 inches	8	5	8	4	12	9	19	21	13		
1b										(acres)	(acre-feet)
Average (inches)	2.7	1.5	1.8	1.5	1.8	0.2	4.1	4.8	2.9	137,042	440,123
Deficits >= 4 inches	10	5	8	5	9	0	20	20	12		
2a										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.1	2.8	4.4	4.7	3.2	137,042	430,382
Deficits >= 4 inches	7	5	8	4	10	9	16	20	11		
2a1										(acres)	(acre-feet)
Average (inches)	1.9	1.2	2.2	1.3	3.1	2.8	4.4	4.6	3.2	137,042	429,784
Deficits >= 4 inches	8	6	8	3	10	9	16	16	11		
2b										(acres)	(acre-feet)
Average (inches)	2.4	1.4	1.6	1.4	1.6	0.2	3.8	4.4	2.7	137,042	447,681
Deficits >= 4 inches	9	5	7	4	6	0	15	17	11		
2c										(acres)	(acre-feet)
Average (inches)	1.4	0.8	1.9	1.0	2.9	2.8	3.9	3.7	2.8	137,042	443,314
Deficits >= 4 inches	6	3	6	3	9	9	14	12	7		
2c1										(acres)	(acre-feet)
Average (inches)	1.4	0.9	1.9	1.1	2.9	2.8	4.1	3.7	2.8	137,042	440,802
Deficits >= 4 inches	5	4	6	4	9	9	14	12	8		
2d										(acres)	(acre-feet)
Average (inches)	2.4	1.2	2.7	1.6	3.7	2.8	4.4	4.6	3.4	137,042	424,061
Deficits >= 4 inches	9	3	11	6	15	9	17	18	13		
2e										(acres)	(acre-feet)
Average (inches)	1.2	0.8	1.9	1.0	2.8	2.8	3.8	3.5	2.6	137,042	447,277
Deficits >= 4 inches	5	3	6	3	9	9	14	11	6		
2f										(acres)	(acre-feet)
Average (inches)	19	8	24	14	39	40	37	32	3.5	137,042	418,282
Deficits >= 4 inches	9	6	8	5	13	9	22	20	13		
3										(acres)	(acre-feet)
Average (inches)	1.8	1.1	2.1	1.2	3.0	2.8	4.2	4.5	3.1	137,042	433,659
Deficits >= 4 inches	7	4	8	3	10	9	14	17	11		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
4a										(acres)	(acre-feet)
Average (inches)	1.6	1.0	2.1	1.2	2.9	2.8	4.1	4.4	3.0	137,042	435,890
Deficits >= 4 inches	7	3	7	4	9	9	15	19	11		
4a1										(acres)	(acre-feet)
Average (inches)	1.8	1.0	2.2	1.3	3.2	2.9	4.2	4.5	3.1	137,042	441,372
Deficits >= 4 inches	8	3	8	3	11	10	16	18	11		
4b										(acres)	(acre-feet)
Average (inches)	2.3	1.0	2.6	1.6	3.7	2.8	4.2	4.4	3.2	137,042	428,358
Deficits >= 4 inches	9	3	11	6	14	9	16	18	13		
4c										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.2	3.0	2.8	4.4	4.8	3.2	137,042	430,792
Deficits >= 4 inches	7	4	7	4	10	9	17	20	11		
4d										(acres)	(acre-feet)
Average (inches)	1.2	0.7	1.9	1.0	2.8	2.8	3.7	3.5	2.6	137,042	448,720
Deficits >= 4 inches	5	2	6	3	9	9	11	10	6		
4e										(acres)	(acre-feet)
Average (inches)	1.1	0.6	1.8	0.9	2.7	2.8	3.6	3.2	2.5	137,042	451,888
Deficits >= 4 inches	5	2	6	2	9	9	11	9	6		
5a										(acres)	(acre-feet)
Average (inches)	1.8	1.1	2.1	1.2	3.0	2.8	4.3	4.7	3.1	137,042	432,062
Deficits >= 4 inches	7	4	8	4	10	9	16	19	11		
5b										(acres)	(acre-feet)
Average (inches)	1.8	1.1	2.1	1.2	3.0	2.8	4.3	4.6	3.1	137,042	432,005
Deficits >= 4 inches	7	4	8	4	9	9	16	19	11		
5c										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.2	2.9	2.8	4.2	4.6	3.1	137,042	434,061
Deficits >= 4 inches	7	3	7	4	9	9	15	20	11		
6a										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.1	2.9	2.7	4.1	4.4	3.0	137,042	436,847
Deficits >= 4 inches	6	3	6	3	9	9	15	18	11		
6a1										(acres)	(acre-feet)
Average (inches)	1.6	1.0	2.0	1.1	2.9	2.8	3.9	4.2	2.9	137,042	439,459
Deficits >= 4 inches	7	3	8	3	9	9	14	15	10		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
6b										(acres)	(acre-feet)
Average (inches)	1.7	1.1	1.9	1.2	2.9	2.7	4.6	5.0	3.2	137,042	428,547
Deficits >= 4 inches	7	6	5	4	10	9	18	19	12		
6c										(acres)	(acre-feet)
Average (inches)	1.5	1.1	1.8	1.1	2.7	2.7	4.4	4.9	3.1	137,042	432,446
Deficits >= 4 inches	6	6	5	4	9	9	17	18	12		
6d										(acres)	(acre-feet)
Average (inches)	2.3	1.0	2.6	1.6	3.7	2.8	4.2	4.3	3.2	137,042	428,877
Deficits >= 4 inches	8	3	11	6	14	9	16	18	13		
7a										(acres)	(acre-feet)
Average (inches)	2.1	1.3	2.2	1.4	3.1	2.8	4.7	5.2	3.4	137,042	422,796
Deficits >= 4 inches	8	7	8	4	12	9	18	21	12		
7b										(acres)	(acre-feet)
Average (inches)	2.1	1.3	2.2	1.4	3.1	2.8	4.7	5.2	3.4	137,042	422,823
Deficits >= 4 inches	8	7	8	4	12	9	18	21	12		
7c										(acres)	(acre-feet)
Average (inches)	2.1	1.3	2.2	1.4	3.1	2.8	4.7	5.2	3.4	137,042	422,992
Deficits >= 4 inches	8	7	8	4	12	9	18	21	12		
8a										(acres)	(acre-feet)
Average (inches)	1.5	1.0	2.0	1.1	2.9	2.8	4.0	3.9	2.8	137,042	441,153
Deficits >= 4 inches	5	5	7	3	8	9	14	13	8		
8b										(acres)	(acre-feet)
Average (inches)	1.6	1.0	2.0	1.1	2.9	2.8	4.0	4.0	2.9	137,042	439,932
Deficits >= 4 inches	6	5	7	3	8	9	12	13	8		
8c										(acres)	(acre-feet)
Average (inches)	1.7	1.1	2.1	1.2	3.0	2.8	4.2	4.3	3.0	137,042	434,796
Deficits >= 4 inches	6	5	7	3	10	9	15	15	9		
8d										(acres)	(acre-feet)
Average (inches)	2.2	1.4	2.3	1.4	3.2	2.8	4.6	5.0	3.4	137,042	423,195
Deficits >= 4 inches	9	7	8	4	12	9	18	18	12		
8e										(acres)	(acre-feet)
Average (inches)	1.4	1.0	1.9	1.1	2.8	2.8	3.9	3.8	2.8	137,042	442,498
Deficits >= 4 inches	5	5	7	3	8	9	13	13	7		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
8f										(acres)	(acre-feet)
Average (inches)	1.5	1.0	2.0	1.1	2.9	2.8	4.0	4.0	2.9	137,042	439,973
Deficits >= 4 inches	5	5	7	3	9	9	13	14	8		
9										(acres)	(acre-feet)
Average (inches)	2.1	0.9	2.5	1.4	3.5	2.8	4.0	4.1	3.1	137,042	433,752
Deficits >= 4 inches	7	3	11	3	14	9	15	16	12		
10a										(acres)	(acre-feet)
Average (inches)	2.0	1.1	2.2	1.3	3.1	2.8	4.7	5.0	3.3	137,042	424,834
Deficits >= 4 inches	8	4	8	4	11	9	20	19	13		
10aWCO										(acres)	(acre-feet)
Average (inches)	2.1	1.2	2.2	1.4	3.1	2.8	4.7	5.1	3.4	137,042	423,274
Deficits >= 4 inches	8	5	8	4	12	9	20	19	13		
10b										(acres)	(acre-feet)
Average (inches)	2.1	1.1	2.2	1.3	3.1	2.8	4.7	4.9	3.3	137,042	425,166
Deficits >= 4 inches	9	4	8	5	11	9	20	19	13		
11a										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.2	2.8	4.2	4.5	3.1	137,042	432,126
Deficits >= 4 inches	8	3	8	3	11	9	16	18	11		
11b										(acres)	(acre-feet)
Average (inches)	1.9	1.0	2.1	1.3	3.0	2.8	4.3	4.5	3.1	137,042	432,195
Deficits >= 4 inches	8	4	8	4	10	9	18	17	11		
12a										(acres)	(acre-feet)
Average (inches)	1.8	1.0	2.1	1.2	3.1	2.8	4.2	4.4	3.0	137,042	434,580
Deficits >= 4 inches	7	3	8	3	10	9	16	16	11		
12b										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.2	3.0	2.7	4.1	4.3	3.0	137,042	435,853
Deficits >= 4 inches	6	3	8	3	10	9	16	16	11		
13a										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.2	2.9	2.8	4.1	4.4	3.0	137,042	436,545
Deficits >= 4 inches	6	3	7	3	9	9	18	18	11		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
13a1										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.2	3.0	2.8	4.0	4.2	2.9	137,042	438,077
Deficits >= 4 inches	7	3	7	3	10	9	16	16	11		
13b										(acres)	(acre-feet)
Average (inches)	1.5	0.9	2.0	1.2	2.9	2.7	4.1	4.3	2.9	137,042	437,823
Deficits >= 4 inches	6	3	7	4	9	9	18	17	11		
14a										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.2	3.0	2.8	4.2	4.5	3.0	137,042	434,857
Deficits >= 4 inches	7	3	6	4	10	10	18	18	11		
14b										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.2	3.0	2.7	4.2	4.4	3.0	137,042	435,695
Deficits >= 4 inches	7	3	6	4	10	9	18	18	11		
15a										(acres)	(acre-feet)
Average (inches)	1.6	1.1	1.9	1.0	2.7	2.8	4.4	4.9	3.1	137,042	432,130
Deficits >= 4 inches	6	6	5	4	9	9	19	18	12		
15b										(acres)	(acre-feet)
Average (inches)	1.5	1.0	1.9	1.1	2.8	2.7	4.4	4.7	3.1	137,042	433,421
Deficits >= 4 inches	6	3	5	4	9	9	19	19	12		
16a										(acres)	(acre-feet)
Average (inches)	1.9	1.2	2.2	1.3	3.1	2.8	4.3	4.7	3.2	137,042	430,508
Deficits >= 4 inches	8	6	8	3	11	9	17	18	12		
16b										(acres)	(acre-feet)
Average (inches)	1.6	1.0	2.1	1.1	3.0	2.8	3.9	4.3	2.9	137,042	438,994
Deficits >= 4 inches	6	3	7	3	11	9	16	16	10		
16c										(acres)	(acre-feet)
Average (inches)	1.9	1.2	2.2	1.4	3.1	2.8	4.3	4.7	3.2	137,042	430,284
Deficits >= 4 inches	8	6	8	5	11	9	17	19	12		
16d										(acres)	(acre-feet)
Average (inches)	1.8	1.1	2.2	1.3	3.0	2.8	4.1	4.4	3.0	137,042	434,609
Deficits >= 4 inches	9	4	8	5	11	9	16	17	11		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
16e										(acres)	(acre-feet)
Average (inches)	1.8	1.1	2.1	1.3	3.0	2.8	4.0	4.3	3.0	137,042	436,333
Deficits >= 4 inches	7	4	7	5	9	9	16	17	10		
16f										(acres)	(acre-feet)
Average (inches)	1.3	0.8	1.9	1.1	2.8	2.8	3.6	3.5	2.6	137,042	448,005
Deficits >= 4 inches	5	4	6	4	9	9	11	8	6		
16g										(acres)	(acre-feet)
Average (inches)	2.5	1.1	2.7	1.7	3.9	2.9	4.4	4.3	3.4	137,042	424,162
Deficits >= 4 inches	10	5	9	7	15	9	20	17	12		
17a										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.1	2.8	4.2	4.5	3.1	137,042	432,408
Deficits >= 4 inches	8	5	8	3	10	9	15	16	11		
17b										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.1	2.8	4.2	4.5	3.1	137,042	433,420
Deficits >= 4 inches	8	5	8	3	10	9	14	15	11		
17c										(acres)	(acre-feet)
Average (inches)	1.4	0.9	1.9	1.1	2.8	2.7	3.6	3.8	2.7	137,042	446,641
Deficits >= 4 inches	5	5	7	3	9	9	9	11	8		
18a										(acres)	(acre-feet)
Average (inches)	1.9	1.2	2.2	1.3	3.1	2.8	4.3	4.4	3.1	137,042	431,863
Deficits >= 4 inches	7	6	7	3	11	9	14	15	11		
18b										(acres)	(acre-feet)
Average (inches)	1.9	1.2	2.2	1.3	3.1	2.8	4.3	4.5	3.1	137,042	431,356
Deficits >= 4 inches	8	6	8	3	11	9	14	15	11		
19a										(acres)	(acre-feet)
Average (inches)	2.0	1.1	2.2	1.3	3.2	2.8	4.3	4.5	3.2	137,042	430,880
Deficits >= 4 inches	8	3	8	5	12	9	17	17	11		
19b										(acres)	(acre-feet)
Average (inches)	2.1	1.1	2.2	1.4	3.1	2.8	4.4	4.5	3.2	137,042	429,650
Deficits >= 4 inches	8	5	8	5	11	9	18	17	11		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
19c										(acres)	(acre-feet)
Average (inches)	2.0	1.1	2.2	1.4	3.1	2.8	4.4	4.6	3.2	137,042	428,881
Deficits >= 4 inches	8	5	8	4	11	9	18	17	11		
19d										(acres)	(acre-feet)
Average (inches)	2.1	1.2	2.2	1.4	3.1	2.8	4.5	4.7	3.3	137,042	427,444
Deficits >= 4 inches	8	5	8	6	11	9	19	17	12		
19e										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.1	2.8	4.4	4.6	3.2	137,042	430,096
Deficits >= 4 inches	8	3	8	4	11	9	17	18	11		
19f										(acres)	(acre-feet)
Average (inches)	1.9	1.0	2.2	1.3	3.2	2.8	4.3	4.5	3.1	137,042	431,932
Deficits >= 4 inches	8	3	8	5	10	9	16	18	11		
20a										(acres)	(acre-feet)
Average (inches)	2.4	1.3	2.5	1.5	3.4	2.8	4.5	4.8	3.4	137,042	423,483
Deficits >= 4 inches	9	6	9	5	13	9	18	17	11		
20b										(acres)	(acre-feet)
Average (inches)	2.7	1.4	2.6	1.7	3.6	2.9	4.8	5.0	3.6	137,042	417,311
Deficits >= 4 inches	9	6	10	9	14	9	19	18	13		
20c										(acres)	(acre-feet)
Average (inches)	2.5	1.4	2.6	1.6	3.5	2.8	4.7	5.0	3.5	137,042	419,087
Deficits >= 4 inches	9	6	10	7	14	9	18	18	12		
20d										(acres)	(acre-feet)
Average (inches)	2.8	1.5	2.7	1.8	3.6	2.9	4.9	5.2	3.7	137,042	413,046
Deficits >= 4 inches	9	7	10	9	14	9	20	19	13		
20e										(acres)	(acre-feet)
Average (inches)	2.3	1.3	2.5	1.5	3.3	2.8	4.5	4.8	3.4	137,042	423,632
Deficits >= 4 inches	9	5	9	6	12	9	17	19	11		
20f										(acres)	(acre-feet)
Average (inches)	2.1	1.1	2.4	1.5	3.3	2.8	4.4	4.6	3.3	137,042	427,670
Deficits >= 4 inches	9	5	8	5	11	9	17	18	11		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
21a										(acres)	(acre-feet)
Average (inches)	0.3	0.3	0.6	0.5	0.5	0.3	0.8	0.5	0.6	137,042	260,949
Deficits >= 4 inches	1	2	3	2	2	2	4	3	3		
21b										(acres)	(acre-feet)
Average (inches)	0.3	0.3	0.5	0.5	0.5	0.3	0.8	0.5	0.6	137,042	261,288
Deficits >= 4 inches	1	2	1	1	1	2	4	2	2		
21c										(acres)	(acre-feet)
Average (inches)	0.4	0.4	1.2	1.2	1.1	0.6	1.7	1.2	1.2	164,229	300,501
Deficits >= 4 inches	2	2	5	5	4	2	7	3	5		
21d										(acres)	(acre-feet)
Average (inches)	0.4	0.5	1.5	1.4	1.5	1.0	2.4	1.9	1.7	137,042	329,884
Deficits >= 4 inches	2	2	7	7	7	3	8	9	7		
21e										(acres)	(acre-feet)
Average (inches)	0.5	0.5	1.5	1.4	1.5	1.1	2.4	1.8	1.7	137,042	329,717
Deficits >= 4 inches	2	2	7	7	7	5	8	9	7		
22										(acres)	(acre-feet)
Average (inches)	4.2	2.7	4.0	3.2	4.3	0.0	6.1	6.4	4.1	156,432	422,500
Deficits >= 4 inches	18	10	15	14	17	0	27	25	18		
23a										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.1	2.9	2.7	4.4	4.7	3.1	137,042	432,251
Deficits >= 4 inches	6	4	6	4	11	8	19	20	12		
23b										(acres)	(acre-feet)
Average (inches)	1.5	0.8	1.9	1.0	2.8	2.7	3.9	4.1	2.8	137,042	442,646
Deficits >= 4 inches	7	3	7	3	9	8	15	16	9		
23c										(acres)	(acre-feet)
Average (inches)	1.2	0.7	1.8	0.9	2.8	2.7	3.7	3.9	2.7	137,042	447,159
Deficits >= 4 inches	4	3	6	3	8	8	14	14	8		
23d										(acres)	(acre-feet)
Average (inches)	1.3	0.8	1.8	0.9	2.8	2.7	3.9	4.1	2.8	137,042	442,995
Deficits >= 4 inches	6	3	6	3	8	8	15	14	10		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
23e										(acres)	(acre-feet)
Average (inches)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Deficits >= 4 inches	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
23f										(acres)	(acre-feet)
Average (inches)	1.7	0.9	2.0	1.1	2.9	2.7	4.0	4.3	2.9	137,042	438,322
Deficits >= 4 inches	7	3	8	3	10	9	16	16	10		
MO2										(acres)	(acre-feet)
Average (inches)	1.9	1.0	2.1	1.2	3.0	2.7	4.4	4.8	3.2	137,042	430,414
Deficits >= 4 inches	8	4	7	4	11	9	18	20	12		
MO2A										(acres)	(acre-feet)
Average (inches)	2.0	1.1	2.1	1.3	3.0	2.8	4.6	4.9	3.3	137,042	427,021
Deficits >= 4 inches	8	4	7	4	11	9	19	19	12		
MO2B										(acres)	(acre-feet)
Average (inches)	2.0	1.1	2.2	1.3	3.1	2.8	4.6	4.9	3.3	137,042	425,549
Deficits >= 4 inches	8	4	8	5	11	9	19	19	12		
MO3										(acres)	(acre-feet)
Average (inches)	1.9	0.9	2.1	1.2	3.6	2.8	4.5	3.8	3.1	137,042	432,442
Deficits >= 4 inches	8	3	7	4	13	9	18	12	11		
MO4										(acres)	(acre-feet)
Average (inches)	1.5	0.9	2.0	1.1	2.9	2.8	4.0	4.2	2.9	137,042	439,873
Deficits >= 4 inches	7	3	6	3	9	9	15	15	10		
MO5										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.1	3.0	2.8	4.0	4.2	2.9	137,042	438,760
Deficits >= 4 inches	6	3	8	3	10	9	15	14	11		
MO6										(acres)	(acre-feet)
Average (inches)	1.7	1.0	2.1	1.2	3.0	2.8	4.2	4.5	3.1	137,042	433,904
Deficits >= 4 inches	8	3	7	4	10	9	15	17	11		
MT1a										(acres)	(acre-feet)
Average (inches)	2.1	1.1	2.2	1.4	3.1	2.8	4.6	4.9	3.3	137,042	425,465
Deficits >= 4 inches	8	4	7	5	11	9	19	18	13		

Table 2D1	Montana Irrigation Performance Summary										
	Private irrigaton Deficits		District Irrigation Deficits						Total Milk River		
	Up stream of Dodson	Down stream of Dodson	Fort Belknap Districts	Paradise Valley	Harlem	Fort Belknap Reservation	Malta Districts	Glasgow	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
MT1b										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.2	1.3	3.1	2.8	4.2	4.5	3.1	137,042	433,168
Deficits >= 4 inches	8	3	7	4	10	9	16	17	11		
MT1c										(acres)	(acre-feet)
Average (inches)	1.6	0.9	2.0	1.2	2.9	2.8	4.0	4.2	2.9	137,042	439,076
Deficits >= 4 inches	7	3	7	3	10	9	16	17	10		
MT1d										(acres)	(acre-feet)
Average (inches)	1.9	1.1	2.1	1.3	3.0	2.8	4.3	4.6	3.1	137,042	431,760
Deficits >= 4 inches	9	3	7	3	11	9	16	16	11		
MT1e										(acres)	(acre-feet)
Average (inches)	1.6	1.0	2.0	1.1	2.9	2.7	4.1	4.3	2.9	137,042	438,142
Deficits >= 4 inches	7	3	7	3	10	9	15	15	11		
CrSysLOICap1										(acres)	(acre-feet)
Average (inches)	2.1	1.2	2.2	1.4	3.1	2.7	4.7	5.1	3.4	137,042	423,762
Deficits >= 4 inches	8	5	8	4	12	9	20	20	13		
CrSysLOICap2										(acres)	(acre-feet)
Average (inches)	2.2	1.1	2.5	1.5	3.4	2.8	4.2	4.5	3.2	137,042	429,544
Deficits >= 4 inches	9	3	9	4	12	9	16	18	11		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
1a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.71	615,681	757,904	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
1b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,719	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,608	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2a1									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,283	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,401	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,316	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2c1									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,208	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,001	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,098	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
2f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,312	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
3									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.72	615,681	757,130	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
4a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	756,824	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
4a1									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,486	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
4b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,803	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
4c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.73	615,681	757,046	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
4d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,056	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
4e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,042	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
5a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,588	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
5b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,518	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
5c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,073	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
6a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.5	0.8	1.8	0.73	615,681	756,770	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
6a1									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,177	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
6b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,333	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
6c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,353	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
6d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,745	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
7a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,546	1.69	23,822	34,285
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
7b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,546	1.76	26,108	37,491
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
7c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,574	1.69	26,108	37,718
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
8a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,087	1.67	24,008	34,620
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
8b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,114	1.67	24,070	34,621
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
8c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,114	1.31	24,070	35,756
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
8d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,237	1.27	26,170	39,124
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
8e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,939	1.42	21,907	32,132
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
8f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.6	0.8	1.8	0.73	615,681	757,114	1.44	22,093	32,363
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
9									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,369	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
10a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,653	4.37	8,069	8,089
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
10aWCO									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.2	0.6	0.8	1.8	0.72	615,681	757,280	4.36	8,069	8,103
Deficits >= 4 inches	8	1	1	1	1	1	1	3				21		
10b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	754,807	1.41	8,687	11,882
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
11a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,229	4.38	8,069	8,082
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
11b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.7	0.8	1.8	0.77	615,681	754,505	1.42	8,687	11,876
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
12a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	755,993	4.39	8,069	8,070
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
12b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.6	0.8	1.8	0.78	615,681	753,803	1.45	8,687	11,846
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
13a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,539	4.39	8,069	8,074
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
13a1									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	755,062	4.39	8,069	8,074
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
13b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.7	0.8	1.8	0.79	615,681	753,222	1.43	8,687	11,865
Deficits >= 4 inches	8	2	1	1	3	2	1	3				5		
14a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	755,993	4.38	8,069	8,080
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
14b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.6	0.8	1.8	0.78	615,681	753,982	1.42	8,687	11,876
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
15a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,656	4.37	8,069	8,096
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
15b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.77	615,681	754,328	1.41	8,687	11,888
Deficits >= 4 inches	8	2	1	1	1	2	1	3				5		
16a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.5	0.8	1.8	0.73	615,681	756,895	4.63	8,070	7,845
Deficits >= 4 inches	8	2	1	1	1	1	1	3				21		
16b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.4	0.6	0.8	1.8	0.77	615,681	754,167	4.49	8,070	7,981
Deficits >= 4 inches	8	2	1	1	2	1	1	3				21		
16c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,365	2.91	8,070	9,493
Deficits >= 4 inches	8	2	1	1	1	1	1	3				12		
16d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.4	0.6	0.8	1.8	0.77	615,681	754,139	1.43	9,500	12,855
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
16e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.4	0.6	0.8	1.8	0.76	615,681	754,488	1.46	9,515	12,837
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
16f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	754,702	1.45	9,500	12,832
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
16g									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.4	0.6	0.8	1.8	0.76	615,681	754,449	2.35	27,000	33,560
Deficits >= 4 inches	8	2	1	1	2	1	1	3				3		
17a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,417	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
17b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,287	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
17c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,572	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
18a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,237	1.10	12,579	18,319
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
18b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,237	1.09	12,579	18,329
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
19a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.3	0.7	0.8	1.8	0.78	615,681	753,754	1.43	13,000	18,468
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
19b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.1	0.7	0.4	1.4	0.7	0.8	1.8	0.80	615,681	752,106	1.57	18,000	25,823
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
19c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.7	0.8	1.8	0.77	615,681	754,242	1.64	13,000	18,141
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
19d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.1	0.7	0.4	1.4	0.7	0.8	1.8	0.79	615,681	752,762	1.72	18,000	25,498
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
19e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,797	1.59	8,069	10,765
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
19f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	755,103	1.48	8,069	10,871
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
20a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,211	1.34	13,000	18,602
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
20b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,211	1.45	18,000	26,066
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
20c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,277	1.34	13,000	18,598
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
20d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,300	1.45	18,000	26,066
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
20e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,283	1.29	8,069	11,057
Deficits >= 4 inches	8	1	1	1	1	1	1	3				5		
20f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,257	0.15	8,069	12,148
Deficits >= 4 inches	8	2	1	1	1	1	1	3				0		
21a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,287	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
21b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.74	615,681	756,485	1.47	25,762	37,867
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
21c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,479	1.47	25,762	37,867
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
21d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,272	4.57	8,069	7,900
Deficits >= 4 inches	8	2	1	1	1	1	1	3				22		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
21e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	757,342	7.67	8,069	4,925
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
22									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	0.9	0.6	0.3	1.2	0.5	0.8	1.8	0.72	615,681	#REF!	7.67	#REF!	#REF!
Deficits >= 4 inches	8	1	1	1	1	1	1	3				36		
23a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	754,924	7.75	8,069	4,847
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
23b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.7	0.8	1.8	0.79	615,681	753,337	7.75	8,069	4,847
Deficits >= 4 inches	8	2	1	1	2	1	1	3				36		
23c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.7	0.8	1.8	0.81	615,681	751,946	7.75	8,069	4,847
Deficits >= 4 inches	8	2	1	1	3	2	1	3				36		
23d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.7	0.8	1.8	0.81	615,681	751,835	1.42	25,676	37,885
Deficits >= 4 inches	8	2	1	1	3	2	1	3				5		
23e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.8	0.5	1.7	0.8	0.8	1.8	0.93	615,681	744,333	n/a	n/a	n/a
Deficits >= 4 inches	8	2	1	2	4	4	1	3				n/a		
23f									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.7	0.8	1.8	0.93	615,681	754,613	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
MO2									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	756,110	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
MO2A									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.72	615,681	755,022	4.23	8,069	7,196
Deficits >= 4 inches	8	2	1	1	1	1	1	3				19		
MO2B									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	755,159	2.79	8,069	7,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				15		

Table 2D2	Alberta Irrigation Performance Summary													
	Southern Tributaries Irrigation											Milk River Irrigation		
	Private irrigators deficits		District Irrigation Deficits						Total Southern Tributaries			Total		
	Southern	Blood Tribe												
	Southern Basins	Blood Tribe Project	SMRID	TID	RID	MID	UID	MVLA	Aggregated Irrigation deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)	Aggregated Irrigation Deficits	Irrigated Area (Acres)	Irrigation Deliveries (Acre-Feet)
MO3									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,475	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
MO4									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,309	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
MO5									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,209	7.67	8,069	4,925
Deficits >= 4 inches	8	2	1	1	1	1	1	3				36		
MO6									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,567	1.52	25,762	37,706
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
MT1a									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.74	615,681	755,909	1.49	8,069	11,805
Deficits >= 4 inches	8	2	1	1	1	1	1	3				7		
MT1b									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.76	615,681	755,083	1.49	8,069	11,805
Deficits >= 4 inches	8	2	1	1	1	1	1	3				7		
MT1c									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.7	0.4	1.4	0.6	0.8	1.8	0.78	615,681	753,799	1.82	8,069	11,488
Deficits >= 4 inches	8	2	1	1	2	1	1	3				7		
MT1d									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.3	0.6	0.8	1.8	0.75	615,681	755,193	1.54	26,082	38,010
Deficits >= 4 inches	8	2	1	1	1	1	1	3				5		
MT1e									(inches)	(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.4	1.4	0.6	0.8	1.8	0.77	615,681	754,066	1.54	26,082	38,010
Deficits >= 4 inches	8	2	1	1	2	1	1	3				5		
CrSysLOlCap1										(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.73	615,681	756,573	2.46	8,069	10,873
Deficits >= 4 inches	8	2	1	1	1	1	1	3				10.00		
CrSysLOlCap2										(acres)	(acre-feet)		(acres)	(acre-feet)
Average (inches)	2.1	1.0	0.6	0.3	1.3	0.6	0.8	1.8	0.74	615,681	756,056	2.46	8,069	10,873
Deficits >= 4 inches	8	2	1	1	1	1	1	3				10.00		