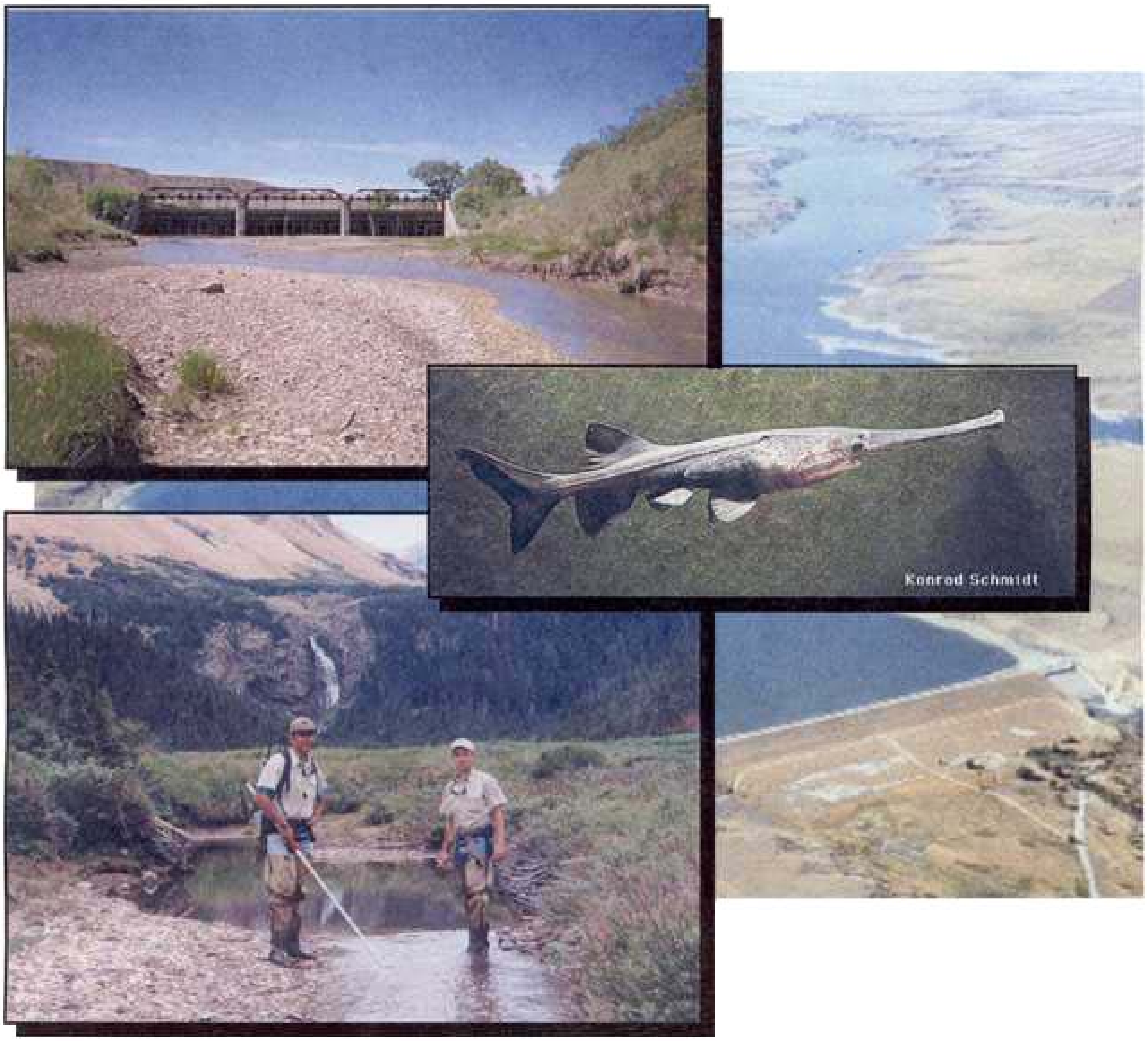
# REGIONAL FEASIBILITY REPORT
# NORTH CENTRAL MONTANA




U.S. Bureau of Reclamation
Montana Area Office
Billings, Montana

OCTOBER 2004

**Photos on Cover**

The photos on the cover are Vandalia Dam, fish shocking in the St. Mary River basin, and a paddlefish superimposed on Fresno Dam.

# C O N T E N T S

## INTRODUCTION: Chapter 1



## SETTING: Chapter 2



## ISSUES AND OPPORTUNITIES: Chapter 3

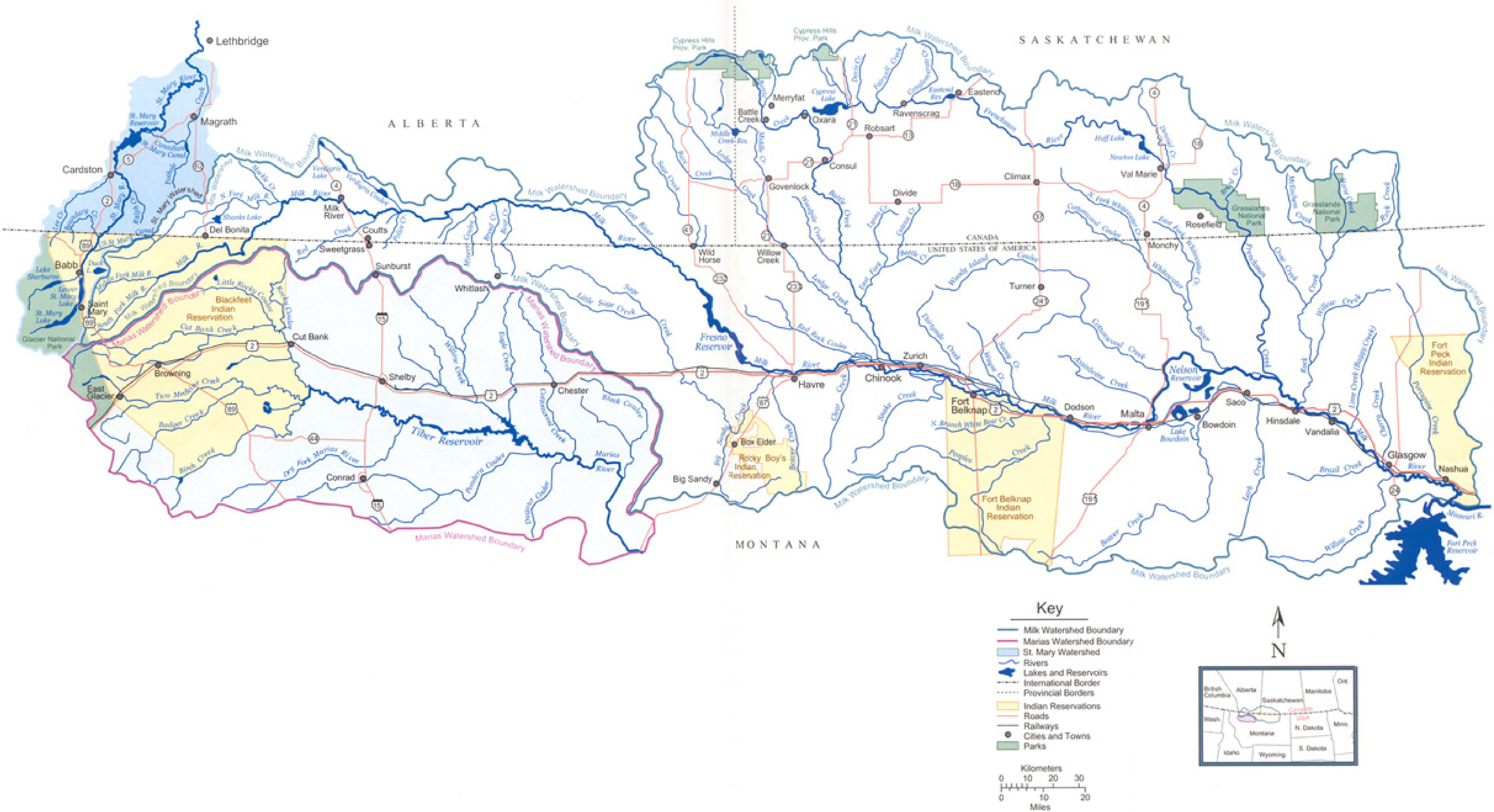
## ALTERNATIVES: Chapter 4

**PROMISING ALTERNATIVES: Chapter 5**



**FINDINGS: Chapter 6**

# LOCATION MAP



# EXECUTIVE SUMMARY

The *Chippewa Cree Tribe of the Rocky Boy's Reservation Indian Reserved water Rights Settlement and Water Supply Enhancement Act of 1999* (P.L. 106-103) directed Reclamation (the U.S. Bureau of Reclamation) to conduct a regional feasibility study of north central Montana. The purpose of the study was to identify present and potential water supplies, water uses and management, major water-related issues, and opportunities to resolve these issues. Background for the study can be found in Chapter 1.

North central Montana includes the basins of the St. Mary River, Milk River, and the Marias River (see the Location Map). Two Reclamation projects–the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program–are located in the region. Mainly rural and agricultural, the region has a number of towns scattered throughout. The Blackfeet, Rocky Boy's, Fort Belknap, and Fort Peck Reservations are located in north central Montana, as is the Bowdoin National Wildlife Refuge. Chapter 2 contains the setting for the study.

## NEEDS

Of the three river basins in north central Montana, the Milk River basin is the only one short of water to meet current needs. Shortages are caused by periodic severe droughts, over-development of irrigation in relation to the available water supply, and aging, under-designed canals unable to meet needs even when an adequate water supply is available. Shortages for irrigation occur two-thirds of the time

Settlement and implementation of Federal reserved water rights of the Fort Belknap and Blackfeet Reservations and of Bowdoin National Wildlife Refuge could stretch the present water supply even further, affecting the Milk River Project and perhaps the towns and the rural water district that rely on the Milk as their source of MR&I water.

## ISSUES

Major water and related issues identified by the study indicate shortages of water for irrigation and for MR&I (municipal, rural, and industrial) supplies, threatened and endangered species, water quality, Federal reserved water rights, fish and wildlife, recreation, and hydro-power development. All issues are discussed in detail in Chapter 3.

## ALTERNATIVES

An *Alternatives Scoping Document* (Reclamation, 2003) was prepared as an interim step in the study process to narrow the alternatives developed during the study from 18 (see Chapter 4) to the 6 most promising alternatives (Chapter 5). The *Alternatives Scoping Document* was reviewed by State and other Federal agencies, Tribes, local government, and interest groups in the region. Their comments were considered in preparation of the present report.

The study found no single alternative would meet the irrigation demands of the Milk River Project and

MR&I needs of the region, mitigate for reserved water rights, and allow the opportunity to provide irrigation for junior water rights holders, threatened or endangered species, water quality, fish and wildlife, recreation, and hydro-power production. Some of the alternatives, however, could improve the water supply and benefit some issues. These promising alternatives are:

- Nelson Reservoir Pumping Plant ― Building a pumping plant of from 50 cfs (cubic-feet/second) to 150 cfs would augment the water supply in the Milk River Project's Nelson Reservoir

- Dodson South Canal Enhancements ― Increasing the capacity of the Dodson South Canal to 600 or 700 cfs would also add to the water supply in Nelson

- Glasgow Irrigation District Re-Regulation Reservoir ― Building a 180 AF (acre-feet) storage reservoir would allow the capture of surplus flows from the Vandalia South Canal for later release to the district

- Enlarge Fresno Reservoir ― Increasing capacity in Fresno Reservoir by raising the crest of the spillway would allow more water to be stored for later release

- St. Mary Canal System Enhancements ― Rehabilitating aging facilities of the St. Mary Canal System, adding new features, and perhaps adding to the canal's capacity would increase the volume of water that could be transferred to the Milk River basin

- Duck Creek-Vandalia Canal ― Building a 100-cfs capacity canal from the South Fork Duck Creek Arm of Fort Peck Reservoir to the Vandalia South Canal would add to the water supply at the end of the Milk River Project.

Since no single alternative would meet all needs and satisfy issues in the region, six combinations of the promising alternatives were examined (see "Combined Alternatives" in Chapter 5).

## PROMISING ALTERNATIVES SUMMARY

Table S.1 displays the promising alternatives in comparison to conditions most likely to exist in the future. The most significant changes anticipated in the future are: settlement and implementation of Federal reserved water rights; loss of surplus water from Canada; continuing loss of storage in Fresno Reservoir; and no diversion of water from the St. Mary to the Milk River.

Table S.1 shows total construction, annual construction, annual OM&R (operations, maintenance, and replacement), and total annual costs for the 6 alternatives. These costs do not include the cost of environmental mitigation that could be required after compliance with the National Environmental Policy Act and other environmental laws and regulations. The column to the right of the costs is the total water delivered to canal headgates in AF (acre-feet). Annual net economic benefits are next.

The rating system for the issues columns on the table requires explanation. Resource specialists made qualitative judgements based on existing information to supply the ratings. The rating symbols are as follows:

- ● — Positive Effect
- ◆ — Slightly positive effect
- ○ —No effect
- ◆ — Slightly negative effect
- ● — Negative effect.

Ratings are specific to a particular issue: it's possible for an alternative with a negative rating for one issue to be rated positive in relation to another.

## STUDY FINDINGS

As shown in Table S.1, St. Mary Canal System Enhancements is the only alternative that would significantly address the water supply and related issues of north central Montana and that would produce positive economic benefits. The other 5 promising alternatives would contribute to the water supply on a much smaller scale and wouldn't produce net economic benefits when only agriculture were considered. These alternatives might, however, play a key role in formulating a comprehensive solution for several issues and might play a significant role in settling reserved water rights in the region.

North Central Regional Feasibility Study
Table S.1 Promising Alternatives

| Alternative[1] | Total Construction Cost[3] ($) | Annual Construction Cost[4] ($) | Annual O&M Cost[5] ($) | Total Annual Costs[6] ($) | Total Water Delivered to Canal Headgate[7] (AF) | Annual Net Economic Benefit[8] | Milk River Agriculture Water Shortage[9] | Municipal, Rural and Industrial Water Supply[9] | Threatened and Endangered Species[9] | Water Quality[9] | Potential Contribution to Reserved Water Rights Settlement-Fort Belknap Indian Reservation[9] | Potential Contribution to Reserved Water Rights Settlement - Blackfeet Indian Reservation[9] | Water Supply - Bowdoin National Wildlife Refuge[9] | Fish and Wildlife[9] | Recreation[9] | Hydropower[9] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Future Without A Project Condition[2] | | | | | 230,766 | | | | | | | | | | | |
| **Improve Water Operations and Management** | | | | | | | | | | | | | | | | |
| Nelson Reservoir Pumping Plant | | | | | | | | | | | | | | | | |
| 50-CFS Unit | $ 4,995,000 | $ 303,000 | $ 104,900 | $ 407,900 | 235,442 | $ (268,900) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 75-CFS Unit | $ 5,922,000 | $ 360,000 | $ 117,800 | $ 477,800 | 237,189 | $ (280,800) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 100-CFS Unit | $ 7,411,000 | $ 450,000 | $ 136,400 | $ 586,400 | 238,282 | $ (348,400) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 150-CFS Unit | $ 9,189,000 | $ 558,000 | $ 166,300 | $ 724,300 | 240,497 | $ (411,300) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| | | | | | | | | | | | | | | | | |
| Dodson South Canal Enhancement | | | | | | | | | | | | | | | | |
| 600-CFS Canal | $ 5,393,000 | $ 328,000 | $ 7,000 | $ 335,000 | 235,287 | $ (202,000) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 700-CFS Canal | $ 11,011,000 | $ 669,000 | $ 7,300 | $ 676,300 | 239,876 | $ (380,300) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| | | | | | | | | | | | | | | | | |
| Glasgow Re-Regulation Reservoir | $ 1,650,000 | $ 105,000 | $ 11,300 | $ 116,300 | 229,602 | $ (64,300) | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect |
| **Improve Water Storage** | | | | | | | | | | | | | | | | |
| Enlarge Fresno Reservoir | | | | | | | | | | | | | | | | |
| 3 ft (84,400 AF) | $ 2,500,000 | $ 159,000 | $ 43,000 | $ 202,000 | 235,444 | $ (63,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| 5 ft (95,400 AF) | $ 10,000,000 | $ 635,000 | $ 44,000 | $ 679,000 | 238,096 | $ (459,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| 10 ft (129,200 AF) | $ 13,500,000 | $ 857,000 | $ 45,000 | $ 902,000 | 243,247 | $ (525,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| **Augment Water Supply** | | | | | | | | | | | | | | | | |
| St. Mary System Enhancements | | | | | | | | | | | | | | | | |
| 500 CFS | $ 80,232,000 | $ 5,189,000 | $ 136,000 | $ 5,325,000 | 453,605 | $ 1,429,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 670 CFS | $ 87,254,000 | $ 5,643,000 | $ 150,000 | $ 5,793,000 | 478,910 | $ 1,697,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 850 CFS | $ 96,347,000 | $ 6,445,000 | $ 165,000 | $ 6,610,000 | 485,340 | $ 1,071,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 1000 CFS | $ 105,706,000 | $ 7,071,000 | $ 170,000 | $ 7,241,000 | 486,794 | $ 492,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| | | | | | | | | | | | | | | | | |
| Duck Ck. -Vandalia Canal | $ 20,621,000 | $ 1,334,000 | $ 226,000 | $ 1,560,000 | 259,316 | $ (644,000) | Slightly Positive | No Effect | No Effect | Slightly Negative | Slightly Positive | No Effect | No Effect | Slightly Positive | No Effect | No Effect |

[1] This is the short list of alternatives that appear to be the most promising to address the issues in the study area. For a complete list of alternatives examined as part of this study, refer to Table 4.1.

[2] The Future Without A Project condition includes: settlement and implementation of Federal reserved water rights; loss of surplus water from Canada; continuing loss of storage in Fresno Reservoir, and no St. Mary Canal System

[3] Cost of construction based on preliminary level of detail, with mobilization, unlisted items, contingencies, and non-contract costs (including an estimate of necessary environmental and cultural resource studies to be completed before construction)

[4] Cost of construction divided by length of time construction would take.

[5] Cost of OM&R (operating, maintaining, and replacement) of the project annually.

[6] The sum of total construction cost, total investment cost, and annual OM&R costs annualized over the 50-year period of analysis

[7] Total water estimated to be delivered to canal headgates by an alternative. A base of 230,766 AF (acre-feet) is estimated for the Future Without the Project Condition.

[8] Incremental annual economic benefits estimated for an alternative minus total annual costs. *Note: figures in red in parentheses denote that annual costs would exceed annual net benefits.*

[9] As compared to the Future Without A Project condition

| Legend | |
|---|---|
| Positive | (green circle) |
| Slightly Positive | (green diamond) |
| No Effect | (open circle) |
| Slightly Negative | (red diamond) |
| Negative | (red circle) |

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

# *INTRODUCTION*
# Chapter 1

## PURPOSE

Water is crucially short in north central Montana. Irrigation, MR&I (municipal, rural, and industrial) water supplies , threatened and endangered species, water quality, Federal reserved water rights, fish and wildlife species, recreation, and hydro-power needs in the region must be met by U.S. Bureau of Reclamation facilities built, in many cases, a century ago. As a result, competing demands are increasingly at odds over a finite supply of water.

Congress recognized this situation when it passed the *Chippewa Cree Tribe of the Rocky Boy's Reservation Indian Reserved Water Rights Settlement and Water Supply Enhancement Act of 1999* (P.L. Law 106-103). This act authorized Reclamation to conduct a regional feasibility study "to evaluate water and related resources in North-Central Montana. . .to determine. . .how those resources can best be managed and developed to serve the needs of the citizens of Montana" (Section 203 (a) (1)). While broad, the act specifically directed that the study:

(1) evaluate existing and potential water supplies, uses, and management;
(2) identify major water-related issues, including environmental, water supply, and economic issues;
(3) evaluate opportunities to resolve the issues. . .and;
(4) evaluate options for implementation of resolution to the issues. (Section 203 (a) (2))

This study fulfills the intent of Section 203. It provides background of the study (Chapter 1) and describes the region (Chapter 2). The report then identifies major water related issues in north central Montana (Chapter 3) and evaluates alternative plans to address these issues (Chapter 4). Chapter 5 identifies the most promising of these alternatives and provides examples of how alternatives could be combined to complement one another (Chapter 5). The report concludes with Chapter 6, findings of the report.

Any further study would require compliance with the U.S. Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, commonly known as the P&Gs. The P&Gs require, among other things, that a NED (National Economic Development) Account be completed that displays changes in the economic value of the national output of goods and services. An EQ (Environmental Quality) Account, showing beneficial and adverse effects on significant environmental resources and attributes, is optional. The P&Gs also require that NEPA (National Environmental Policy Act) compliance be completed.

## STUDY PROCESS

While P.L. 106-103 directed that major water-related issues be identified and alternatives to address these issues be evaluated, it also directed that "the regional study shall utilize, to the maximum extent possible, existing information " to minimize costs (Section 203 [c] [1]). Both the identification of issues and development of alternatives information were used from previous studies (see "Previous Investigations" at the end of this chapter). In addition to existing information, specific studies were also undertaken for this report: a fishery study on the bull trout in the St. Mary River; fisheries and riparian habitat on the Milk and Marias rivers; geology investigations (along with survey work) on locations of some of the alternatives; and Milk River Project canal efficiencies. All of this information—both existing and initiated specifically for the study—was used to identify issues and develop alternatives, as called for in the legislation.

The present study determined major water-related issues such as irrigation and MR&I water supplies, water for fish and wildlife (including Threatened and Endangered Species), water quality, settlement of Federal reserved water rights, recreation, and hydro-power development. In order to evaluate alternatives to resolve these issues, Reclamation examined both structural and non-structural plans. Structural alternatives included such things as increasing canal or on-farm efficiencies, importing water from other basins, changes to the St. Mary Canal system, or construction of storage reservoirs on tributaries. Non-structural alternatives included retirement of irrigated lands or introduction of a water marketing plan in the region.

Each of the alternatives was evaluated on the basis of how they resolved issues and in terms of net economic benefits. Environmental issues were identified for the study, but NEPA compliance was not done.

An *Alternatives Scoping Document* was prepared on north central Montana to narrow the alternatives from 18 (excluding variations) to the 6 most promising highlighted in Chapter 5 of the present report. The *Alternatives Scoping Document* was reviewed by other Federal and State agencies, Indian tribes, local government, and interest groups in the region. Comments from that report were used in preparation of this regional feasibility report.

## HISTORY OF THE REGION

Humans have occupied north central Montana for at least 11,900 years, evidenced by finds of distinctive stone artifacts. Early people depended on hunting game during this period. Climatic and technological changes occurred in the years before 1,300 BP (before present): smaller projectile points associated with light darts or atlatls have been excavated in the region, used on species including big game. During the final stages of prehistory, arrow points became dominant. Contact with Euro-Americans led to use of the horse and trade goods, which transformed the native culture. Impacts from epidemics such as smallpox, reported as early as 1732, resulted in population shifts and cultural disruption.

First records were made by Lewis and Clark in 1804, although fur trappers traveled the region for some time before. The fur trapping period saw establishment of a string of trading posts and forts along the Missouri River.

The region was designated a common hunting grounds for Indian tribes in 1851. The Federal government established forts specifically for distribution of annuities and other goods to the tribes. Fort Belknap, for instance, was first built as one of these posts in 1871, abandoned in 1876, and then reestablished in 1878. In 1888, 17,500,000 acres of the common hunting grounds were ceded back to the Federal government, with three reservations—Blackfeet, Fort Belknap, and Fort Peck—all that remained.

The Rocky Boy's Reservation was created in 1916 (see Chapter 2, "Social and Economic Characteristics" for details).

The discovery of gold in the 1860s drew people to Montana. Wagon traffic on the Fisk Trail and other trails and steamboat traffic to Fort Benton on the Missouri River became common. The Federal government began issuing grazing permits to the region in 1883. The Great Northern Railroad was authorized by Congress through the region in 1887 and parts were completed a year later. Homesteading of the area followed as lands were made available for settlement. A few private irrigation systems were developed along the Milk River, but uncertain water supplies led to Federal development of the Milk River Project, authorized in 1903.

A U.S. Supreme Court case concerning Fort Belknap around the turn of the century resulted in a finding that, when the reservation was created, enough water had implicitly been set aside for this purpose by the Federal government . This ruling, known as the *Winters Doctrine*, along with other cases, established the concept of Federal reserved water rights, as explained further on in this report (see Chapter 3, "Reserved Water Rights").

## MILK RIVER PROJECT OPERATION

Reclamation's Milk River Project serves much of north central Montana. Lake Sherburne on the St. Mary River and Fresno and Nelson Reservoirs on the Milk River store water, while the St. Mary Canal, Lohman, Paradise, Dodson, and Vandalia Diversion Dams and the Dodson and Harlem Pumping Plants divert water for the project. About 200 miles of canals and 219 miles of laterals convey diverted water to project lands.

Spanning two basins, project facilities are still operated as an integrated system. The St. Mary Canal diverts the U.S. share of the St. Mary River to the North Fork of the Milk River. When the U.S. share is less than the needed volume of the diversion, stored water is released from Lake Sherburne to make up the deficit. When the U.S. share is more than needed, water is stored in Lake Sherburne. The St. Mary Canal begins diversions in March or April, continuing until September or October. Lake Sherburne generally stores water from October-February or March, releasing water in April and May, again storing water in June and July, and finally releasing water in August and September.

Fresno Reservoir doesn't fill every year. It generally stores water from October-March or April, most runoff in the Milk River Basin occurring those months. Releases during late March to mid-May transfer water downstream to Nelson Reservoir, the volume determined by the basin supply. Fresno releases for irrigation usually begin by May 1 but can begin as early as mid-April, the volume determined by basin water users. Releases continue through the summer until about September 15. Water is again transferred to Nelson in the fall to balance storage between the two reservoirs.

## NEEDS

Water is needed for irrigation, MR&I water supplies, threatened and endangered species, water quality, reserved water rights, the Bowdoin National Wildlife Refuge, fish and wildlife, and recreation, as explained in more detail in Chapter 3.

**Irrigation**

Irrigated agriculture is an economic mainstay of the region. Two Reclamation projects are located in the region—the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program.

Other acres are irrigated by the U.S. Bureau of Indian Affairs on the Blackfeet and Fort Belknap reservations, Tribal systems on the Rocky Boy's Reservation, and by individual irrigators.

**MR&I Water Supplies**

Many people in the region depend on Reclamation facilities for MR&I water supplies. Several towns along the river have contracts for water from the Milk River Project, as does the Hill County Water District for a rural water supply. The Lower Marias Unit supplies a town, rural water district, and a private water corporation.

Photo 1.1 - The bull trout, a threatened species in the St. Mary basin, has been studied since 1996.

**Threatened and Endangered Species**

Several water-associated species listed on the Federal threatened and endangered species list occur in north central Montana. Other threatened and endangered species reside in or migrate through the region. In addition, a number of Montana *Species of Special Concern* can be found in the region. Water is needed for these species.

**Water Quality**

Segments of the St. Mary, Milk, and Marias River basins are designated as impaired under the *Clean Water Act*. Water is needed to protect, improve, or maintain water quality.

**Reserved Water Rights**

Water is needed in the region to settle Federally reserved water rights for four Indian reservations, a national park, and a wildlife refuge. Three of the reservations have negotiated water compacts with the State.

### Fish and Wildlife

North central Montana provides habitat for many fish and wildlife species, including a number of game species. Water is needed to protect, improve, or maintain fish and wildlife habitat.

### Recreation

The region offers fine hunting and fishing opportunities, water-borne recreation like boating, water skiing, and swimming, as well as camping, picnicking, and wildlife observation. Water is needed to preserve recreational opportunities.

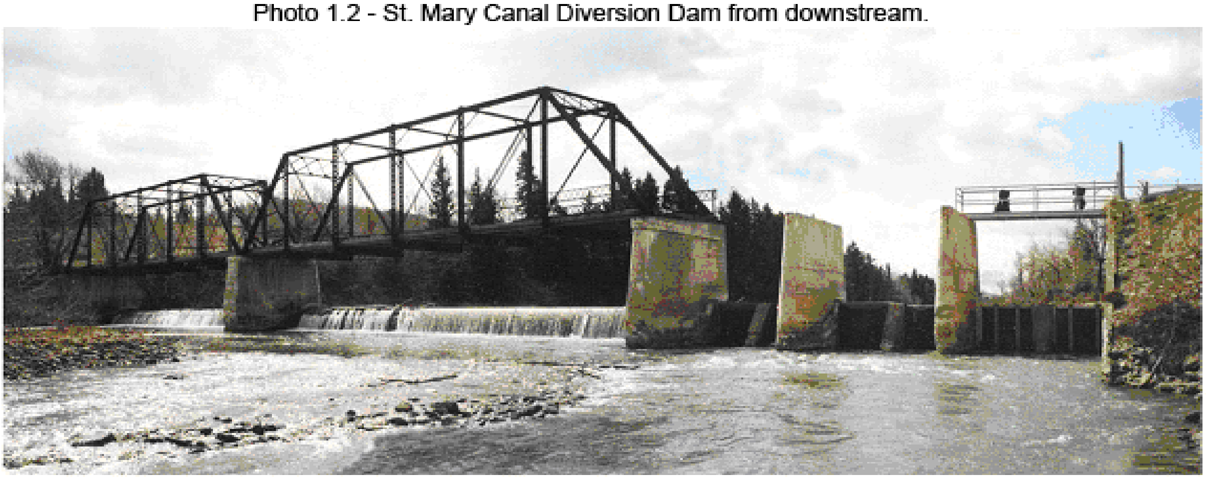
## PUBLIC INVOLVEMENT PROCESS

P.L. 106-103 directs that this regional feasibility study "be planned and conducted in consultation with all affected interest, including the interest of Canada" (Section 203[c][2]). In accordance with the act, Reclamation solicited comments from many sources, including the tribes, State agencies, other Federal agencies, local irrigators (both in Montana and in the Province of Alberta, Canada), and other interest groups in the Milk River basin, as shown below. Reclamation either met with these entities and interests or received written comment from them.

- Blackfeet Tribe
- Chippewa and Cree Tribes
- Gros Ventre and Assiniboine Tribes
- Milk River Project Joint Board of Control
- Milk River Project Irrigation Districts
- Montana Department of Natural Resources and Conservation
- Montana Department of Fish, Wildlife, and Parks
- Montana Department of Environmental Quality
- Montana Bureau of Mines and Geology
- U.S. Bureau of Indian Affairs
- U.S. Geological Survey
- U.S. Fish and Wildlife Service
- U.S. Natural Resources Conservation Service
- Federal Water Rights Negotiating Team
- Milk River Project Development Association
- Milk River International Alliance
- Milk River Basin Water Management Committee (Alberta, Canada).

Information was mainly gathered from meetings with the entities and interests and from correspondence received from them throughout the study process. Issues and alternatives were discussed many times with those whom they would most affect. The *Alternatives Scoping Document* was released to entities and interests in March 2003 to confirm that Reclamation had captured major issues and appropriate alternatives required by the authorizing act. Comments received from this report have been incorporated into this regional feasibility study.

Photo 1.2 - St. Mary Canal Diversion Dam from downstream.



## PREVIOUS INVESTIGATIONS

Many studies of the region (in particular the Milk River basin) have been done as shown below. Information, and—in some cases—alternative plans were updated from these studies for the present report.


- U.S. Bureau of Reclamation, 1977. *Milk River Feasibility Study*. Department of the Interior, Billings, Montana.
- Montana Department of Natural Resources and Conservation, 1977. *Supplemental Water for the Milk River*. Helena, Montana.
- Missouri River Basin Commission, 1981. *Upper Missouri River Basin Level B Study Report and Environmental Impact Statement*.
- U.S. Bureau of Reclamation, 1987. *Draft Report on Proposed Rehabilitation and Betterment Program, Malta Division, Milk River Project*. Department of the Interior, Billings, Montana.
- U.S. Bureau of Reclamation, 1987. *Draft Report on Proposed Rehabilitation and Betterment Program, Glasgow Division, Milk River Project*. Department of the Interior, Billings, Montana.
- U.S. Bureau of Reclamation, 1988. *Report on Canal Seepage*. Department of the Interior, Billings, Montana.
- U.S. Bureau of Reclamation, 1990. *Summarizing the Milk River Water Supply Study*. Department of the Interior, Billings, Montana.
- HKM Engineering, 2001. *Rocky Boy's Reservation MR&I Water System Planning/Environmental Report*. Billings, Montana. (This study was authorized by P.L. 106-163 also.)
- HKM Engineering, 2002. *Northcentral Montana System*. Billings, Montana.

# S E T T I N G
# Chapter 2

T he St. Mary, Milk, Marias rivers region stretches nearly 350 miles from the Rocky Mountains in the west to the confluence of the Milk with the Missouri River in the east. The region extends about 60 miles south from the Canadian border to the confluence of the Marias with the Missouri River (see Location Map). Climate, water volume and quality, geology, soils, threatened or endangered species, fish and wildlife species, social and economic characteristics, recreation, and cultural resources in the region are described in this chapter.

## CLIMATE

Climatological information was obtained from the 2001 *Montana Climate Summaries* (Western Regional Climate Center, 2001). The climate of the region is typical of the northern Great Plains, with summers cooler and wetter in the higher elevations of the western part near Glacier National Park. The Babb, Montana, station (6NE) is closest to the St. Mary River. For the station's 1948-2001 period of record, average maximum temperature in June-August was 73°F. Average minimum temperature December-February was 9.8 º F. Precipitation averaged 18.27 inches/year, most falling May-September. The average frost-free period was only 66 days, with snow reported every month of the year.

The Havre, Montana, station (Havre WSO AP) is located near the center of the region. Average maximum temperature for the station's 1961-2001 period of record for June-August was 81.6 °F, while the average minimum temperature December-February was 7.3° F. Precipitation averaged 11.35 inches/year, most falling April-September. The average frost-free period was 128 days.

The Glasgow, Montana, weather station (Glasgow WSO Airport) is on the eastern edge of the region. Average maximum temperature for June-August for the 1955-2001 period of record was 81.6°F. The average minimum temperature December-February was 5.3° F. Precipitation averaged 10.99 inches/year, most falling May-September. The average frost-free period was 138 days.

## WATER VOLUME AND QUALITY

Figure 2.1 shows annual total and the U.S. annual share of stream flows of the St. Mary, Marias, and Milk rivers. Much of the water supply of the Milk River Project comes from the St. Mary River (see Chapter 3, "Water Supply Shortage"). Apportionment of water between the St. Mary and Milk Rivers is governed by the *Boundary Waters Treaty of 1909* (clarified by the 1921 Order of International Joint Commission). U.S. and Canadian representatives to the Commission compute natural flows of both rivers, apportioning flows from meteorological and hydrological data.

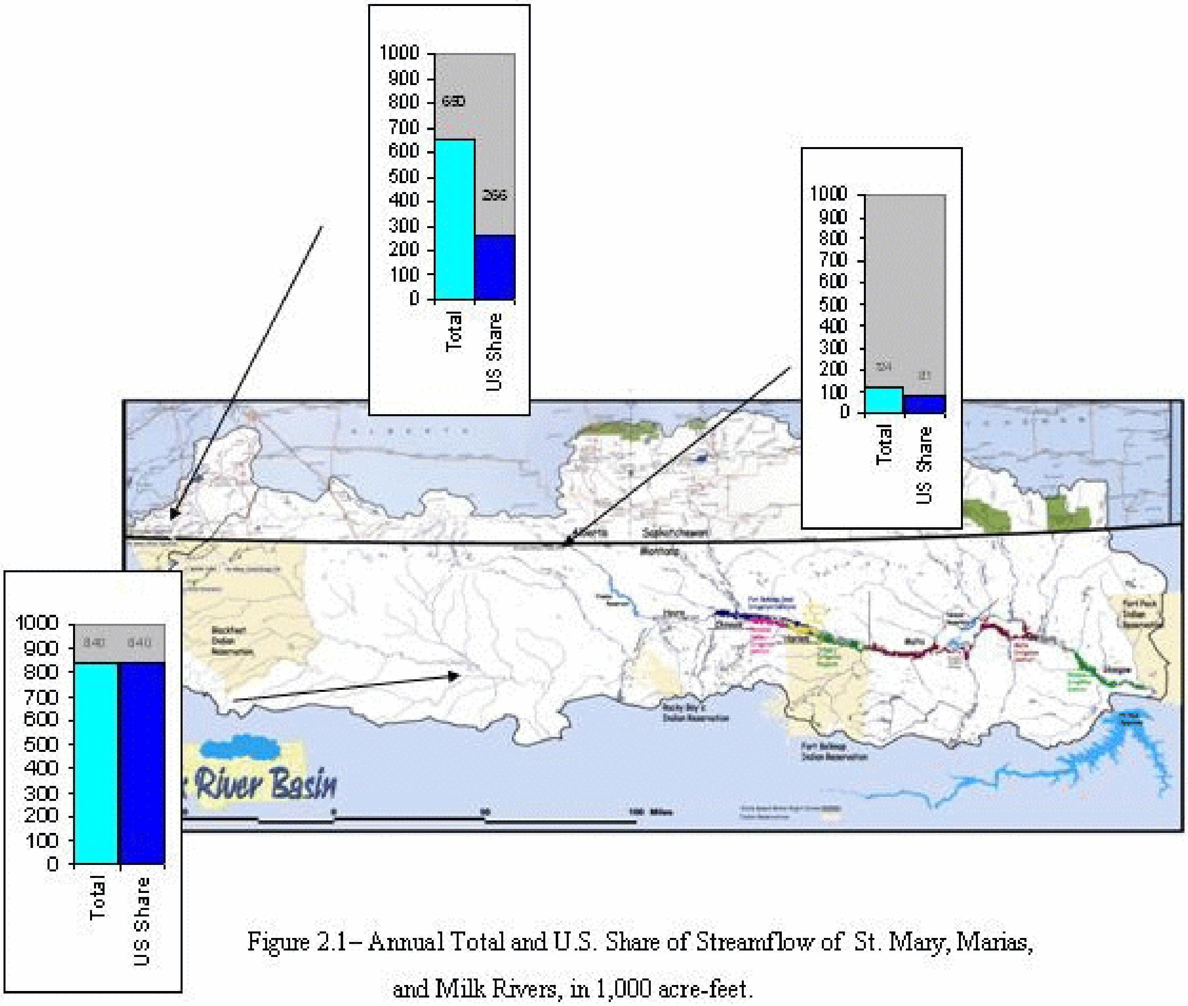



Figure 2.1– Annual Total and U.S. Share of Streamflow of St. Mary, Marias, and Milk Rivers, in 1,000 acre-feet.

Snowmelt from mountains provides most of the runoff in north central Montana. It's generally of good quality, but nutrients, salts, and water temperature gradually increase as the rivers flow from the mountains to the plains. Degradation is due to evaporation and transpiration that concentrates minerals; irrigation diversions and return flows; suspended sediment from erosion; and pollutants from farming and ranching.

Under the Clean Water Act, the Montana DEQ (Department of Environmental Quality) classifies quality by water use, with standards equal to or exceeding EPA water quality standards. Classes run from *A-closed* (the highest quality) through *A-1*, *B*, *C*, to *I* (the lowest quality). Water uses are by suitability for drinking; processing food; bathing; swimming; propagation and growth of fish and aquatic life, waterfowl and furbearers; and agricultural and industrial use.

In drought years, water quality problems are more pronounced. Dissolved chemical concentrations and water temperatures are highest during droughts. In contrast, suspended sediments are the reverse: highest concentrations are during high river flows, primarily during spring runoff. Irrigation can contribute to non-point pollution. Problems typically result when irrigation diversions result in low flows and when irrigation return flows contain higher concentrations of salts, nutrients, suspended solids, and pesticides than the water diverted.

**St. Mary River**

The St. Mary River heads on the east slope of the Rocky Mountains in Glacier National Park and flows northerly, joining the Oldman River near Lethbridge, Alberta, Canada (Location Map).

***Volume***

During the April 1-October 31 irrigation season, the U.S. share of the natural flows of the river at the International Boundary is a fourth of the flows when they are 666 cfs (cubic-feet/second) or less. Excess flows are divided equally between Canada and the U.S., and the rest of the year flows are divided equally between the two countries.

Stream flows in the St,.Mary River are fairly consistent from year-to-year. Information on flows is available from 1902 to the present (U.S. Geological Survey, 2001). During that period, maximum flow of the river at the International Boundary (Station 05020500) was estimated to be 40,000 cfs on June 5, 1905. The lowest annual seven-day minimum flow was 27 cfs ending November 26, 1936. The average annual natural flow of the river is 900 cfs or 650,000 AF, of which the U.S. share is 266,000 AF.

Figure 2.2 shows the average natural flows (those that would exist without human interference) and measured flows of the St. Mary River. The difference in natural and measured stream flow is the volume used by the U.S.

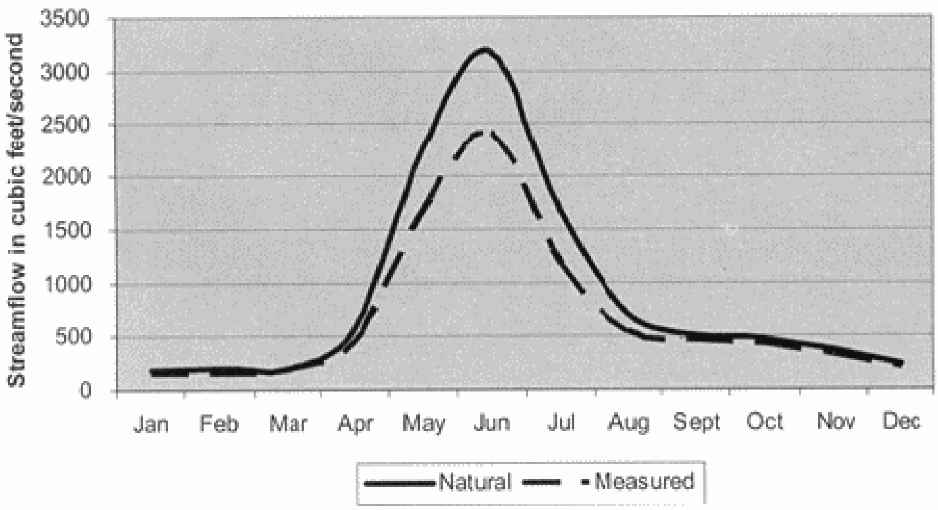
***Quality***

The St. Mary and its tributaries outside Glacier National Park are classified B-1: to be maintained for drinking, culinary, and food processing after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fish and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supplies.

**Milk River**

The Milk River, a tributary of the Missouri River, heads in Glacier National Park and the Blackfeet Reservation. The river flows northeasterly into Canada, then turns easterly for about 200 miles before it reenters the U.S. about 50 miles northwest of Havre, Montana (Location Map). The Milk flows southeasterly in Montana to near Glasgow, where it enters the Missouri River just downstream of Fort Peck Reservoir.

**Figure 2.2 – Average Streamflow of St. Mary River at International Boundary, natural flow for 1928-89 and measured flow for 1917-2001**




Milk River flows are stored in Fresno Reservoir near Havre, and Nelson Reservoir, an off-stream reservoir, near Malta, Montana. The reservoirs store water and provide recreation, flood control, and fish and wildlife benefits. Most consumption is for irrigation by the Milk River Project. Primary lands irrigated are located along a 165-mile reach of river in Blaine, Phillips, and Valley counties.

***Volume***

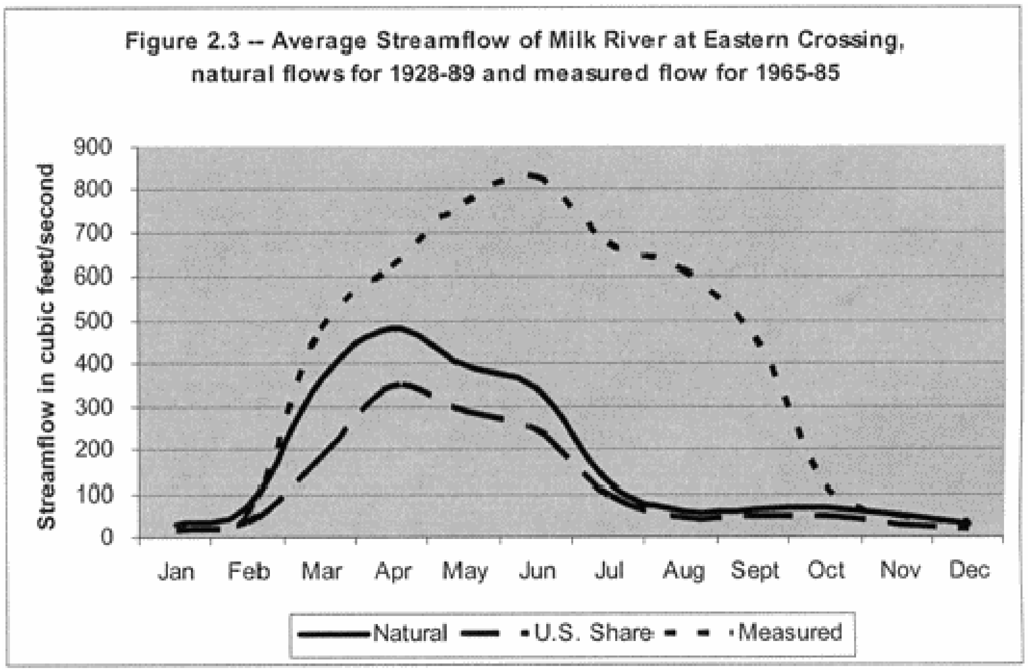
Apportionment of the Milk River is similar to that of the St. Mary River, except that most of the natural flows go to the U.S. The U.S. share during the irrigation season at the Eastern Crossing of the International Boundary is three-fourths of the natural flows when flows are 666 cfs or less. Flows beyond that volume are divided equally. The rest of the year flows are divided equally between the countries. Flows of Lodge Creek, Battle Creek, and Frenchman River—all tributaries of the Milk —are divided equally where they cross the International Boundary.

Stream flows in the Milk River are more erratic year-to-year than flows in the St. Mary River (U.S. Geological Survey, 2001). Information on flows near the mouth of the Milk River is available from 1939-present. During that period, maximum flows at the Nashua, Montana (Station 06174500) near where the river joins the Missouri River was 45,300 cfs, recorded on April 18, 1952. The lowest annual seven-day minimum flow was 0 cfs ending July 17, 1984. The average March-October flows at the Eastern Crossing (Station 06135000) upstream of Fresno Reservoir are 235 cfs, or 113,500 AF. The U.S. share is 75,600 AF. Average estimated natural flows during the non-irrigation season is 10,800 AF, 5,400 AF of which is the U.S. share. Figure 2.3 shows total computed natural flows, the U.S. share, and measured stream flow at the Eastern Crossing.

The difference between the U.S. share of computed natural flows and measured flows represents the unused part of Canada's share of natural flows plus the water from the St. Mary River diverted into the Milk. If water were not transferred into the basin by the St. Mary Canal, the Milk River would dry up in the vicinity of Havre about one out of every four years. Most likely, the river would dry up during July or August and could remain dry from a few days up to two months.

***Quality***

The Milk River in Glacier National Park is classified as A-1, to be maintained suitable for all uses, such as drinking, culinary, and food processing after conventional treatment to remove naturally occurring impurities. The river and tributaries from the Park to the Canadian Border are classified B-1. The river from where it reenters the U.S. to the joining with the Missouri is classified B-3, to be maintained as suitable for drinking, culinary, and food processing after conventional treatment; bathing, swimming, and recreation; growth and propagation of non-salmonid fish and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supplies. All tributaries in the lower reach are classified B-3, except for the Big Sandy Creek drainage (to the town of Big Sandy's infiltration wells), Beaver Creek, Little Box Elder Creek, Clear Creek drainage (near Havre) and Peoples Creek drainage 9 (to and including the South Fork of Peoples Creek). These exceptions are classified B-1.




**Marias River**

The Marias River is formed by the joining of Cut Bank Creek and Two Medicine River southeast of Cut Bank, Montana (Location Map). Cut Bank Creek heads on the east slope of the Blackfeet Reservation, flowing east to Cut Bank and then southeast to its confluence with Two Medicine River. Two Medicine River heads on the east slope of the Continental Divide, flowing easterly through the Blackfeet Indian Reservation.

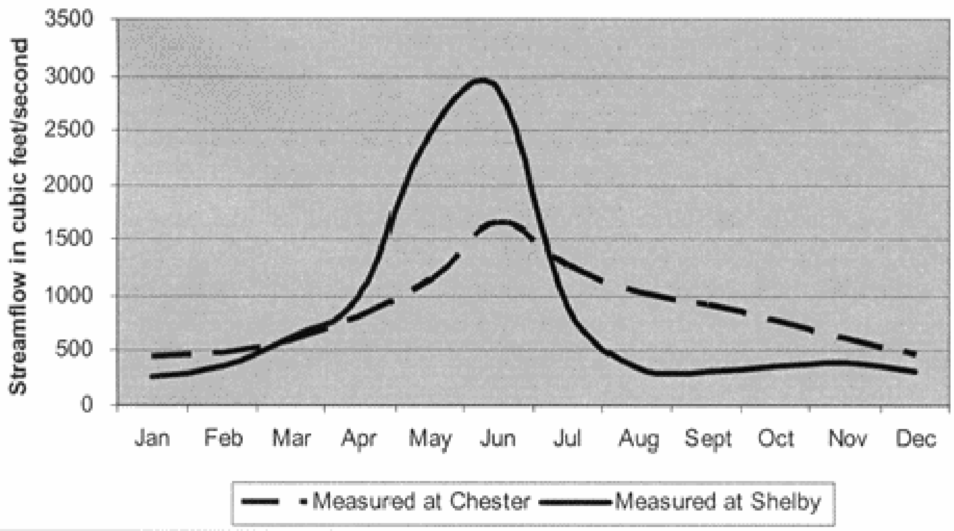
From this juncture, the Marias River flows easterly about 60 miles to Tiber Reservoir (Lake Elwell), formed behind Tiber Dam. The dam was completed in 1956. From the dam, the Marias flows southeast about 80 miles to join the Missouri River near Loma, Montana.

Water is diverted from the river for irrigation and M&I uses, and the river is home to several native fish species, sport fish, and fish of special concern. Recreational use includes boating, fishing, and hunting along the river.

***Volume***

Information for the Marias River is available for 1921-present (U.S. Geological Survey,2001). During that period, maximum flows of the river near Chester, Montana (Station 06101500), downstream of Tiber Dam, was 10,400 cfs on June 16, 1964. The lowest annual seven-day minimum flow was 0.2 cfs ending October 29, 1955. Average annual measured flows are 830 cfs, 604,000 AF; measured flows reflect upstream irrigation depletion and many storage reservoirs. Average estimated natural flows of the Marias River near Chester, Montana, are 11160 cfs, 840,000 AF. Figure 2.4 shows flows near Shelby, Montana (Station 06099500), upstream of Lake Elwell, and the Marias River near Chester. The difference in flows between the two stations reflects the flow regulation effect of Tiber Reservoir.

Figure 2.4 -- Average Streamflow of the Marias River at Shelby and at Chester, 1960-2000




***Quality***

The Marias River and tributaries are classified B-1 and B-2, to be maintained suitable for drinking, culinary, and food processing after conventional treatment; all other uses except marginal for salmonid fish. Cut Bank Creek drainage is classified B-1, except for Willow Creek from the Highway 464 crossing about ½ mile north of Browning, Montana, to Cut Bank Creek and Cut Bank Creek mainstem from Old Maid Miller Coulee near Cut Bank to Birch Creek. These sections are classified B-2.

Two Medicine River is B-1, except for Midvale Creek drainage to the town of East Glacier's water supply intake, and Summit Creek drainage to the town of Summit's water supply intake. These are classified as A-closed, maintained suitable for swimming and recreation, growth and propagation of fish and associated aquatic life, although access restrictions to protect public health may limit actual use of the water for these purposes.

The mainstem of the Two Medicine from Badger Creek to Birch Creek is classified B-2. The Dry Fork of the Marias River (mainstem) is B-3 from the Interstate 15 crossing near Conrad, Montana, to the Marias River. The Teton River drainage (to and including Deep Creek near Choteau) is B-1. The Marias mainstem from Tiber Reservoir to the county road crossing in Section 17, T29N, R6E is classified B-1, and the Teton River below Interstate 15 to the Marias River is classified B-3.

Water quality data for the Marias immediately downstream of Tiber Reservoir near Chester exists from 1964-1986, when the recording station was discontinued. Data set summaries are available on U.S. Geological Survey and EPA STORET data bases.

## GEOLOGY

Geology of north central Montana consists of unconsolidated and consolidated deposits ranging in age from Cambrian to recent. Unconsolidated deposits mantling much of the area include Quaternary alluvium and glacially-deposited silt, sand, and gravel. Tertiary terrace and pediment gravels can be found in several locations, which—if thick enough—provide significant volumes of water. One such source is the Tertiary Flaxville gravels found in Blaine County and along the eastern boundary of the Milk River basin. Unconsolidated deposits form the most widely used aquifers in the area, as they can supply water for irrigation where sufficiently thick.

Part of the region is located in the Glaciated Central Region, which has been covered by several episodes of continental glaciation. Advancing glaciers rerouted some pre-glacial stream channels and buried the old channel deposits. The ancestral Missouri River channel used to be located where present-day Big Sandy Creek joins the Milk River below Havre. Retreating glaciers left behind unconsolidated till, glacial lake deposits, and outwash deposits. Coarser glacial deposits and buried stream channels can be significant sources of groundwater if thick enough. Less permeable glacial lake and till deposits of poorly sorted clay, silt, sand, and gravel are less likely to supply significant volumes of water.

Underlying unconsolidated deposits (also called bedrock formations) are Cretaceous sedimentary formations consisting of sandstones and shales. These deposits, generally without sufficient transmissivity to supply large volumes of water, are used for domestic supply or stock watering. Included among these formations are the Hell Creek, Foxhills, Bearpaw Shale, Judith River, Clagett, Eagle, and Colorado Group. Sandstones can supply significant water volumes in some localities, especially where exposed near the land surface. Generally, these Cretaceous deposits slope gently to the east towards the structural depression called the Williston Basin in far eastern Montana.

Pre-Cretaceous deposits exposed near the land surface are generally found near mountain uplifts where they were thrust upward and younger overlying formations were eroded away. Mountain uplifts comprised of igneous and metamorphic formations generally are not a source of significant volumes of water in the region. They have a low primary permeability and depend on fracture zones and other secondary permeability for storage and movement of water. Older and deeper formations also tend to have poor quality water since recharge and movement through them is relatively slow. One potential pre-Cretaceous formation with the potential for yielding moderate volumes of water (although it may contain high total dissolved solids) is the Mississippian Madison Group.

## SOILS

Soils in the region are predominately derived from glacial till. Many of the irrigated lands—especially in the Milk River basin—are alluvial soils, but they also include soils derived from wind-blown deposits, old lake plains, glacial outwash, in addition to upland glacial till. Much of the till was derived from mixed rock sources, but a few soils have formed in till from specific rock sources.

Most of the irrigated land in the region is in the Milk River Valley east of Havre; some irrigation also occurs in the upper parts of the Marias River basin. Besides individual irrigators, there are also public and private developments on the Marias River tributaries, including Birch Creek and Two Medicine River. Soils irrigated by these projects include old alluvial soils on bottomlands and glacial-till derived soils on uplands.  Individual irrigators are found throughout the region who irrigate soils ranging from glacial till to eolian (wind blown deposits) to alluvial in origin.

## THREATENED AND ENDANGERED SPECIES

A number of species listed under the ESA (Endangered Species Act) can be found in the region, residents and migrants alike: the bull trout, grizzly bear, bald eagle, gray wolf, piping plover, and pallid sturgeon. The mountain plover is proposed for listing.  Candidate species (those for which sufficient information is available to support a proposal to list) include the black-tailed prairie dog.  A detailed list of threatened, endangered, and candidate species is in Table 2.1.

In addition to threatened and endangered species, Montana DFWP (Department of Fish, Wildlife, and Parks) has identified a number of species as *Species of Special Concern* that occur in the region (Table 2.1). These species are included in this section since they are the most likely to be listed as threatened and endangered species in the future.

### St. Mary River Basin

The bull trout has been subject of continuing studies by Reclamation, USFWS (U.S. Fish and Wildlife Service), NPS (National Park Service), and the Blackfeet Tribe for several years (Mogen and Kaeding, 2002).  The DPS (*Distinct Population Segment*) in the St. Mary basin is the only one found east of the continental divide.  This DPS is also unique as most of its habitat —including all spawning habitat—is within Glacier National Park or the Blackfeet Reservation.

Studies identified three major effects Reclamation facilities may have on bull trout.  First, the Lake Sherburne outlet works are closed after the irrigation season, de-watering a stretch of Swiftcurrent Creek, occasionally stranding bull trout which use it for wintering habitat.  Second, the St. Mary Diversion Dam (see Photo 1.2 in Chapter 1) acts as a partial barrier to fish, disrupting bull trout migration patterns from wintering habitat to upstream tributary spawning habitat.  Finally, bull trout have been entrained by the St. Mary Canal and thereby lost from the population.

Other bull trout issues that should be evaluated include maintaining quality of spawning tributaries, further study and protection of  the population above Sherburne Reservoir in Cracker Lake, use of Lower St. Mary Lake as wintering habitat and migration corridor, the relationship between these fish and the upper St. Mary Lake bull trout, and instream flows in the St. Mary River to support growth, migration, and wintering.

The grizzly bear uses the St. Many Canal System as a travel corridor, using the narrow bands of riparian vegetation along the canals to move through open parts of their range.  An environmental assessment (Reclamation, 1990b) concluded that selective removal of vegetation along the canal wouldn't affect the grizzly.

**Table 2.1 –Threatened and Endangered Species/Montana Species of Special Concern**

| Species | Status | Habitat and Special Requirements |
|---|---|---|
| bull trout | Threatened | Cold water of headwater streams and rivers adjoining natal streams |
| pallid sturgeon | Endangered | Turbid, free-flowing river habitat with rock or sandy substrate; migrates upstream to spawn |
| piping plover | Threatened | Breeds on gravel shores of shallow saline lakes, man-made reservoirs, and prairie lakes |
| interior least tern | Endangered | Breeding highly dependent on dry exposed sandbars and forage fish |
| whooping crane | Endangered | Uses intermingled wetlands and agricultural fields during migration |
| bald eagle | Threatened | Winters in mature cottonwoods along Milk, Marias and Missouri rivers, and can also be found along shorelines of Nelson Reservoir and Bowdoin National Wildlife Refuge |
| mountain plover | Proposed | Prefers large flats or short grass prairie; associated with prairie dog colonies |
| black-footed ferret | Endangered | Associated with prairie dog colonies |
| grizzly bear | Threatened | Large home ranges requires undisturbed habitat and migratory corridors |
| gray wolf | Endangered | Found in forests, plains, and mountains; habitat loss a problem |
| swift fox | Candidate | Prefers mid-grass prairie; associated with prairie dog colonies |
| black-tailed prairie dog | Candidate | Native to short grass prairie; less than 1% of previous habitat remains |
| westslope cutthroat trout | Species of Special Concern | Cold, headwater streams with gravel substrate of riffles and pools |
| troutperch | Species of Special Concern | Rocky cover in Lower St. Mary Lake and the St. Mary Canal |
| spoonhead sculpin | Species of Special Concern | Deep lakes and streams of the St. Mary and Waterton drainage |
| sauger | Species of Special Concern | Turbid water of large rivers and reservoirs |
| blue sucker | Species of Special Concern | Swift current areas of large rivers; migrates upstream to fast rocky areas to spawn |
| paddlefish | Species of Special Concern | Slow, quiet water of large rivers or impoundments; migratory spawners |
| pearl dace | Species of Special Concern | Small cool streams, Milk River in tailwaters directly below diversion dams |

The area around Reclamation facilities in the St. Mary basin is also occupied by bald eagles and gray wolves. Effects to these species aren't as well understood as those to bull trout, but it's known that these species use riparian habitat as travel corridors like the grizzly.

Species of Special Concern found in the St. Mary basin are the westslope cutthroat trout, troutperch, and spoonhead sculpin.

**Milk River Basin**

Piping plover nesting habitat on the shore and islands in Nelson Reservoir, as well as Bowdoin National Wildlife Refuge, are a concern in the basin. Reclamation began formal consultation with USFWS on operation of the Milk River Project—specifically Nelson Reservoir—in 1990 following inadvertent inundation of a piping plover nest. The USFWS responded with a *No Jeopardy* biological opinion, with recommended conservation actions and mandatory RPMs (reasonable and prudent measures) to reduce the take ((U.S. Fish and Wildlife Service, 1990). These RPM's include annual monitoring of piping plovers at the reservoir and coordination with USFWS. A *Memorandum of Understanding* among Reclamation, USFWS, and the irrigation districts established a framework of communication regarding monitoring and operation of the reservoir to reduce effects. In addition, two islands in the reservoir have been graveled about two feet higher to provide further operational flexibility while avoiding the inundating of nests.

Nelson Reservoir was recently included as proposed critical habitat under ESA but was removed from final designation. The official designation of critical habitat cited the Memorandum of Understanding, implementation of the 1990 biological opinion, and the conservation measures enhancing habitat on the islands as the reasons.

The Milk River provides suitable habitat for the pallid sturgeon, though none have been captured there. Preliminary studies (Stash, et al., 2001) indicated use of the lower Milk by Missouri River fish for spawning and rearing, including shovelnose sturgeon which have a similar life history and are often used as a surrogate species for pallid sturgeon. Fort Peck Reservoir alters water temperatures and flows downstream in the Missouri, affecting migration and spawning, however. Without spawning cues, pallid sturgeon aren't likely to move up to the mouth of the Milk. Altering Missouri flows would provide suitable habitat for pallid sturgeon, and spawning in the Milk could be expected as the species recovered and re-established its historic territory. Blue sucker, paddlefish, pearl dace, and sauger, native species in the Milk, are considered Species of Special Concern by the State. Flathead chub and western silvery minnow are on the Montana Natural Heritage Program watch list.

Bald eagles, peregrine falcons, mountain plovers, swift foxes, black-tailed prairie dogs, and black-footed ferrets could also be expected to be found within the Milk River basin. Black-tailed prairie dogs provide unique habitat for many wildlife species, including the black-footed ferret, burrowing owl, mountain plover, and ferruginous hawk, all except the first Species of Special Concern.

### Marias River Basin

The Marias River is not known to be used by any listed fish species but could be used by fish in the Missouri River, including pallid sturgeon. Flows below Tiber Reservoir could affect Missouri River fish as well, and any operational modifications should examine possible effects. Habitat in the Marias River basin could also be used by bald eagles, peregrine falcons, mountain plovers, swift foxes, black-tailed prairie dogs, and black-footed ferrets.

Species of Special Concern include the sauger, blue sucker, and paddlefish.

## FISH AND WILDLIFE

The three river basins provide diverse aquatic and terrestrial habitat for other fish and wildlife species, forming a complex, dynamic ecosystem: riparian habitat mixed with wetlands can be found along the rivers; upland habitat—mixed grass prairie of short and moderate grasses and some shrubs—much of which has been converted to croplands and rangelands; and Montane zones primarily of aspen forest, shrub lands, and intermixed spruce, lodgepole, and douglas fir conifers.

### Fish

Fish species native to the St. Mary drainage include bull trout, westslope cutthroat trout, mountain whitefish, lake trout, northern pike, burbot, white sucker, longnose sucker, lake chub, trout-perch, longnose dace, pearl dace, mottled sculpins, and spoonhead sculpins (Brown, 1971).

Larger natural lakes in the St. Mary drainage contain native populations of bull trout, lake trout, burbot, northern pike, and sucker species, as well as the smaller species listed above. This habitat is shared with non-native populations of Yellowstone cutthroat trout, rainbow trout, brook trout, kokanee, and lake whitefish. St. Mary lakes also contain the only known population of trout-perch in Montana. Lake Sherburne has native mountain whitefish, burbot, northern pike, and sucker species, in addition to introduced populations of rainbow trout, brook trout, and kokanee.

A study of the Milk River fishery completed as part of this report (Stash, et al., 2001), was done to collect baseline information on populations and habitat use. Species found during the study are listed in Table 2.2. The most numerous were flathead chub, river carpsucker, shovelnose sturgeon, and stonecat in spring, and emerald shiner, flathead chub, goldeye, and shorthead redhorse in fall. An additional fishery study is underway on the lower Milk River below Vandalia Dam. Preliminary findings of this study indicate use of the Milk for spawning by Missouri River fish. Several sampling methods, including larval sampling , have not yet documented pallid sturgeon in the Milk.

**Table 2.2 -- Fish in the Milk River**

| | | | | |
|---|---|---|---|---|
| bigmouth buffalo | black bullhead | black crappie | blue sucker | brook stickleback |
| brown trout | burbot | brassy minnow | carp | channel catfish |
| creek chub | emerald shiner | fathead minnow | flathead chub | freshwater drum |
| Hybognathus spp | Iowa darter | lake chub | lake whitefish | largemouth bass |
| longnose sucker | longnose dace | northern pike | northern redbelly dace | paddlefish |
| pearl dace | rainbow trout | river carpsucker | sand shiner | sauger |
| shorthead redhorse | shovelnose sturgeon | smallmouth bass | smallmouth buffalo | spottail shiner |
| stonecat | walleye | white crappie | white sucker | yellow perch |
| goldeye | | | | |

The Milk River is a productive warm water river with a substrate generally of sand and silt, with occasional gravel and cobble. The river teems with aquatic invertebrates including many species of insects and plankton, which support a highly diverse and valuable fishery. It is typically a warm water fishery, but the river immediately below Fresno Dam is home to a few introduced rainbow and brown trout. Stash et al. (2001) found 28 native species and thirteen introduced species in the river, among them 12 intentionally introduced to serve as game fish like northern pike, walleye, and yellow perch (Table 2.2). Very popular with fishermen, these introduced game fish, in conjunction with other introduced species, may compete with native populations. Native game fish such as sauger, shovelnose sturgeon, and paddlefish also provide fishing opportunities.

Conditions in the Milk change with elevation. Temperature, turbidity, and velocity of the river vary a great deal from the headwaters to the confluence with the Missouri River. Because of the variety of habitat, fish species vary from location to location. Generally, the fish community is more diverse in the lower section of the river than in the upper. Only five species—flathead chub, Hybognathus species (western silvery minnow and plains minnow), northern pike, spottail shiner, and white sucker were found throughout the river (Stash, et al., 2001). The upper section is characterized by cool, clear water running in shallower habitat compared to downstream of Fresno. The upper section has more sauger than downstream, as well as more of other native fish like the flathead chub than the sections of the river bounded by dams.

Releases from Fresno are cool enough to sustain a "put and take" trout fishery immediately below the dam, as mentioned. This fishery extends only about 500 meters downstream, where the warm water fishery again takes over the river.

The middle section of the river from Fresno to Vandalia Diversion Dam near Hinsdale, Montana, runs a little slower and murkier than the upper section. Throughout the Milk, natural and man-made barriers (such as diversion dams) inhibit or prevent fish movement and migration. Flows in this section are tends to be regulated by Fresno releases. Some species have morphological adaptions allowing them to navigate around barriers or have life histories that don't require migration. Other species, like shovelnose sturgeon, paddlefish, and sauger, need to migrate to spawn and recruit young into the population. These three species are limited to certain sections of the river by barriers and typically don't receive the high spring flows that cue them to migrate. Perhaps due to this habitat fragmentation and alternation of flows, this section of the river is dominated by non-native species such as common carp, northern pike, and spottail shiner.

The lower section of the river, from Vandalia Diversion Dam to the confluence with the Missouri, is the only section of the Milk that retains its connection to the Missouri River. This section tends to be the most diverse in the Milk, with most of the species found elsewhere, in addition to paddlefish and shovelnose sturgeon. Bednarski and Scarnecchia (2003) are currently studying this section of the river and its importance to fish in the Missouri. Preliminary results indicate that many of these species are migrating up into the Milk in the spring and early summer to spawn. An increase in movement was detected in response to rises in the water levels, and larval sampling found successful spawning upstream in the Milk by paddlefish and blue suckers, among others (Bednarski and Scarnecchia,2003).

The Marias River fishery was studied in 2000 as part of the Milk River study (Zollweg and Leathe, 2000). Many species found in the Milk were also found in the Marias. Diversions have affected the character of the Marias River fishery by limiting species distribution and abundance, influencing timing and success of spawning, changing thermal regimes, and changing the availability of suitable habitat. Also, Tiber Dam has affected the fishery by blocking migration, replacing stream with reservoir habitat, and creating coldwater habitat immediately downstream of the dam.

Species in the upper Marias River include mountain sucker, mountain whitefish, and sculpin, in addition to those listed in Table 2.2. Flathead chub and mountain whitefish were the most abundant in this reach of the river.

In 1955, the upper Marias basin was chemically treated to remove unwanted species like carp and goldeye, then restocked with rainbow trout. Due to this treatment— and to Tiber Dam—sauger are no longer found in the upper Marias, and shovelnose sturgeon and blue suckers no longer spawn there.

Thirty species were documented in the eighty-mile reach of the river below Tiber Dam. Three new species (western silvery minnow, plains minnow, and white crappie) were confirmed in the lower Marias during the study. Brook trout are rare and none were collected. Paddlefish, blue suckers, and bigmouth buffalo use the Marias only seasonally during spawning, which did not correspond to the sampling times.

Species found in the lower Marias include mountain sucker, plains minnow, sculpin, western silvery minnow, in addition to the species listed in Table 2.2. Emerald shiner, flathead chub, and longnose sucker were the most abundant.

**Wildlife**

Diversity of habitat allows for a great number of wildlife and bird species. The region contains three Montana WMA's (Wildlife Management Areas): Blackleaf (northwest of Great Falls), Milk River (northeast of Malta), and Freezeout Lake (west of Great Falls). The region also contains two national wildlife refuges: Benton Lake (northeast of Great Falls) and Bowdoin (east of Malta).

Big game in the region are elk; whitetailed and mule deer; and pronghorn antelope. Bison can be found on Indian reservations. Many predatory species exist in the region, including grizzly and black bear; mountain lion; lynx; coyote; red fox; and badger. Small mammals, like the beaver; muskrat; cottontail and jack rabbit; black-tailed prairie dog; mink; weasel; raccoon; porcupines; skunk; and several bat species can be found.

The region is a haven for songbirds, shorebirds, and waterfowl. Over 150 species of non-game birds can be found in the region during at least part of the year, including redheaded and downy woodpecker; belted kingfisher; grasshopper and Bairds sparrow; common loon; white pelican; and trumpeter swan. Shorebirds include the long-necked stilts,; American avocet; piping plover; willet; long-billed curlew; and marbled godwit. Game birds include the ring-necked pheasant; hungarian partridge; Merriams turkey; sharptailed, sage grouse; blue grouse; ruffled grouse; mourning dove; Canada goose and snow goose; and blue winged teal, green winged teal, canvasback, gadwall, pintail, lesser scaup, shoveler, American widgeon, and mallard ducks. Birds of prey in the region include bald and golden eagle; peregrine and prairie falcon; ferruginous hawk; and great horned owl and burrowing owl. A study of the riparian community and associated wetlands is currently underway.

A crucial part of the ecosystem, many reptile and amphibian species inhabit the region. Reptiles include the western painted turtle, soft shelled turtle, prairie rattlesnake, bull snake, short horned lizard, and garter snake. Amphibians in the abundant wetlands and riparian areas include the western chorus frog, leopard frog, and Woodhouse's toad.

## SOCIAL AND ECONOMIC CHARACTERISTICS

The study area includes Blaine, Chouteau, Glacier, Hill, Liberty, Phillips, Pondera, Toole, and Valley counties (Location Map). While primarily rural and agricultural, the region has a number of towns scattered throughout.

### Irrigation Projects

Two Reclamation projects—the Milk River Project and the Lower Marias Unit of the Pick-Sloan Missouri Basin Program—are located in the region. The Milk River Project contains three divisions with eight irrigation districts and two pumping units, as shown in Table 2.3.

About 150,000 irrigated acres can be found in the Marias River basin, most upstream of Tiber Reservoir. Two large projects, both upstream, make up 80% of this irrigated acreage. The Blackfeet Irrigation Project is located mainly in the east part of the Blackfeet Reservation. Principle streams supplying the project are the Two Medicine River, Badger Creek, Birch Creek, and their tributaries. Operated by the BIA (U.S. Bureau of Indian Affairs), the Blackfeet Irrigation Project supplies water to about 35,000 acres in three active units lying west and south of Cut Bank, Montana, and west and north of Valier, Montana. Three reservoirs store high flows in the spring: Lower Two Medicine Lake with a capacity of 13,500 AF, Four Horns Reservoir with 19,250 AF capacity, and Swift Reservoir with 30,000 AF capacity

**Table 2.3 -- Districts in the Milk River Project**

| Chinook Division | Malta Division | Glasgow Division |
|---|---|---|
| Fort Belknap District | Malta District | Glasgow District |
| Alfalfa Valley District | Dodson District | |
| Zurich District | | |
| Paradise Valley District | | |
| Harlem District | | |

The second large project, the Pondera County Canal and Reservoir Company Irrigation Project, is about 50 miles south of the Canadian border and about 35 miles east of the Rockies. The project consists of two main storage reservoirs and 360 miles of canals and laterals. Water is diverted from Birch Creek and Dupuyer Creek to irrigate about 83,000 acres. The storage reservoirs are Lake Francis with a capacity of 112,000 AF and Swift Reservoir, 29,975 AF.

There is little irrigation on the Marias below Tiber Dam. Flows is this reach generally range from 380-500 cfs after spring runoff. About 100 cfs is needed to satisfy water rights of the water users downstream of the dam.

**Reservations**

The region also contains four Indian reservations: Blackfeet, Rocky Boy's, Fort Belknap, and Fort Peck (Location Map). The Blackfeet Reservation occupies about 1,500,000 acres, bordered to the north by Canada, to the west by Glacier National Park. Topography is rolling plains rising to the west, with elevations ranging from 3,800 in the east to 9,066 feet at Chief Mountain. In 1855, a treaty was concluded with the Blackfeet, Flathead, and Nez Perce. By act of Congress on May 1, 1888, the Tribes ceded most of their joint reservation, and were confined to their present-day reservations. Browning, Montana, is the seat of Tribal government. Major economic endeavors on the reservation are ranching and farming.

Rocky Boy's was created for the Chippewa and Cree Tribes by executive order in the 20$^{th}$ century rather than by treaty in the 19$^{th}$. In 1916, it was the last reservation to be created, out of lands once part of the Fort Assiniboine Military Reserve. It occupies 108,015 acres of rolling plains and foothills in Hill County southwest of Havre. Box Elder, Montana, is the seat of Tribal government. Ranching and dryland farming are the major economic activities.

Home to the Gros Ventre and Assiniboine Tribes, Fort Belknap was created in 1851 at the same time as the Blackfeet Reservation. It occupies 653,939 acres in Blaine and Phillips counties, bordered on the north by the Milk River, on the south by the Little Rocky Mountains. Most of the reservation is rolling prairie. Tribal seat is at Fort Belknap Agency, Montana. Ranching and farming are the major economic activities.

The Fort Peck Reservation occupies about 2,900,000 acres in extreme northeastern Montana. While just outside the region at the confluence of the Milk and the Missouri rivers, the reservation has been included because it affects social and economic characteristics of the region. Mainly rolling prairie, major economic activities are ranching and farming. It was created in 1888 for the Assiniboine and Sioux Tribes. Tribal seat is at Poplar, Montana.

**Population**

The study area is a sparsely populated rural region in north central Montana. With a total area of 29,117 square miles, it has a population density of 2.4 people/square mile. Of the nine counties, only two have populations that exceed 10,000. Between the 1990 and 2000 Census, total population of the region declined by 0.2%, compared to a decline of 3.9% between 1980 and 1990. Table 2.4. shows total regional population by county (U.S. Bureau of Census, 2003).

**Table 2.4 -- Regional Population**

| County | 1980 | 1990 | 2000 | % Change 1980-2000 |
|---|---|---|---|---|
| Blaine | 6,999 | 6,728 | 7,009 | .01 |
| Chouteau | 6,092 | 5,452 | 5,970 | -2.0 |
| Glacier | 10,628 | 12,121 | 13,247 | 24.6 |
| Hill | 17,985 | 17,654 | 16,673 | -7.3 |
| Liberty | 2,329 | 2,295 | 2,158 | -7.3 |
| Phillips | 5,367 | 5,163 | 4,601 | -14.3 |
| Pondera | 6,731 | 6,433 | 6,424 | -4.6 |
| Toole | 5,559 | 5,046 | 5,267 | -5.3 |
| Valley | 10,250 | 8,239 | 7,675 | -25.1 |
| **Totals** | 71,940 | 69,131 | 69,024 | -4.1 |

Source: U.S. Census Bureau.

The Native American part of the total population has increased significantly in the last two decades, growing from 16% of the population in 1980 to 25% in 2000 (U.S. Bureau of Census, 2003). Table 2.5 gives Native American populations on the four reservations for the past three decades, as well as summarizing percentages of Native Americans compared to the total population in the region.

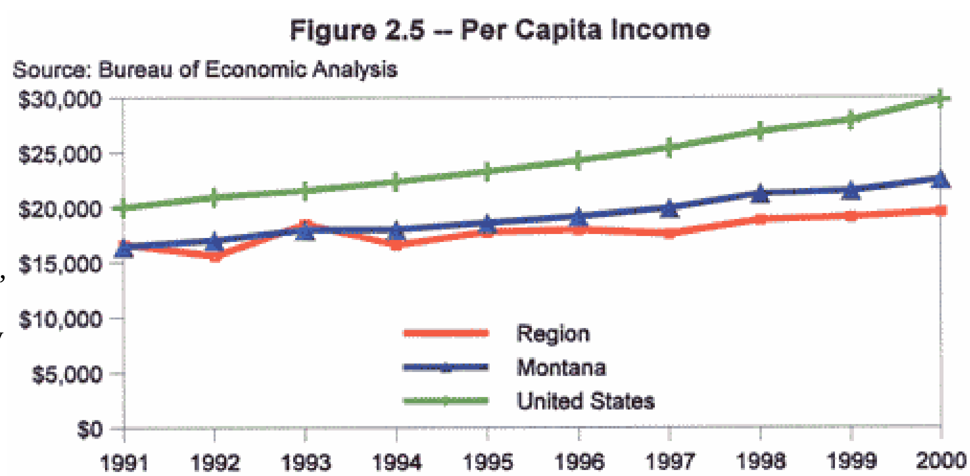
**Table 2.5 -- Regional Native American Population and Percentage of Total**

| Reservation | 1980 | 1990 | 2000 | % Change 1980-2000 |
|---|---|---|---|---|
| Blackfeet | 5,080 | 7,025 | 8,507 | 67.5 |
| Rocky Boy's | 1,549 | 1,882 | 2,578 | 66.4 |
| Fort Belknap | 1,870 | 2,338 | 2,790 | 49.2 |
| Fort Peck | 4,273 | 5,782 | 6,391 | 49.6 |
| **Totals** | 12,772 | 17,027 | 20,266 | 58.7 |
| **Total Regional Population** | 71,940 | 69,131 | 69,024 | -4.1 |
| **Native American Percentage of Total** | 16.3 | 20.8 | 25.1 | 8.8 |

Source: U.S. Census Bureau.

### Income

PCPI (*Per Capita Personal Income*) for the nine-county area increased from $16,673 in 1991 to $19,566 in 2000 (U.S. Bureau of Census, 2003). The regional PCPI has lagged behind that of the State, however, which in turn has lagged behind that of the nation. Montana has ranked 46th nationally in PCPI since 1998. Figure 2.4 compares PCPI for the region, Montana, and the U.S. from 1991-2000.




### Major Industries

In terms of earning as listed by the U.S. Bureau of Economic Analysis, State and local government, Federal civilian government, and services are the major industries in the nine-county area (2003). Farming and transportation and utilities also constitute major industries in some counties. Table 2.6 shows the top three major industries in the region by county, percentage of earnings by this industry to the total, and the same information for the State as a whole.

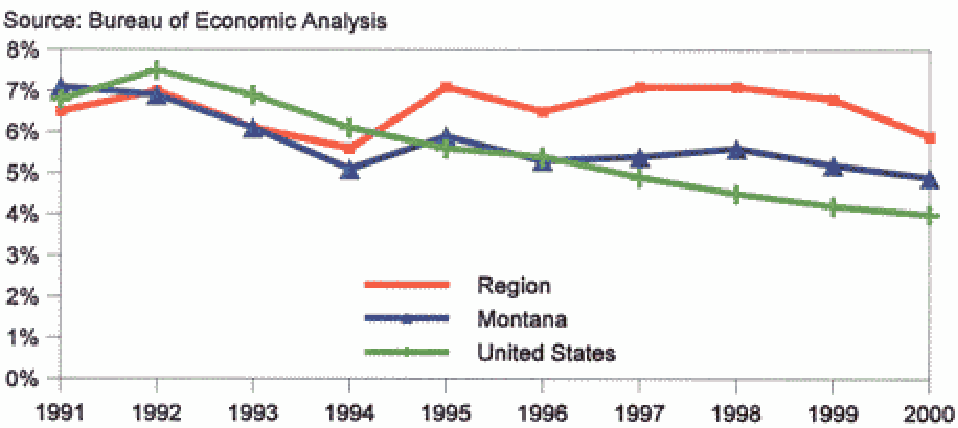
**Table 2.6 -- Major Industries by Earnings**

| | First | Second | Third |
|---|---|---|---|
| Blaine | State and Local Government–24.2% | Federal Civilian Government–20.6% | Services–15.3% |
| Chouteau | State and Local Government–25.0% | Farm–24.5% | Services–13.9% |
| Glacier | Services–26.1% | Federal Civilian Government–19.5% | State and Local Government–19.1% |
| Hill | Services–28.7% | Transportation and Utilities–18.2% | State and Local Government–16.9% |
| Liberty | Farm–20.6% | Services–19.0% | State and Local Government–15.7% |
| Phillips | State and Local Government–20.5% | Services–19.2% | Transportation and Utilities–10.2% |
| Pondera | State and Local Government–17.4% | Services–17.2% | Construction–16.7% |
| Toole | Transportation and Utilities–20.4% | State and Local Government–19.3% | Services–18.8% |
| Valley | Services–19.9% | Farm–16.2% | State and Local Government–15.0% |
| **State** | Services–27.8% | State and Local Government–14.2% | Retail–11.5% |

Source: U.S. Bureau of Economic Analysis.

**Unemployment**

**Figure 2.6 -- Unemployment Rate**




As shown in Figure 2.5, unemployment in the nine-county area and the State has been higher than the national rate since about 1995. The national rate has declined steadily since 1992, while the region's and State's have fluctuated above it.

Unemployment rates for Blaine and Phillips counties are particularly high, 6.8% and 13.0% of the workforce, respectively. One reason for the high unemployment rate is the relatively high Native American populations, which have an extremely high rate. Table 2.7 shows unemployment for the reservations in north central Montana (Montana Department of Labor and Industry, 2003).

**Poverty**

U.S. Census Bureau estimates indicate the poverty rate is generally higher in Montana than in the U.S. as a whole (U.S. Bureau of Census, 2003). Individual counties in the region have higher poverty rates than the State as a whole, particularly in Blaine and Glacier counties. Table 2.8 compares poverty rates in the nine counties to the State and the U.S. in 1989 and in 1999.

**Table 2.7 -- Unemployment Rate by Reservation, 1996-2000**

| | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|
| Blackfeet | 20.2% | 20.3% | 21.8% | 21.3% | 19.6% |
| Rocky Boy's | 26.1% | 28.4% | 31.8% | 30.0% | 27.1% |
| Fort Belknap | 27.2% | 27.0% | 25.8% | 23.7% | 19.3% |
| Fort Peck | 11.4% | 10.3% | 10.6% | 11.4% | 11.0% |

Source: Montana Department of Labor and Industry

**Table 2.8 -- Poverty Rates in the Region**

| | 1989 | 1999 |
|---|---|---|
| Blaine | 27.7% | 25.1% |
| Chouteau | 13.7% | 13.4% |
| Glacier | 35.7% | 28.8% |
| Hill | 18.0% | 18.2% |
| Liberty | 18.0% | 15.2% |
| Phillips | 17.3% | 18.3% |
| Pondera | 17.5% | 19.1% |
| Toole | 14.9% | 15.2% |
| | | |

| | | |
|---|---|---|
| Valley | 16.6% | 15.8% |
| **Montana** | **16.1%** | **14.3%** |
| **U.S.** | **13.1%** | **11.9%** |

Source: U.S. Census Bureau.

## RECREATION

The region provides recreational opportunities for residents and visitors alike, much of it directly related to the river and reservoirs as described below (Location Map). Fishing; boating; other water-borne sports; picnicking and camping; and winter sports are popular at Reclamation facilities in the region. The wildlife refuges WMAs, and private lands offer hunting, hiking, photography, and wildlife observation. Hunting and fishing along the rivers also provides recreational opportunities. Water-borne recreation, picnicking, wildlife observing, and other recreational activities provide about $16,000,000 annually to the region, according to a November 2001 report (Majerus, 2001). (This report was indexed to 2002 dollars for this study using the Consumer Price Index.)

### Reservoir Recreation

Recreational use of reservoirs in the region correlates with physical characteristics of the lake, usable range of water access facilities, water levels, storage, substitute sites, mix of recreation facilities, and weather. Recreation at Fresno and Nelson Reservoirs in the Milk River Project and at Tiber Reservoir on the Marias River are shown in Table 2.9 (no information is available on visitors to Lake Sherburne).

**Table 2.9 - Average Annual Visitor Days**

| Fresno | Nelson | Tiber |
|---|---|---|
| 64,362 | 23,803 | 174,613 |

#### *Lake Sherburne*

This 1,601 surface-acre lake on Swiftcurrent Creek, an impoundment of Sherburne Dam, is mostly within Glacier National Park, partly within the Blackfeet Reservation. The NPS manages recreation. Facilities are limited, with scenic views of the lake and park being the principal draw. Visitor usage is unavailable.

#### *Fresno Reservoir*

Fresno is on the Milk River near Havre. Only 5 of the 25,618 acres of land surrounding the 7,388 surface acres of water are developed. The lake surface and its 65 miles of shoreline are available for recreation, however. Reclamation manages recreation: facilities are a boat launching ramp, 40 mooring slips, and 3 picnic areas, with 4 shelters and 12 tables. These facilities complement two swimming beaches. There are also 24 leased cabin sites.

#### *Nelson Reservoir*

Nelson Reservoir is located 19 miles northeast of Malta on U.S. Highway 2. Of the site's 7,702 acres of land, 10 acres are developed for public use. The reservoir's 4,320 surface acres and 30 miles of shoreline are also available for public use. Nine campsites, three picnic areas with two shelters and sixteen tables, and one boat-launching ramp are available, managed by Reclamation.  There are also 106 leased cabin sites.

Nelson experienced the same conditions as other reservoirs in the region, with similar effects.  Visitors at the reservoir, as shown in Table 2.9, were down in comparison to 2001.  (It should be noted that the traffic counter at Nelson wasn't installed until May, 2001, so some of the early usage for that year was estimated and private areas also provide access to the reservoir, which Reclamation estimated at 20% of other usage.)

Nelson boasts a substantial northern pike fishery, attracting visitors both in summer and winter.  Many waterfowl or upland game bird or big game hunters in the Malta area use the reservoir for camping.

### *Tiber Reservoir*

Tiber Reservoir (Lake Elwell), on the Marias River near Chester includes 17,176 surface acres of water and 21,244 acres of land, with about 68 acres developed.  A marina and 5 boat ramps are available. About 179 of the reservoir's 180 miles of shoreline are available for camping and picnicking. Reclamation manages 7 campgrounds provide 32 campsites, 3 tent-only sites, and 5 recreational vehicle sites with hookups.  An RV dump station is available.  Seven picnic areas offer nine picnic shelters and 164 picnic tables.  While the Marias River basin has started to recover from the drought, high runoff and maximum water levels in 2002 made some recreational areas unavailable.  Also, Sanford Park below the dam was closed for months because of national security concerns.  Weather hampered some activities. Still, visitor hours rebounded to nearly their 2000 level as shown in Table 2.9.

Two walleye fishing tournaments are held yearly at Tiber, attracting visitors from the region as well as from the nation.  As at Nelson, many bird or big game hunters in the area use Tiber for camping.

## Bowdoin National Wildlife Refuge

The refuge, about 7 miles east of Malta is within the Central Flyway of the great waterfowl migration route extending from Canada to Mexico.  The 15,550-acre refuge provides food and habitat for up to 100,000 ducks, geese, and other waterfowl each fall and spring.  Hunting, wildlife viewing, and photography are popular.  Recreational use was 1,293 visitors in 2001, 1,734 in 2000, 1,834 in 1999, and 1.803 in 1998.  Recreation has been declining in recent years due to drought.  As the water level drops, fewer people visit the refuge since they can't get close to the water to see the birds.

The WMAs also provide wildlife viewing and photography opportunities.

## Other Recreation

People hunt and fish along the rivers but the number is unknown.  Fishing along the Milk and Marias rivers (including Fresno and Nelson reservoirs) is estimated to provide about $9,500,000 in net economic value to the region annually (Majerus, 2001), indexed to 2002 dollars using the Consumer Price Index. Hunting in the State's *Block Management Areas* in the region (including Bowdoin) provides about $245,0000 annually in net economic value indexed to 2002 dollars.

## CULTURAL RESOURCES

North central Montana abounds in prehistoric and historic resources (see "History of the Study Area," Chapter 1). Cultural resources include prehistoric archeological sites, Indian sacred sites, other traditional sites important to Native Americans, and historic sites of Euro-American heritage. Cultural resources are required to be protected under the NHPA (National Historic Preservation Act).

In much of the west, Euro-American settlement patterns and land usage depended on availability of water for agriculture and other uses. The U.S. Reclamation Service was created in 1902 to transform the west by irrigated lands and supporting communities. A few, small privately-owned canals operated in the vicinity of Chinook and Harlem, for instance, before Reclamation's Milk River Project was constructed, and the Office of Indian Affairs operated an irrigation system on the Fort Belknap Reservation.

The objective of the Milk River Project, authorized in 1903, was to provide a stable source of water from which to irrigate the lower river valley. Since the supply from the Milk was insufficient, the St. Mary River was developed as the major water source. Construction of the St. Mary Canal began in 1907, with the St. Mary Canal being completed in 1915. Water was first diverted from the St. Mary into the Milk in 1916, the first full operational irrigation season beginning the next year. Construction of the lower part of the project continued at the same time as construction of the upper part. Dodson Diversion Dam was completed in 1910, but major washouts causing design modifications delayed completion until 1919. Nelson Reservoir was completed in 1916, Vandalia Dam in 1917. Fresno Dam, the last major feature of the project, was completed in 1939 by the Public Works Administration and National Reemployment Service.

Many of the facilities of the Milk River Project are considered eligible for the *National Register of Historic Places*. Criteria by which facilities are judged includes sites that are ". . .associated with events that have made a significant contribution to the broad patterns of our history." Since the project had a profound influence on settlement of the region, its facilities would be eligible for the Register. Because of this eligibility, major changes to project facilities would require consultation with the State Historic Preservation Office and the Advisory Council on Historic Preservation.

Before actions were undertaken that could affect cultural resources in the region, cultural resource surveys would be completed. The surveys would comply with NHPA and other laws and regulations.

# *I S S U E S and O P P O R T U N I T I E S*

## Chapter 3

Water is vital to north central Montana for a dependable irrigation and MR&I water supply, threatened and endangered species, water quality, reserved water rights, fish and wildlife, and recreation. There is also an opportunity for hydro-power development in the region. The water supply in the St. Mary and Marias River basins can be characterized as abundant in general, but the supply in the Milk River basin is generally short, insufficient to meet existing and future water needs. Present irrigation and MR&I demands together exceed the current supply. The environment is also affected by this water shortage.

The water shortage in the Milk River basin is complicated by several factors: the aging infrastructure of the Milk River Project makes a reliable water supply problematic; Canada is considering plans to use more of its allocation of the Milk River under the Boundary Waters Treaty; several water-associated threatened and endangered species can be found in the basin; parts of water bodies in the region are classified *Impaired* under the Clean Water Act; settlement of reserved water rights require water. All these factors affect water supply in the basin.

Water issues and resultant opportunities are the subject of this chapter, divided into statements of the *Issue*, then the *Opportunity* for solution. Background on each issue is also included.

### IRRIGATION WATER SUPPLY SHORTAGE

Of the three river basins in north central Montana, the Milk River basin is the only one short of water to meet current needs. Shortages are caused by a combination of periodic severe droughts, over-development of irrigation in relation to the available water supply, and canal systems unable to carry enough water to meet needs even when an adequate supply is available.

About 140,000 acres on average are irrigated in the basin each year as shown in Table 3.1. The Milk River Project irrigates 110,306 acres, including district irrigation and irrigation under contracts with individual farmers. The Fort Belknap Indian Irrigation Project contains 10,425 acres, but only about 5,000-6,000 acres are presently irrigated with natural flows and supplemental water from Fresno Reservoir. Another 25,000 acres are irrigated in the basin under private water rights.

Diversions from the St. Mary River supply about half the Milk River Project's water in an average year, more than 90% during drought years. The St. Mary River provided an average of about 160,000 AF/year to the project over the past 20 years. The current system of canals and storage reservoirs supply irrigators with only one-third to one-half of the water needed for full crop production in a normal year.

**Table 3.1: Annual Milk River Basin Irrigation**

| | Average Acres |
|---|---|
| Project Irrigation Districts | 98,777 |
| Contracts with Project | 11,529 |
| Fort Belknap Indian Irrigation Project | 5,000-6,000 |
| Private | 25,000 |
| **Total** | **140,000** |

Irrigators often don't receive a full allocation of water, undermining their ability to maximize crop production. Being accustomed to frequent water shortages, the irrigators routinely don't apply the full crop irrigation requirement even when water is available. In this way, frequent water shortages affect the irrigators' willingness to invest in necessary equipment and infrastructure to diversify crops. The lack of crop diversity contributes to water shortages as project facilities were not designed to meet current peak irrigation demands.

Throughout the west, Reclamation has historically used these water shortage criteria below to plan irrigation projects: cumulative annual shortage in any 10-year period shouldn't exceed 100% of demand, and maximum shortage in any one year of that 10 year period shouldn't be more than 50% of demand. These criteria describe a level considered a break point between tolerable and intolerable shortages for economic reasons. The criteria implies that an annual shortage of 10% is acceptable. If a shortage of more than 50% occurs, however, then the shortage during the other 9 years of the 10 year period can total no more than 50%.

Shortage in the Milk River basin far exceeds the water shortage criteria. Analysis for this study indicated that irrigation shortages occur every year, with the basin suffering an annual average shortage of 24%. Of the 53 10-year periods on record, in 35 of these periods Reclamation's shortage criteria was exceeded, or about two-thirds of the period of record.

Most shortages result from a water supply insufficient to meet demands, but some shortage results from insufficient capacity in the canals to deliver water when it's available. Some canals were built before planning and development of the Milk River Project, and water users haven't increased the canal sizes to accommodate the acreage they are irrigating. Also, limits on canal capacity are reached when the forage crops which make up most of the irrigated acreage in the project require water at the same time.

At present, individual water users with a right only to natural flows in the river actually are getting some project water to reduce their shortages. Shortages to this group would increase if water rights in the basin were adjudicated and enforced.

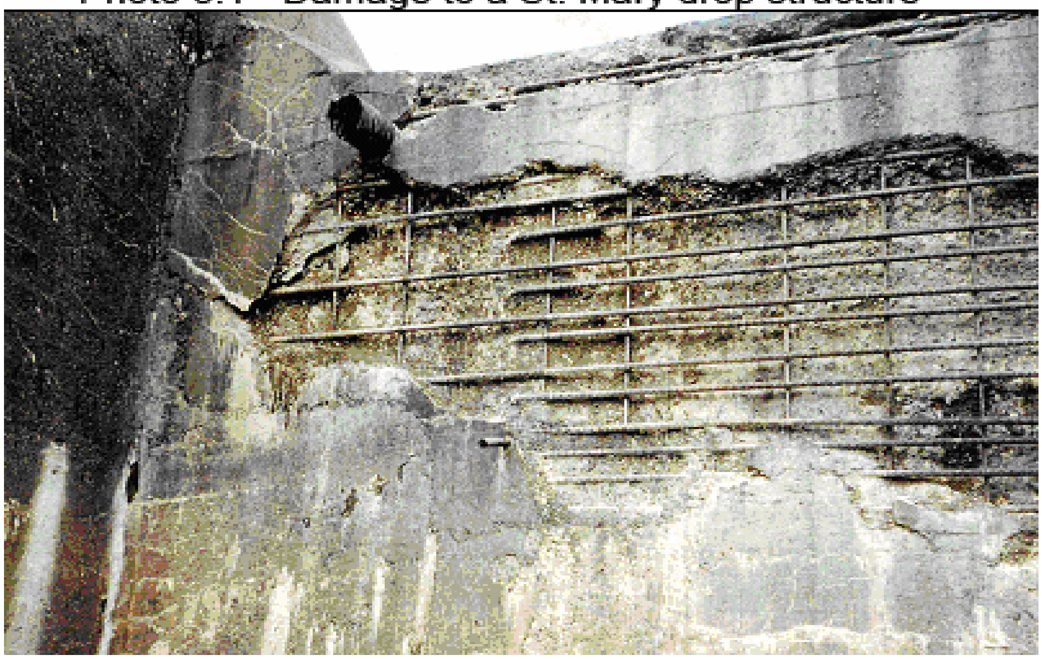
Shortages will probably increase with settlement of the reserved water rights of the Fort Belknap and Blackfeet Tribes. In addition, the Bowdoin National Wildlife Refuge also has a reserved water right to water in the Milk River basin. The rights claim of the USFWS from tributaries of the Milk River is junior in priority to the project's water rights. A settlement could enhance habitat within the refuge. Milk River water might be necessary to mitigate the effect of any settlement between the State and USFWS.

The Milk River is apportioned between Canada and the U.S. under terms of the Boundary Waters Treaty of 1909 (see Chapter 2, "Water Volume and Quality"). The U.S. receives on average about 40,000 AF of Canada's share of the Milk. Irrigators and towns in Alberta, Canada, are currently looking at plans to use their share of the river more fully. Locations for storage reservoirs are being reinvestigated as the southern part of the province experiences a drought. Construction of a reservoir and the possibility of more irrigated acres in Alberta could increase the water shortages of project irrigators, towns, and other water users in the Milk River basin.

**Issue**

The capacity of the St. Mary Canal system and storage available in Milk River reservoirs are major considerations in addressing the water shortages in the Milk River basin.

Photo 3.1 - Damage to a St. Mary drop structure



The Milk River Project was authorized as only an irrigation project. Thus, irrigators are responsible for most O, M, & R (operations, maintenance, and replacement) costs of the facilities. They have generally kept up with routine operations and maintenance costs of the St. Mary Canal system, which they pay in addition to their individual conveyance systems, but they don't have the ability to pay for replacement of major infrastructure.

The key component of the project is the St Mary Canal. The 29-mile long canal was completed in 1915. Capacity of the canal system has diminished from the design capacity of 850 cfs to about 650 cfs today. Canal headworks and diversion structures may require modification to avoid effects to the threatened bull trout.

Fresno Reservoir, main storage reservoir of the project, was completed in 1939. Original storage capacity was 130,000 AF. A 1999 survey of the reservoir indicated capacity of 93,000 AF. Loss of storage has affected the ability of the project to store enough water to meet irrigation and MR&I demands, along with maintaining adequate water levels in the reservoir and flows in the river downstream for fish, wildlife, and recreation.

Nelson Reservoir supplies irrigation needs in the lower end of the basin. At present, Nelson can only be filled through the Dodson South Canal. Filling must be coordinated with irrigation demands and with USFWS to avoid affecting the piping plover during nesting season.

There are few demands for St. Mary River water on the U.S. side of the border, except for the Milk River Project. The St. Mary River is apportioned between Canada and the U.S. like the Milk River. Some of the U.S.'s share of the St. Mary flows unused into Canada most years, except when the water supply is at its lowest. Settlement of the Blackfeet's reserved water rights could affect water available to the project.

While local shortages occur in the headwaters of the Marias River basin, none exist in the lower basin because of Tiber Reservoir, which stores spring runoff for release during the rest of the year. There are no significant contracts for Tiber water. The Chippewa and Cree Tribes of Rocky Boy's Reservation, however, were allocated 10,000 AF out of the reservoir as part of their reserved water rights settlement, and the Fort Belknap Tribes are negotiating for water out of the reservoir as part of their settlement. At the same time, the Blackfeet Tribe contends that all water in Tiber Reservoir is part of their reserved water right.

### Opportunity

While the issue is complicated, there is the possibility of providing north central Montana with a more stable, dependable water supply. An improved water supply would benefit irrigators, towns, Tribes, environmental concerns, and recreation in the region.

## MR&I WATER SUPPLY

Havre, Chinook, and Harlem, and the Hill County Water District receive an MR&I supply under contract from Fresno Reservoir. Current water use is about 50% of the contracted volume from Fresno. Releases during the non-irrigation season vary from 20-40 cfs, providing flows in the river downstream. The Fort Belknap Agency also draws its municipal supply from the Milk River.

The town of Chester, the Liberty County Water District, and Devon Water, Inc. receive an MR&I supply from Tiber Reservoir under contract. In addition, the North Central Rural Water Project was recently authorized by Congress; it would draw about 6,000 AF annually from Tiber.

**Issue**

During drought years, water for the Milk River Project, including MR&I supplies, comes almost entirely from the St. Mary River. The capacity of the St. Mary Canal is important to the MR&I water supply in the Milk River basin during droughts.

**Opportunity**

Increasing the water supply in the Milk River and enhancements of the St. Mary Canal and storage systems could provide a more stable MR&I water supply for the Milk River Basin.

## THREATENED AND ENDANGERED SPECIES

Two species listed associated with the project can be found in the region: the bull trout and the piping plover. In addition, the pallid sturgeon is in the Missouri River at the confluence with the Milk. Other threatened and endangered species also reside or migrate through the region (see Table 2.1 in Chapter 2). The State has Species of Special Concern in the region.

**Issue**

Managing the river basins compatibly with needs of threatened and endangered species and species of concern could affect existing water users. Altering existing flows could further aggravate issues associated with the declining range and diversity of species.

The bull trout is found in the St Mary River drainage. Studies among Reclamation, USFWS, and the Fish and Wildlife Department of the Blackfeet Tribe (2001) indicate that operation of the St Mary Canal headworks and diversion dam may affect bull trout through entrainment into the canal and as a fish barrier, respectively. Studies are underway to determine how best to manage facilities to aid recovery of the species. Changes in operation of the Milk River Project might be necessary to maintain instream flows in Swiftcurrent Creek.

The piping plover is found in the Milk River basin at Bowdoin National Wildlife Refuge and Nelson Reservoir. The plover uses the reservoir's shore as nesting habitat. Reclamation consulted on operations of Nelson Reservoir in 1990, and the USFWS issued a *non-jeopardy opinion* under the Endangered Species Act in 1991. An agreement among Reclamation, USFWS, and the irrigation districts to reduce effects on nesting habitat allows the reservoir to avoid designation as critical habitat.

Pallid sturgeon are found in the Missouri River below Fort Peck Dam. Studies are underway to determine if they are using warmer waters of the lower Milk River as breeding habitat and what kind of flows attract them into the river.

Issues affecting bull trout in the St. Mary River basin also affect the westslope cutthroat trout, a State Species of Special Concern. Sauger are a Species of Special Concern as well as a game fish. Stash (2001) found a strong sauger run in the section of the Milk from the Canadian border to Fresno Reservoir. Another Species of Special Concern—pearl dace—was found in the Milk River from below Fresno to Vandalia Dam associated with the tailwater fishery below diversion dams. From Vandalia Dam to the confluence with the Missouri River, three Species of Special Concern can be found. Sauger, paddlefish and blue suckers have been shown to migrate up into the Milk in springtime with adequate flows (Stash, 2001; Dennis Scarnecchia, University of Idaho, personal communication).

Downstream of Tiber Reservoir on the Marias River is a warmwater fishery, sauger being the most numerous game fish (Montana Department of Fish, Wildlife, and Parks, 1998). Paddlefish were believed to have used the Marias River for spawning in the 1960's and 1970's, but recent surveys haven't found them above the confluence.

**Opportunity**

Bull trout may be benefitted by modification of the outlet works at Lake Sherburne Dam to provide winter flows. The St. Mary Diversion Dam and canal headworks could be modified to incorporate fish passage through the dam and fish screens to prevent or reduce entrainment in the canal. These changes could also benefit the westslope cutthroat trout.

More flexibility in water deliveries to Nelson Reservoir could further protect nesting piping plover without a loss of water supply.

Project facilities and operations could be modified to enhance favorable breeding habitat for the pallid sturgeon in the lower reaches of the Milk River if it were determined that this would benefit the species.

## WATER QUALITY

The Montana DEQ (Department of Environmental Quality) has responsibility under the Clean Water Act and the Montana Water Quality Act to assess and monitor quality of surface water and to identify impaired or threatened stream segments and lakes. DEQ uses a watershed approach to determine how best to restore impaired streams, coordinating with conservation districts, watershed groups, and other State and Federal agencies.

Certain water bodies in the State are designated as *impaired* in accordance with Section 303(d) of the Clean Water Act (Figure 3.1.) Once a water body is designated as impaired (shown in purple on the figure), a restoration plan must be done. These plans include a TMDL (total maximum daily load) for each pollutant impairing beneficial use of the water. Beneficial uses include household, irrigation, stock water fishery, and recreation. The TMDL allocates loads for natural sources, point sources, and non-point sources so that the total load can be assimilated by the water body and still meet water quality standards. A point source could be the water treatment plants of towns along the Milk River, for instance, while a non-point source could be agriculture. The TMDL allocation becomes a regulatory requirement for point sources incorporated into the National Pollutant Discharge Elimination System permits.

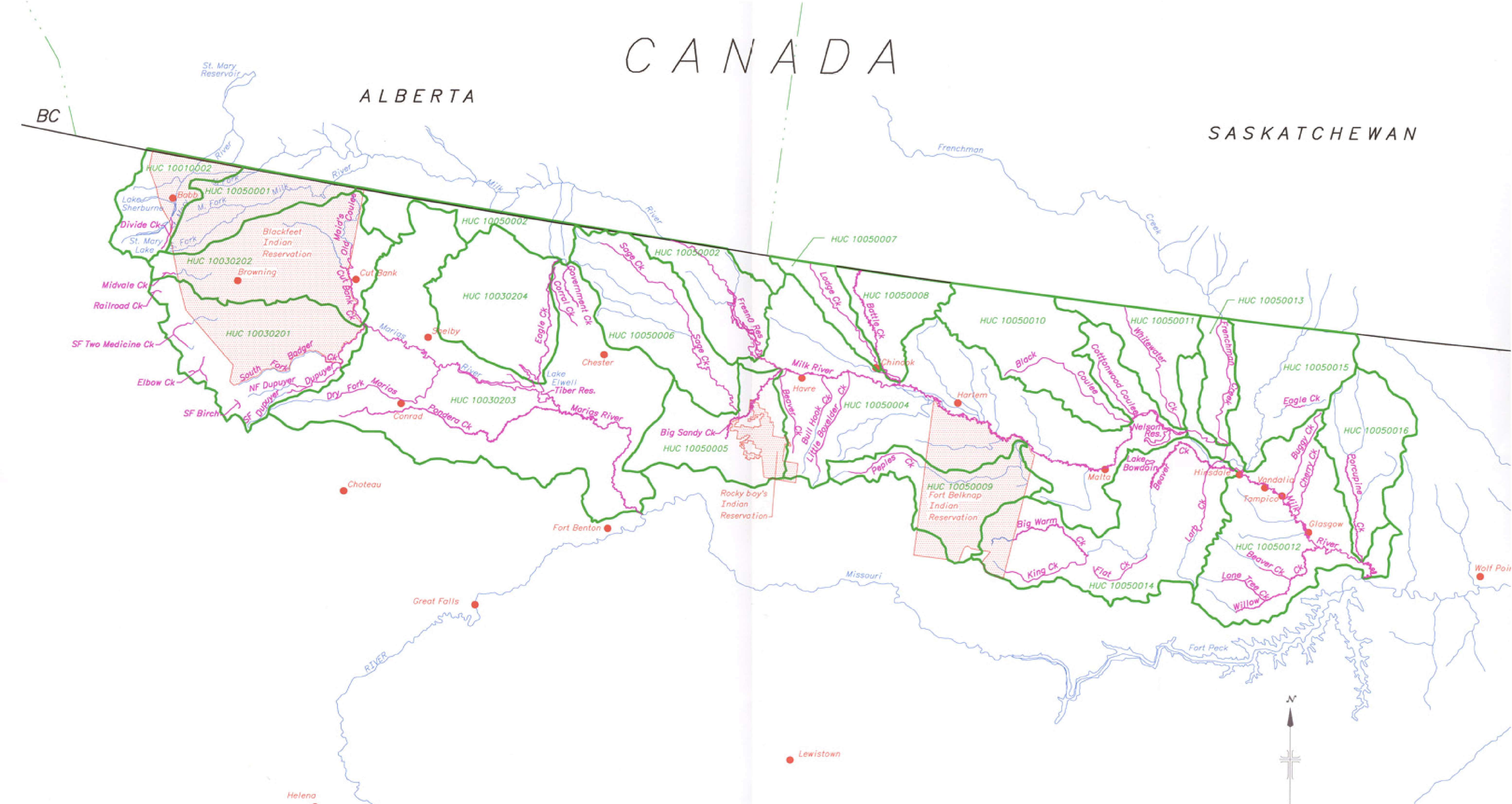



FIGURE 3.1
IMPARIED WATERS ACCORDING TO THE 2002
MONTANA 303 (d) LIST

00000A0N
Revised May 2003

**Issue**

Segments of the St. Mary, Milk, and Marias rivers and tributaries are on the State's 303(d) list. Probable impaired uses include cold water fishery, recreation, agriculture, aquatic life support, drinking water supply, and swimming. Degree of impairment is listed as either a threat or as only partially supporting the designated uses of the stream. Probable causes of pollution are flow alteration, siltation, suspended solids, nutrients, thermal modifications, salinity, metals, and organic enrichment.

Agriculture is both a beneficial use of water to be protected and a potential source of pollution. As a non-point source, agriculture is encouraged to participate in all aspects of planning and voluntary implementation of restorative measures. Individual landowners most often participate through projects administered by conservation districts and watershed groups.

Ten separate watersheds (designated HUCs–*Hydrologic Unit Codes*) exist within north central Montana, containing 1 individual impaired stream segment in the St. Mary River, 25 in the Milk, and 23 in the Marias (Figure 3.1). The 1996 list includes water bodies in the Milk and Marias rivers and tributaries and Fresno Reservoir. The date for completion of the TMDL process for all impaired segments is 2007. TMDLs have been approved for Sage, Big Sandy, and Lone Tree Creeks. Reassessment has shown Midvale and Elbow Creeks to be fully supporting beneficial uses of the water.

Several point source discharges are permitted by DEQ within the region. Havre, Chinook, and Harlem all have wastewater discharge permits. A minimum release of 25 cfs from Fresno Reservoir provides mixing flows for these communities discharging treated wastewater into the Milk.

**Opportunity**

Improving flows in the Milk River and reducing water demands along with State and local efforts to implement best management practices would provide an opportunity to improve water quality.

## RESERVED WATER RIGHTS

The Blackfeet, Rocky Boy's, Fort Belknap, and Fort Peck Reservations, the USFWS, and the NPS (National Park Service) have Federally reserved water rights in the St. Mary, Milk, and Marias River basins. Since the USFWS claim for the Bowdoin National Wildlife Refuge is somewhat different, it's treated as a separate issue below.

In the Winters Doctrine, the U.S. Supreme Court in 1908 decided that the Fort Belknap Tribes had a reserved water right of 125 cfs for an existing irrigation project with an 1888 priority date. The Supreme Court reaffirmed that when Federal lands are reserved for a specific purpose, the reservation included water to fulfill the reservation's purpose. In the case of Indian reservations, this includes water for domestic use, stock watering, MR&I supplies, irrigated agriculture, and propagation of fish and wildlife.

**Issue**

Reserved water rights have various priority dates. Settlement of these water rights could affect other water users in the region since reserved water rights generally have the senior priority date.

The Blackfeet of the Blackfeet Reservation and the Gros Ventre and Assiniboine Tribes of the Fort Belknap Reservation assert a water rights priority date of 1851 based on the *Stevens Treaty*, which established a territory for these Tribes encompassing both present-day Blackfeet and Fort Belknap Reservations. The Fort Belknap Reservation was established by an Act of Congress of May 1, 1888, under which the Tribes ceded all lands except those on the reservation.

The Blackfeet Tribe has wavered between litigation and negotiation of their water rights, more recently in favor of negotiation. Their reservation has unquantified reserved water rights in each basin in the region. They are in the process of developing a settlement proposal.

The reserved water rights compact for the Rocky Boy's Reservation has been signed by the Chippewa and Cree Tribes, Montana Legislature, and Congress. The Montana Water Court adjudicated their water rights in 2002. The settlement provided water to the Tribes from tributaries of the Milk River, but not from the mainstem as the reservation doesn't border the river. The Tribes were also allocated 10,000 AF annually from Tiber Reservoir. The Chippewa and Cree Tribes have the right to either use the water to meet their own needs or to market the water as they see fit.

The Montana Legislature in 2001 approved a reserved water rights compact with the Fort Belknap Tribes. The compact must be approved by Congress, the Tribes, and adjudicated by the Water Court to become final. The proposed settlement recognizes the 125-cfs water right decreed in *Winters.*, and quantifies another 520 cfs from the U.S.'s share of natural flows of the mainstem of the Milk and water from the tributaries.

The Fort Peck Reservation settled their reserved water rights in 1985. The compact relinquishes claim to water from the Milk River in exchange for water in the Missouri River. Congress doesn't need to ratify the compact unless the Sioux and Assiniboine Tribes decide to market part of their water.

Finally, the NPS has reserved water rights for Glacier National Park, which contains the headwaters of all three rivers. The park's reserved water rights have been approved by Congress and adjudicated by the Water Court. These rights are largely non-consumptive—being for instream flows—which don't affect downstream water users.

**Opportunity**

Enhancements to the St. Mary Canal system could provide an opportunity to help resolve Blackfeet reserved water rights.

## WATER FOR BOWDOIN

This section is summarized from an earlier analysis done by the USFWS (Prellwitz, 2002). Bowdoin National Wildlife Refuge was established as a "refuge and breeding ground for migratory birds and other wildlife" in 1936. Water is a critical habitat component of many species of waterfowl, shorebirds, and colonial nesting birds.

Bowdoin has reserved water rights in the basin, but these rights are not directly from the mainstem of the Milk. The main source of water for the refuge is the mainstem of the Milk River, either directly from the Dodson South Canal under a contract with Reclamation, or indirectly from laterals and drains carrying irrigation return flows to impoundments in Bowdoin. The USFWS filed a water rights claim for another 8,000 AF from the Milk to cover water use at the refuge in wetter years. Bowdoin received an average of 3,615 AF of return flows annually from 1995-2000. A Federally reserved water rights claim of 3,500 cfs/35,000 AF from Beaver Creek is rarely satisfied because of infrequent spring floods.

Water management has been a recurring problem at the refuge because of its cyclic water shortages and build-up of salts from shallow groundwater flows from cultivated fields north of Bowdoin. Reclamation verified the source of the water by a series of groundwater monitoring wells along the Dodson South Canal in 1991. Data helped determine that the problem didn't stem from leakage of the canal but from greater water infiltration rates in cultivated fields leaching salts to the shore of Lake Bowdoin.

### Issue

On the average, Bowdoin receives at least 3,500 AF/year from the project but some years receives far less because of water shortages. The refuge estimates it needs between 14,000-16,000 AF/year to meet objectives.

The USGS completed a salt-water balance model for Bowdoin in 1999 (Kendy, 1999) in which management strategies were evaluated based on data collected during water deliveries and water management from 1990-1997. Model predictions were developed for increasing the volume and changing the timing of deliveries from the canal, increasing deliveries from or releases to Beaver Creek, reducing return flows, and reducing salinity of groundwater seepage. These possibilities were refined into a set of five water management plans.

Also, several neighboring landowners approached Bowdoin in 2001 about wind-blown salt from the Dry Lake Unit of the refuge settling onto their lands. Blowing salt is a common occurrence during droughts when some units in the refuge dry out.

### Opportunity

The USFWS and USGS are currently evaluating five water management plans for Bowdoin as listed below. Two include extensive management actions, three being less detailed.

- No action
- Abandoning water management at the refuge
- Dewatering and vegetating Dry Lake

- Water management with a discharge schedule to Beaver Creek
- Winter discharge to Beaver Creek with Mixing on Beaver Creek Wildlife Production Area.

Effects of these plans would be analyzed during National Environmental Policy Act compliance. In general, however, increasing flexibility of water deliveries to either Bowdoin or Nelson Reservoir could provide water when it's most needed for refuge purposes.

## FISH AND WILDLIFE

In addition to threatened and endangered species and Species of Special Concern, north central Montana is rich with a diversity of other fish and wildlife species.

### Issue

Effects to the relatively pristine St. Mary River basin should be minimized. Burbot are found in the upper end and may be susceptible to entrainment into the St. Mary Canal as indicated by a recently conducted study (J. Mogen, U.S. Fish and Wildlife Service, personal communication). The St. Mary is the only Montana drainage with native trout-perch and spoonhead sculpin populations (Brown, 1971, Montana Department of Fish, Wildlife, and Parks, 2002; Bramblett, 2001). Trout-perch have also been found in the upper Milk River basin (Bramblett, 2001), indicating a cross-basin transfer of biota. Operation of the St. Mary headworks and diversion dam affects fish by entrainment in the canal and by acting as a fish barrier.

The St. Mary basin is also rare in that several top predators—bull trout, lake trout, and northern pike— are indigenous (the latter two considered non-native almost everywhere else in Montana). Some species have been introduced in the basin, such as brook, brown, and rainbow trout, but these don't appear to have dominated fisheries as they have elsewhere in the State. Some commercial fishing for whitefish exists on the Blackfeet Reservation, particularly in the St. Mary lakes.

Mountain species of wildlife are abundant in the St. Mary area. There are several wetlands that benefit from canal seepage and need to be protected. This area is also heavily used by raptors. Wildlife is managed by the Blackfeet Tribe's Fish and Wildlife Department; coordination with them is critical for wildlife issues in the area.

Loss of fish due to habitat fragmentation is a concern throughout the Milk River basin. The section of the Milk River from the Canadian border to Fresno Reservoir is relatively unaffected by the project, except for the addition of St. Mary water. Stash (2001) found a high percentage of native species in this section, including a strong sauger run. Another native—flathead chub—were more abundant here than any other section in the study.

The Milk River from Fresno to Vandalia Dam is heavily influenced by operations of the reservoir and by project depletions. This section was found to be dominated by non-native species, some of which are game fish (Stash, 2001).

Several species that live in the Missouri River are also commonly found in the Milk from Vandalia Dam to the confluence with the Missouri. This section may provide spawning and rearing habitat for sauger, paddlefish, and blue sucker, Species of Special Concern, as well as the native shovelnose sturgeon.

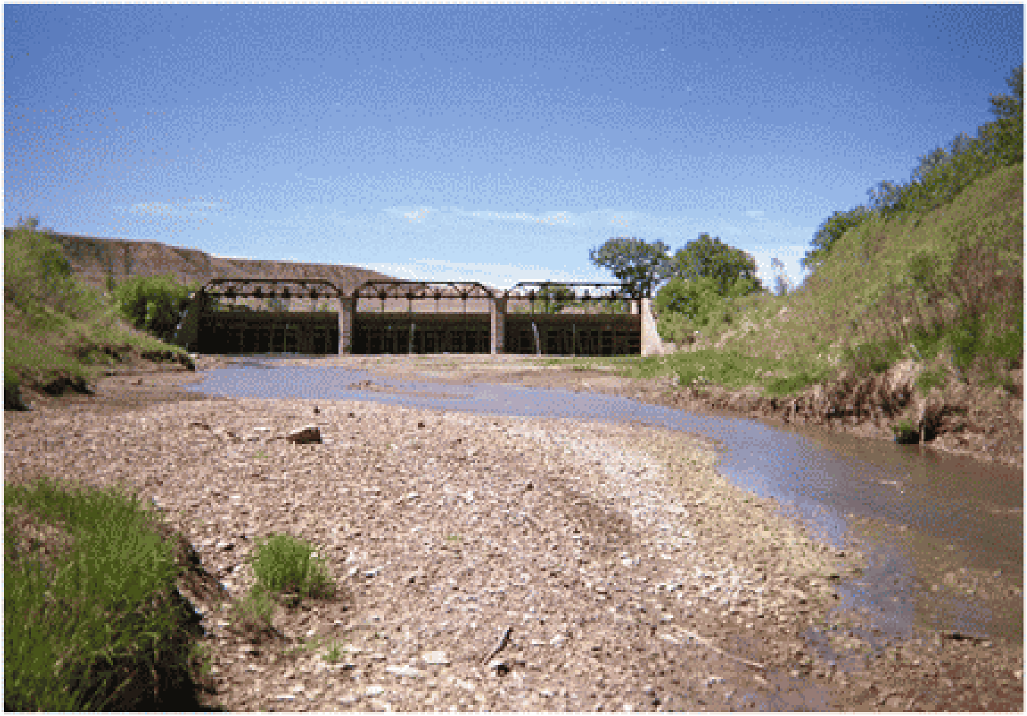


Photo 3.2 - Vandalia Dam, operated by the Glasgo Irrigation District.

These species rely on natural rises in flows to cue spawning migrations. Any alternatives that further alter the natural hydrograph should consider effects to these species. Concern has been expressed about fish kills below Vandalia Dam when the irrigation season ends and accumulated sediment is flushed down the river.

In addition to river fisheries, project reservoirs are managed for walleye, perch, and northern pike fisheries. Fluctuating water levels can damage these fisheries. Any alternatives involving water level changes or additional reservoirs should consider fishing opportunities.

Wildlife issues in the Milk River basin include effects from agriculture on wetland and upland game species that inhabit irrigated croplands and associated riparian areas. The possibility for conflict between ranchers and environmental interests over protection of prairie dog colonies could also become an issue.

Planned irrigation at Tiber Reservoir was never developed, so the public expect operations to be tailored to recreation, fish, and wildlife needs. The fishery in the reservoir—walleye, northern pike, and yellow perch, plus forage and sucker species—is considered good, maintaining itself through natural reproduction. The Marias River fishery is influenced by effects of water regulation: water released from the reservoir through a river outlet low in the water column is colder than what would be expected normally. The first 20 miles below Tiber is thus a cold water fishery with rainbow trout, brown trout, and mountain whitefish. Further downstream the fishery converts to warmwater species, with sauger being the most numerous resident game fish (Montana Department of Fish, Wildlife, and Parks, 1998).

The Montana Department of Fish, Wildlife, and Parks established guidelines in 1998 for reservoir and river operations for fish, wildlife, and recreation. Recommendations for Fresno include maintaining conservation pool between elevations 2560 feet and full pool of 2575 feet to provide maximum benefit to the fishery and recreation.  Minimum pool of 2551 feet is also recommended.  Recommendations for Nelson include maintaining conservation pool between elevations 2215 feet and full pool of 2221.6 feet to provide maximum benefit to the fishery and recreation.  Minimum pool of 2210 feet is recommended. A gradual drawdown for both reservoirs after mid-May is recommended for walleye and perch eggs to hatch.

If any alternatives affected Reclamation's ability to meet these guidelines, there could be negative effects to these resources.

At times, Reclamation can mimic natural river flows by periodic releases from Tiber, since there is no irrigation demand from the reservoir.  These releases are probably highly beneficial to cold water and warm water fisheries.

Many species of wildlife are associated with the riparian areas of the Marias River, those most influenced by the project being beaver and Canada geese.  Beaver lodges may be threatened by unnatural flows. Canada geese nest on the islands in the river; when spring flows are high, predators are discouraged from crossing side channels, so goose nest success is good.

### Opportunity

Increasing the water supply in the river basins, increasing reliability of the project, and increasing flexibility of water deliveries could provide fish and wildlife benefits both in and around the reservoirs and riparian corridors.  Reservoir water levels could be maintained at more desirable levels for fish, including minimum pool levels.  Minimum flows in the Milk River in winter could be maintained.

## RECREATION

Fish and wildlife species in the region provide both local and non-resident hunting and fishing opportunities.  In addition, the scenery and undeveloped nature of the area encourages a wide variety of outdoor recreation like canoeing, hiking, recreational floating, camping, and picnicking.  Much of the water-based recreation is affected by operations of the Milk River Project.

The St. Mary basin is on Blackfeet Reservation and Glacier National Park, with spectacular scenery and wildlife viewing opportunities.  Also, hunting is important to Tribal members, and they are accustomed to enjoying healthy herds of elk.

Fishing on the reservation is managed by the Blackfeet Tribe, with focus on stocked lakes on the reservation not directly linked to the basin.  Reclamation has been asked to contribute to an on-reservation Tribal fish hatchery and to stocking Lower St. Mary Lake with westslope cutthroat trout.  Lake Sherburne does not have any developed boat access and angling pressure is usually low.  It is situated at one of Glacier's entrances, however, and is important to the quality of the scenery.

Much of the recreational opportunity in the region is focused on the reservoirs in the Milk River basin. Fresno Reservoir has good walleye, northern pike, and yellow perch fishing, and water-based recreation is popular. The Milk itself also provides recreational fisheries and is considered good for sauger, channel catfish, and pike. While issues with entrainment and passage cause concern for many native species, they also create habitat for non-native sport fish that flourish in fragmented habitat and canals.

The Marias River and Tiber Reservoir provide most of the water-based recreation in that area. The river from below the dam to Loma, Montana, is a popular float trip highly valued by local residents and recreation clubs. Tiber sees significant fishing pressure for walleye, pike, perch, and trout. People are accustomed to water levels in the reservoir that allow for recreation, so changes may cause significant public concern. The coldwater trout fishery below Tiber is considered especially valuable by the Montana Department of Fish, Wildlife, and Parks (1998), since stream trout fishing is scarce in this area.

**Issue**

Fluctuations in the water levels of the reservoirs limit fishing opportunities in the Milk River basin. Low water levels during drought years sometimes restricts fishing and other water borne recreation. Low flows in the river also affect fishing and floating.

The U.S. National Park Service is concerned about the aesthetic value of an entrance to Glacier National Park being affected by low water levels at Lake Sherburne.

**Opportunity**

Maintaining the reservoirs at more desirable water levels for fishing and water borne activities could improve recreational opportunities in the region and provide an economic stimulus for Montana. Towns in the basin have already expressed interest in enhancing recreational opportunities as a means of economic diversification. Maintaining flows in the river would improve fisheries and improve recreation.

## HYDRO-POWER

Reclamation has no authority to pursue hydro-power development for the Milk River Project or the Lower Marias Unit. The agency which has the authority, FERC (Federal Energy Regulatory Commission), however, has received proposals for development through its hydro-power permitting process.

For the Milk River Project, hydro-power development has been investigated under FERC jurisdiction at the St. Mary Canal terminal drop structures and at Fresno Dam. A private enterprise evaluated a small development at the St. Mary Canal drops, while several others showed interest in a small hydro-power plant at Fresno in the 1980s. Economic factors precluded hydro-power development at either point.

More recently, several companies indicated renewed interest in hydro-power development of the Milk River Project. FERC issued preliminary permits to study development at Fresno Dam in June 2000 to the Universal Electric Power Corporation of Akron, Ohio, and to study development at Sherburne Dam in May 2002 to Symbiotics, LLC, of Rigby, Idaho.

On the Lower Marias Unit, Tiber Dam has been the focus of interest. CHC (Continental Hydro Corporation) of Boston, Massachusetts, applied for a preliminary permit from FERC for study of development at Tiber Dam in 1993. After completion of economic and environmental studies, FERC issued an Environmental Assessment/Finding of No Significant Impacts for the proposal in September 1996. CHC received a license to construct and operate a 7.5 megawatt hydro-electric power plant at the dam in June 1997. This license has a term of 50 years. In 2001, this license was transferred from CHC to Tiber Montana, LLC, of Idaho Falls, Idaho. Plans and specifications for the power plant were begun in 2002, and construction could begin in the summer of 2003.

**Issue**

Continued interest of private enterprises in development could indicate undeveloped hydro-power potential in the region.

**Opportunity**

Development of small hydro-power plants at various facilities of the Milk River Project could provide economic benefits to the region if such development becomes economically justified in the future.

# *A L T E R N A T I V E S*
# Chapter 4

This chapter presents alternatives to address water and related issues identified in Chapter 3. The *Future Without the Project Condition* serves as a basis of comparison for the alternatives.

Non structural alternatives would reduce demands on water resources in the region; structural alternatives (those that would require construction) would meet one of the following functions:

- To improve water operations and management
- To improve water storage
- To augment the supply of water.

After a section on how alternatives were developed, the Future Without the Project is discussed, followed by the alternatives arrayed in the categories above. Alternatives are described; contribution to the water supply estimated; ability of the alternative to satisfy various water issues discussed; and economic benefits and costs estimated. Table 4.1 at the end of the chapter profiles costs and benefits of the alternatives. Chapter 4 concludes with a section on alternatives considered but dropped during the study.

## DEVELOPMENT OF ALTERNATIVES

Some alternatives were updated from previous reports, while others were suggested during meetings with interest groups, tribes, and other agencies. Information for the alternatives was developed from a number of sources, as explained below. Assumptions, benefits, costs, and other information could change after further study.

### Water Supply Contribution

This study included field work to better determine canal delivery efficiencies and analysis to better determine crop water use in the Milk River basin. Alternatives were evaluated by their ability to improve the water supply in two steps. The first step was to identify alternatives best able to improve the water supply with hydrology model information to hand. The most promising alternatives passed on to the second step, which was evaluation again using a model with updated water use information.

The model used in the first step included a CIR (crop irrigation requirement) of about 6 inches, or between 13-15 inches at the farm headgates. The full CIR determined by the *Montana Irrigation Guide* is about 29 inches at farm headgates (U.S. Natural Resources Conservation Service, no date). Canal efficiencies were determined to range from 40-55% efficiency based on the limited canal diversion records.

A hydrology model was used to characterize present operations in the St. Mary River and Milk River basins. The model described how water enters, is used, and how it leaves the basins. Information fed into the model included: monthly streamflows from several locations along the rivers; reservoir capacities;

irrigation demands in the form of a CIR (*crop irrigation requirement*) and acres irrigated; canal and on-farm efficiencies; canal diversion capacities; return flow factors; and minimum stream flow requirements. Other information was also included. Results of the initial computer run were compared to past information on stream flows in the basin to calibrate the model. The model allows for changes in water entering, being used, and exiting the basins as well.

In this way, the model could be used to estimate how an alternative would (or would not) meet water needs of the basins. It was used in this report to determine the volume of water delivered to the canal head gates in the Milk River basin. The volume delivered in an alternative was then compared to the volume estimated for the Future Without the Project Condition. Any increase in the volume delivered became the *Water Supply Contribution* of the alternative (see Table 4.1).

**Issues**

The water supplied by an alternative was also used to estimate effects on MR&I (municipal, rural, and industrial water) benefits; threatened and endangered species (and species of special concern); water quality; reserved water rights; the Bowdoin National Wildlife Refuge; other fish and wildlife species; and recreation.

**Economic Benefits**

Economic benefits in this report include only the direct benefit of increased crop production, not indirect benefits resulting from increased production. Economic benefits of the alternatives were estimated from AF (acre-feet) of water delivered to canal headgates (acre-inches to the farm headgates). AF/acre of water from the hydrology model were used to estimate increases in production of alfalfa. The increased crop production was then converted to dollars for the economic benefits. Economic benefits of the alternatives are compared in Table 4.1.

Many incidental benefits would accrue from the different alternatives. A regression analysis was done for Fresno and Tiber reservoirs to show the correlation between visitation and water levels, using just these two variables. This analysis showed that as water levels decline at a given reservoir, overall recreational use and value also decline. Other variables affecting changes in recreation in relation to water levels are: physical characteristics of the lake; usable range of water access facilities; availability of substitute sites; tolerance of visitors to water level changes; and the mix of recreational activities.

**Cost Estimates**

Cost estimates were developed at a preliminary level of detail, depending on existing information. Estimates generally were prepared from preliminary layouts of facilities on existing maps, such as U.S. Geological Survey 7.5 minute quad sheets or Reclamation drawings. Quantities and units necessary were computed. To these costs was added a percentage of the costs for mobilization, unlisted items, contingencies, and other costs, including costs to complete environmental and cultural resource studies.

Particular cost estimates developed were *total investment cost* (costs of construction plus interest during construction), annual *O&MR costs* (costs of operation, maintenance, and replacement), and *annual energy costs* figured on 50 mills/kilowatt-hour. *Total annual costs* are the sum of OM&R and energy costs. Table 4.1 compares costs of the alternatives.

## FUTURE WITHOUT THE PROJECT CONDITION

Reclamation plans new water projects under direction of the U.S. Water Resource Council's *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (1983), commonly known as the *P&Gs*. The P&Gs require assumptions to be made of the most likely condition in the future if no Federal action were taken. Thus, both the *Future Without the Project Condition* and the future with a project (or, in other words, the alternatives) are based on assumptions of what would occur in the future. The Future Without a Project Condition is the baseline to which the alternatives are compared.

Each alternative was compared to the most likely conditions in the region 2050 if no Federal action were taken. The Milk River Project was assumed to exist at this date, although in a much different form than today.

### General Assumptions

It was assumed that the State water rights adjudication process would be completed with issuance of final decrees, and water rights would be enforced in the Milk River. Irrigated acres junior in right to the Blackfeet and Fort Belknap Reservations and the Milk River Project would be left without a water supply in all but extremely wet years when some natural flows would be available.

It was assumed that holders of junior water rights would agree to contribute to the construction and operation and maintenance costs of any water supply project that provided them with water. Based on this assumption, the hydrology model provides an equal share of water to all current irrigated acres in the basin along with the additional acres proposed for development under the Fort Belknap Compact. Irrigated acres would thus total about 150,000 acres.

It was assumed that the St. Mary Canal system would most likely not be operable by 2050, and there would be no diversion of water from the St. Mary to the Milk River if no Federal action were taken.

Photo 4.1 - Landslides along the St. Mary Canal.

The U.S. receives on average about 40,000 AF/year from the Milk that rightly belongs to Canada. In the Future Without the Project, it was assumed that Canada would significantly reduce this surplus by 2050 as they developed storage facilities north of the border and added irrigated acreage in southern Alberta.

An assumption was made about future capacity of Fresno Reservoir, also. Based on data for the past twenty years, the average loss to sedimentation is about 500 AF/year; extending this average loss to 2050 would mean Fresno's capacity would be reduced to about 68,000 AF by that time. Fresno's average elevation would drop to 2,547 feet msl, 18 feet below the current historical average.

The Fort Belknap Compact was assumed to be fully implemented by 2050, by which acres would be added to the present irrigation on the reservation. New irrigation on the reservation would have the senior water right to natural flows of the Milk. The Blackfeet Tribe's reserved water rights have yet to be settled, although a settlement would be expected by 2050. The effects are not known at this stage.

Current trends suggest that irrigators in the project would increase both on-farm and canal efficiencies in the future to stay in business and maximize crop production with available water. An increase in on-farm efficiency of 7% was assumed in the Future Without the Project, from the basin-wide average of 43% at present to 50% in 2050. The canal efficiency estimated to range from 40-55% among districts' diversion canals was increased to 60% for each canal. While specific programs might change, Federal and State funds would probably be available (along with local funds), to help fund increases in efficiencies.

**Effects of the Future Without the Project Condition**

Based on the assumptions above, the future would affect irrigation, MR&I supplies, threatened and endangered species, water quality, settlement of reserved water rights, fish & wildlife, and recreation as described below.

***Irrigation***

With no St. Mary River water, loss of storage capacity in Fresno Reservoir, and with Canada using it's full share of the river, the Milk River basin could not support irrigation at the present level. The water supply would be significantly reduced from present levels of 18.12in/ac (inches/acre) at the farm headgates to an average of 11.82 in/ac annually.  This would be much less the 29 in/ac needed annually according to the U.S. Natural Resources Conservation Service (nd).  The water supply would vary greatly from year to year with no St. Mary River water and Fresno's reduced storage capacity.

#### *MR&I*

Towns (Havre, Chinook, Harlem, and Fort Belknap) and the Hill County Water District draw water directly from the Milk River for their MR&I supply.  Based on the 2000 Census, total population served by the river is about 12,055.  With no St. Mary River water there would be a drastic effect on these towns and the rural water district.  They would have to find another water supply–possibly from Tiber Reservoir–or request reallocation of storage in Fresno Reservoir.  While the reallocation would be minor, it would still affect the irrigation water supply, perhaps leading to further loss of irrigation in the basin.

#### *Threatened and Endangered Species*

The bull trout in the St. Mary River basin would probably benefit from no St. Mary system.  The river would revert to a more natural hydrologic pattern and the barrier to fish migration would be removed.  No St. Mary water for the piping plover around Nelson Reservoir wouldn't necessarily be  adverse as more shoreline could provide more habitat.  Operation of Nelson would probably change as some acres were no longer irrigated.  Effects (if any) on the pallid sturgeon are unknown.

#### *Water Quality*

Loss of the diluting effect of good quality water from the St. Mary River would result in a decrease of water quality in the Milk River.  As on-farm and canal efficiencies improved, the volume of return flows from irrigated fields back to the river would decrease, but concentrations of pollutants would increase. Segments of the river would probably be "dewatered" more often; when flowing, water temperatures would increase.

A number of stream segments in the region and Fresno Reservoir are impaired, with TMDL (total maximum daily load) development scheduled for 2011-2013 (see Chapter 3, "Water Quality").  Probable causes of impairment include nutrients, metals, habitat alternation, flow alternation, bank erosion, riparian degradation, thermal modification, among others.

#### *Reserved Water Rights*

No water from the St. Mary would require the Tribes, State, and Federal Negotiating Team in the Fort Belknap Compact to re-enter "negotiations on alternative remedies to supply water to portions of the Reservation served from the Milk River and to water rights arising under state law within the Milk River Project" (MCA 85-20-1001, Article VII.A.1).

A settlement with the Blackfeet Tribe hasn't progressed to the point where effects could be estimated. The Tribe may be interested in using the St. Mary Canal to transport water to the North Fork of the Milk River for benefit of the Tribe.  With no St. Mary Canal this possibility would be removed.

#### *Fish and Wildlife*

In the Future Without a Project, fisheries in the St. Mary River basin would generally benefit by no St. Mary Diversion Dam through elimination of the canal entrainment and return to more natural flows.

In the Milk River, however, fisheries could suffer as irrigation demands were met without St Mary River water, resulting in very little water left in the river. Reservoirs would probably fluctuate more that at present, resulting in adverse effects on reservoir fisheries.

Wildlife in the St Mary River basin would generally remain the same, but habitat in the Milk River basin could be affected. Water probably couldn't be provided as consistently to the Bowdoin National Wildlife Refuge, reducing habitat, which could lead to overcrowding and disease outbreaks among waterfowl. Loss of waterfowl production, however, would become more detrimental than loss to disease. On the other hand, if loss of water resulted in some croplands reverting back to grasslands, upland species such as sage grouse could benefit from increased habitat.

#### *Recreation*

No St. Mary River water would have an adverse effect on water-borne recreation and other forms of recreation in Fresno and Nelson reservoirs since water levels probably would drop. Fishing below the reservoirs would also decrease because releases from the reservoirs would decline. Fresno would see an annual decrease of about 3,775 visitors to the reservoir if there was no St. Mary water, an annual decrease of about $45,000. Historical data was unavailable for Nelson, so no analysis could be done.

## WATER OPERATIONS AND MANAGEMENT ALTERNATIVES

Alternatives in this category would improve water operations and management in the Milk River Project by improving on-farm efficiency; river operations; efficiency of the canal system; water management at Nelson Reservoir; or, by construction of a re-regulation reservoir in the Glasgow Irrigation District.

### On-Farm Efficiency Improvements

The *Milk River On-farm Irrigation Study* (Dalton, 2001) provided the information for this alternative. This study estimated average on-farm efficiency could be improved by implementing irrigation system and management improvements.

#### *Description*

The Dalton study proposed field leveling, conversion from flood irrigation to sprinkler, and shorter irrigation canal runs for providing water more efficiently to the crop root zone when water is needed by the plant. On-farm efficiency would be improved to about 55%, an increase of 5% in comparison to the Future Without.

#### *Water Supply Contribution*

Improvement in the efficiency in use of water on-farm would reduce the supply available to the canal headgates by 12,881 AF annually, which equates to 0.63 inch less water delivered to the farm headgates than in the Future Without the Project (11.19 inches/acre compared to 11.82 inches/acre–see Table 4.1). Because of improvement in efficiency, however, about ¼- inch more water would be consumed by crops, increasing production. Twenty-nine inches/acre would be required for full crop production.

### *Issues*

Improving efficiency on-farm would improve crop production by increasing the volume of water consumed by crops, reducing the supply available for other uses. Less water would return to the river from irrigated lands (*return flows*), and fertilizers would be used more efficiently, thereby improving water quality in the Milk River. Less water would be available for implementation of the Fort Belknap Compact. Water available for the Bowdoin National Wildlife Refuge would be reduced. Lack of an adequate supply in Fresno in the future would probably result in the river being dewatered more frequently, affecting the river fishery, wildlife along the river, and riparian and wetland habitat. Game species like deer and pheasants might benefit from increased crop production. Recreational opportunities would decrease as water levels in Fresno and Nelson reservoirs were drawn lower.

### *Economic Benefits*

Incremental crop yields are estimated to increase 0.05 tons/acre of alfalfa annually, a basin-wide increase of 7,549 tons/year. This would equate to an annual economic benefit of $649,000 (Table 4.1).

### *Costs*

Total investments costs would be $10,600,000 (Dalton, 2001) and annual OM&R costs $61,162, and energy costs $57,240. Total annual costs would be $704,402. The benefit-to-cost ratio would be 0.9 (Table 4.1).

## River Operations Improvements

Water deliveries in the Milk River Project are measured using non-standard devices, the accuracy of which is less than optimum. USGS (U.S. Geologic Survey) gauges, of which there are five in this reach of the Milk, are used by Reclamation to monitor flows and adjust releases from Fresno Reservoir. Reclamation also remotely monitors water diversions from project canals and for the Fort Belknap Irrigation Project. Deliveries are commonly measured by ditch riders using hand-held propeller flow meters in headgate/pipe structures. Meters are calibrated for a typical pipe size, being adjusted by tables or formulas when other sizes are encountered. While reasonably accurate, field checks in 2001 indicated these measurements varied depending on the condition of the meters or headgate/pipe structures. Practices among the districts and individual ditch riders also varied considerably, ranging from several measurements per delivery per day to no measurements at all.

### *Description*

This alternative would improve water deliveries measurement by adding more gauging stations and more frequent measurement of discharge. Reclamation would improve the accuracy and reliability of canal diversion measurements, including permanent measurement structures at the heads of the Paradise, Harlem, Fort Belknap, and Dodson North and Dodson South Canals, which might include remote monitoring at some locations.

A river basin management program would be developed and managed by a full time river manager. The manager would be responsible for scheduling water releases and deliveries of water from Fresno, while monitoring river flows and diversions by canals and pumpers along the river. The manager would maintain water measurement equipment at sites throughout the project to assure accuracy and transmittal of information on a timely basis, and work with irrigation districts, Milk River Joint Board of Control, Fort Belknap Irrigation Project, and river pumpers to develop delivery plans and water allotments based on water supply and forecasts.

### *Water Supply Contribution*

This alternative would allow for more efficient, timely, and equitable delivery of water throughout the basin. Continuous monitoring and daily management of river operations would probably contribute to the water supply, but the increase wasn't estimated since it couldn't be adequately modeled.

### *Issues*

Improving river operations would probably improve the water supply in the Milk River basin and allow some more water to remain stored in the reservoirs, perhaps making MR&I deliveries more reliable. Slightly more water could be available for implementation of the Fort Belknap Compact. Project facilities would be operated more efficiently, slightly improving conditions for the piping plover around Nelson Reservoir. More water could be routed to Bowdoin occasionally. Intensive management to maximize water deliveries could result in more frequent dewatering of the river, affecting the river fishery, wildlife along the river, and riparian and wetland habitat. Water levels in the reservoirs would probably be a little higher, slightly improving recreational opportunities, but recreational fishing along the river might decline.

### *Economic Benefits*

Economic benefits couldn't be determined for this alternative separately.

### *Costs*

Total investment costs are estimated to be $100,000 and annual OM&R costs $245,000 (Table 4.1). There would be no added energy costs. Total annual costs would be $251,000. No benefit/cost ratio was estimated.

## Canal Efficiency Improvements

Canals in the Milk River Project could be modified to deliver water more efficiently to farm headgates. Releases from Fresno irrigate project lands over 300 river miles away, a trip that may take water up to two weeks before reaching the last canal headgate at Vandalia Dam. Nearly half the water diverted from the Milk River returns from canal and lateral wasteways. Project main canals and laterals are earth-lined. These canals and laterals are often too small to supply peak irrigation demand. At other times, they supply more water than irrigators can efficiently use.

### *Description*

Methods to improve efficiency would include lining canals and laterals, putting laterals into pipe, and reusing spills and return flows, in addition to improving water measuring devices. Canal efficiency would improve by 10%, from 60% in the Future Without to 70% in this alternative.

***Water Supply Contribution***

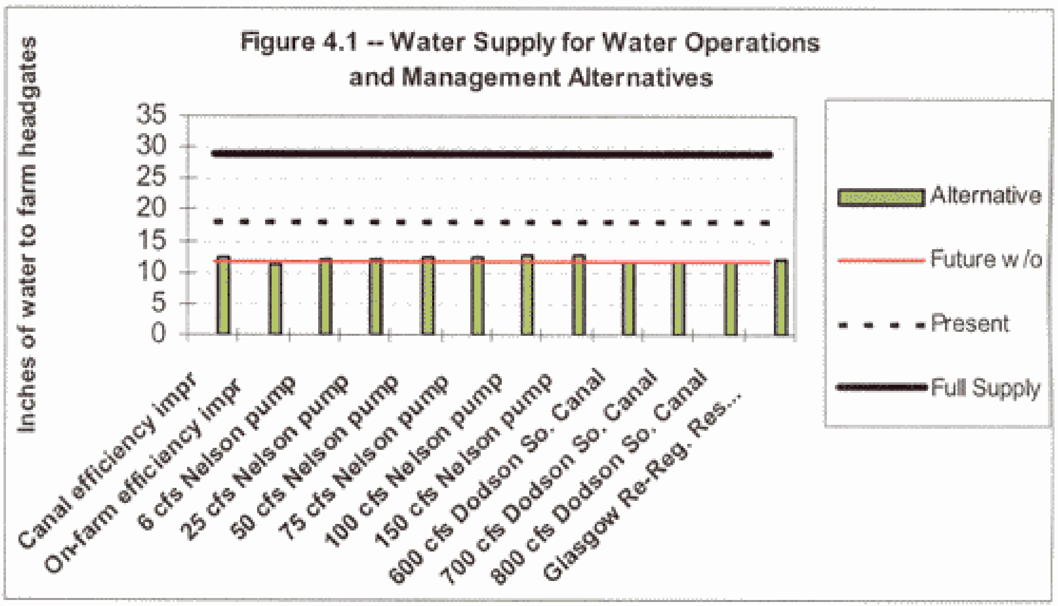
Improvement in canal efficiency would reduce water delivered to the canal headgates by 8,369 AF annually, 0.68 inches/acre more would be delivered to farm headgates than in the Future Without the Project (12.50 inches/acre compared to 11.82 inches/acre–Table 4.1). About 29 inches/acre would be required for full crop production. Water supply for Water Operations and Management Alternatives are compared in Figure 4.1.

***Issues***

Similar to on-farm efficiency improvements, water saved by canal efficiency improvements would be delivered to irrigators for improved crop production, reducing the supply available to other uses. Less water would be available to contribute to implementation of the Fort Belknap Compact. Water available for Bowdoin would be reduced. Less water would return to the river from canal spills, resulting in more frequent dewatering with consequent adverse effects on the river fishery, wildlife along the river, and riparian and wetland habitat. Recreational opportunities would probably remain the same at Fresno but would decrease at Nelson.

***Economic Benefits***

Incremental crop yields would increase 0.07 tons/acre of alfalfa annually, a basin-wide increase of 10,498 tons/year. This would equate to an annual economic benefit of $903,000 (Table 4.1).




***Costs***

Total investment costs are estimated to be $12,920,000, annual OM&R costs $34,800, and energy costs $66,000 (Table 4.1). Total annual costs would be $814,800. The benefit/cost ratio would be 1.1.

**Nelson Reservoir Pumping Plant**

Nelson Reservoir, with a total storage capacity of about 79,000 AF, is formed by a series of five homogenous earth-filled riprapped dikes. The reservoir supplies water to about 20,000 acres in the lower part of the Malta Irrigation District through the Nelson South Canal. Water is also sometimes released through the Nelson North Canal into the Milk River as part of the supply to the 18,000 acres in the Glasgow District.

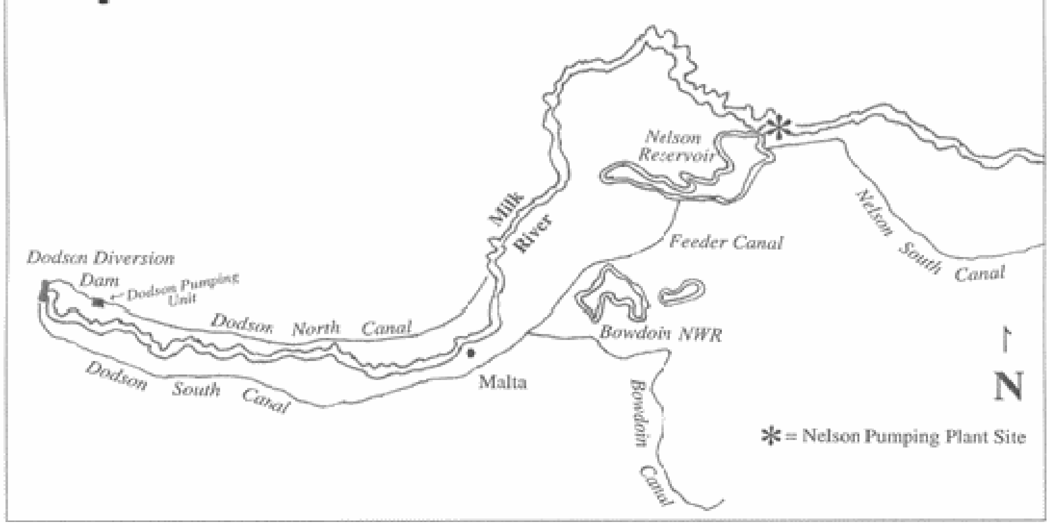
Water for Nelson ─a combination of natural flows and water from Fresno Reservoir─is diverted from the river at Dodson Diversion Dam and delivered to Nelson via the 45-mile long Dodson South Canal (Figure 4.2). Water usually is delivered to Nelson in March-early May and September-October. The canal also delivers water for irrigation: during the irrigation season (May-mid-September), there is only capacity in Dodson South Canal to satisfy irrigation, with little or no capacity to transport water to Nelson Reservoir. In drought years, the only water available for Nelson is stored Fresno water.

Typically water is stored in the reservoir in the spring after the ice breaks up and before full irrigation begins. Water is also stored in the fall after the irrigation season, but before the river freezes. During the irrigation season, Dodson South Canal is typically flowing at maximum capacity to serve lands above the reservoir. Storage in Nelson is thus limited by availability of flows in the Milk and by the short time the Dodson South Canal can be used to fill the reservoir.

### *Description*

Nelson's water supply could be augmented by pumping water up 70 feet from the Milk River at Cree Crossing to the reservoir (Figure 4.2). Facilities would include a lowhead diversion dam, a multi-bay pump house with varying size pumps, and a 3,300-foot long pipeline to the reservoir terminating in a concrete outlet structure. Pumps ranging from 6-150 cfs capacity were examined for this report. At 6 cfs they would pump year-round, while at 150 cfs they would pump just during runoff.

**Figure 4.2 – Milk River from Dodson Diversion Dam to Nelson Reservoir**




### *Water Supply Contribution*

Total water delivered to farm headgates would vary from 11.95 inches/acre annually for the 6-cfs pumps to 12.86 inches/acre annually for the 150-cfs pumps. This would be 0.13-.1.04 inches/acre more for the 6-cfs and 150-cfs pumps, respectively, than in the Future Without. It would be less than the 29 inches/acre required for full crop production.

### *Issues*

All sizes of pumps in a pumping plant at Nelson would reduce water supply shortages to some extent and allow for more flexibility in operations. Irrigators could receive water both earlier and later in the irrigation season when flows are often used for filling Nelson. More water could be left in Fresno, improving reliability of MR&I supplies. The pumping plant would allow water levels in Nelson to be kept higher in the spring, causing piping plovers to build nests higher on the shoreline, thereby reducing possible effects to nesting sites. River flows below the pumping plant would be reduced, while more sediment might be delivered to Nelson Reservoir from the river. By improving management in the basin, the pumping plant could contribute to implementation of the Fort Belknap Compact. Water could be provided more consistently to Bowdoin since water normally routed to Nelson could go to the refuge. Nelson water levels could be better controlled and coordinated with Montana DFWP to improve fish production, but pumping high flows from the spring river rise could adversely affect migratory spawning fish like paddlefish, sauger, and blue suckers that rely on high peak flows for spawning cues. All sizes of pumps in a pumping plant would allow water levels to be kept higher in Fresno and Nelson later in the season, providing more recreational opportunities.

***Economic Benefits***

Incremental crop yields would range from an increase of less than .01 tons/acre of alfalfa annually with the 6-cfs pumps to 0.11 tons/acre annually for the 150-cfs pumps, a basin-wide increase ranging from 2,007-16,056 tons/year, respectively (Table 4.1). This would equate to an annual economic benefit ranging from $173,000-$1,381,000, respectively.

***Costs***

Pumping plant sizes in relation to costs, crop yields (in tons of alfalfa), annual economic benefits, and benefit-cost ratios are:

| Pumping Plant Capacity | Total Investment | Annual OM&R | Annual Costs | Crop Yields | Annual Economic Benefits | B/C Ratio |
|---|---|---|---|---|---|---|
| 6 cfs | $3,046,000 | $24,400 | $192,400 | 2,007 | $173,000 | 0.9 |
| 25 cfs | $3,907,000 | $74,300 | $290,300 | 3,088 | $266,000 | 0.9 |
| 50 cfs | $5,136,000 | $104,900 | $388,900 | 7,410 | $637,000 | 1.6 |
| 75 cfs | $6,089,000 | $117,800 | $453,800 | 10,035 | $863,000 | 1.9 |
| 100 cfs | $7,620,000 | $136,400 | $557,400 | 12,505 | $1,075,000 | 1.9 |
| 150 cfs | $9,449,000 | $166,300 | $688,300 | 16,056 | $1,381,000 | 2.0 |

Table 4.1 compares all the alternatives in these respects.

**Dodson South Canal Enhancements**

Increasing the 500-cfs capacity of this canal to 600 cfs, 700 cfs, and 800 cfs was examined for this alternative. It would provide a means of transferring to Nelson Reservoir early spring flows and excess water available during the irrigation season.

Related to rehabilitation of the Dodson South Canal, the Malta Irrigation District commissioned a study to determine plans to rehabilitate Dodson Diversion Dam. Rehabilitation of the South Canal is part of the beneficiary's O, M, & R responsibilities. Currently, the diversion dam's spillway gates constrain the operating season to between spring thaw when most of the ice melts on the river to just before freeze-up in the fall. The district is proceeding with a plan to rehabilitate the dam by replacing the spillway gates, adding a de-icing system to the Dodson South Canal headworks, and repairing some of the concrete. This will improve the dam's reliability and extent the operating season to provide water for district needs, Bowdoin National Wildlife Refuge, and Nelson Reservoir. The cost to rehabilitate Dodson Diversion Dam is estimated to be $2,200,000.

***Description***

Capacity of Dodson South would be increased to 600-800 cfs, depending on which capacity offered the greatest economic benefits.

***Water Supply Contribution***

Total water delivered to farm headgates would range from 12.13 inches/acre annually for the 600 cfs canal to 12.38 inches/acre for the 800 cfs canal, respectively, 0.31-0.56 inches/acre more than the 11.82 inches/acre annually in the Future Without (Table 4.1). This would be less than the 29 inches/acre required for full crop production.

***Issues***

A larger capacity canal would allow Nelson to receive more early spring flows and other flows from the river during the irrigation season, reducing water supply shortages and slightly improving reliability of MR&I supplies. More flexibility in Nelson operation would slightly benefit the piping plover. This alternative would slightly decrease water quality as more water would be diverted from the river into the reservoir. More water in Nelson would contribute to implementation of the Fort Belknap Compact, albeit slightly. A larger canal could provide water more consistently to Bowdoin. Fish and wildlife habitat in and around Nelson Reservoir could improve, but diversion of high flows from the spring rise of the Milk could adversely affect spawning paddlefish, sauger, and blue sucker that rely on high peak flows for spawning cues. This alternative would allow water levels to be kept higher in Fresno and Nelson later in the season, providing more recreational opportunities.

***Economic Benefits***

Incremental crop yields increases would range from 4,786-8,646 tons/year basin wide for the 600-cfs and 800-cfs canals, respectively (Table 4.1). This would equate to annual economic benefits of from $412,000-$744,000, respectively.

***Costs***

Canal capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are shown below. Table 4.1 compares all alternatives in these respects.

| Canal Capacity | Total Investment | Annual OM&R | Annual Costs | Crop Yields | Annual Economic Benefits | B/C Ratio |
|---|---|---|---|---|---|---|
| 600 cfs | $5,347,000 | $7,000 | $302,000 | 4,786 | $412,000 | 1.4 |
| 700 cfs | $10,797,000 | $7,300 | $604,300 | 7,256 | $624,000 | 1.0 |
| 800 cfs | $16,966,000 | $7,700 | $945,700 | 8,646 | $744,000 | 0.8 |

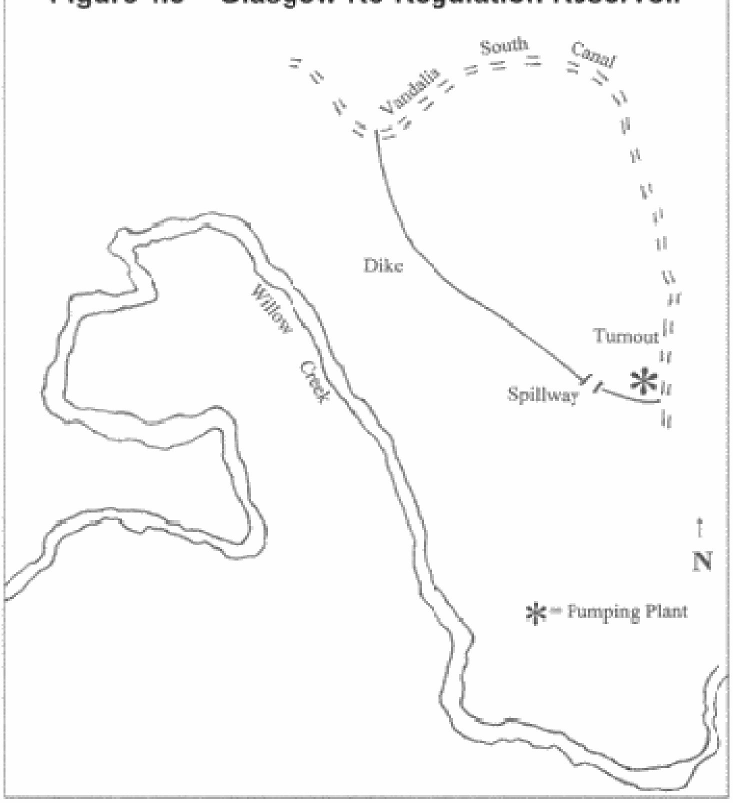
**Glasgow Irrigation District**
**Re-Regulation Reservoir**

Water supplied to the Vandalia Canal is sometimes insufficient. The 130-AF Glasgow Irrigation District Re-Regulation Reservoir would capture surplus flows from the canal, to be released later when needed.

***Description***

The reservoir would be located on state and private lands near the Vandalia South Canal Siphon about 3¼ miles south of Glasgow, Montana (Figure 4.3). It would be constructed by building an embankment about 1,450 feet long and modifying the present canal bank.

Figure 4.3 – Glasgow Re-Regulation Reservoir




The embankment would be about 10 feet high, with a 14-foot top width. A PVC liner would be installed on the face of the embankment to reduce seepage and erosion. The canal bank would be raised about 1 ½ feet to provide adequate freeboard and widened to provide for a 16 foot road. Filter fabric and 12-inch riprap would be installed on the reservoir side of the bank to reduce erosion. Total storage of the reservoir would be 130 AF, with a maximum water surface elevation of 2089.61 feet. Total surface area would be 18 acres.
The reservoir would be filled by gravity from a new turnout off the canal, consisting of a reinforced, concrete inlet structure, 48-inch reinforced concrete pipe, and a flared end section. The turnout would have a maximum capacity of 36 cfs.

An overflow structure would control the water level in the reservoir and would provide a means of draining the reservoir in an emergency. It would consist of a reinforced, concrete inlet structure, 48-inch reinforced concrete pipe, and a flared end section. The reservoir could be drained using a 24-inch diameter slide gate in the overflow structure.

Water would be raised a maximum of 13 feet from the reservoir back into the canal. The pumping plant would consist of a vertical turbine pump mounted on a reinforced, concrete intake structure. A 20-inch steel pipe would be installed from the pump into the existing siphon inlet. Power is available within 400 feet of the pump plant.

***Water Supply Contribution***

Total water delivered to farm headgates would be 11.94 inches/acre annually, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.12 inch/acre annually (Table 4.1). The alternative would deliver less than the 29 inches/acre required for full crop production.

***Issues***

This alternative would have little—if any—effect on water supply shortages in the basin but would improve crop production in the Glasgow Irrigation District by improving efficiency of canals and other delivery facilities. Improvement in operation of the district might reduce their needs for water from Nelson Reservoir. Added operational flexibility would benefit the piping plover at Nelson. The new reservoir would contribute little towards implementation of the Fort Belknap Compact. No additional water would be available for Bowdoin. The fishery at Nelson could improve slightly. While operational improvement would reduce canal spills back to the river, less water would have to be diverted at Vandalia Dam, leaving more water in the river for the fishery. Recreational opportunities at Nelson could improve slightly.

***Economic Benefits***

Incremental crop yields would increase 0.01 tons/acre annually or 1,853 tons/year basin wide. This would equate to annual economic benefits of $159,000 (Table 4.1).

***Costs***

Total investment costs in this alternative are estimated to be $1,400,000, annual OM&R costs $9,200, and energy costs $2,100 (Table 4.1). Total annual costs would be $88,300. The benefit/cost ratio would be 1.8.

## WATER STORAGE ALTERNATIVES

This category includes alternatives for the St. Mary River basin—the Babb Dam—and three in the Milk River basin: enlarging Fresno Reservoir, enlarging Nelson Reservoir, and constructing storage reservoirs on Milk River tributaries.

**Babb Dam**

A dam on the St. Mary River near Babb, Montana, could store water, either to be transferred to the Milk River Project or used by the Blackfeet Tribe. This alternative includes the assumption that the capacity of the St. Mary Canal system is its design capacity of 850 cfs.

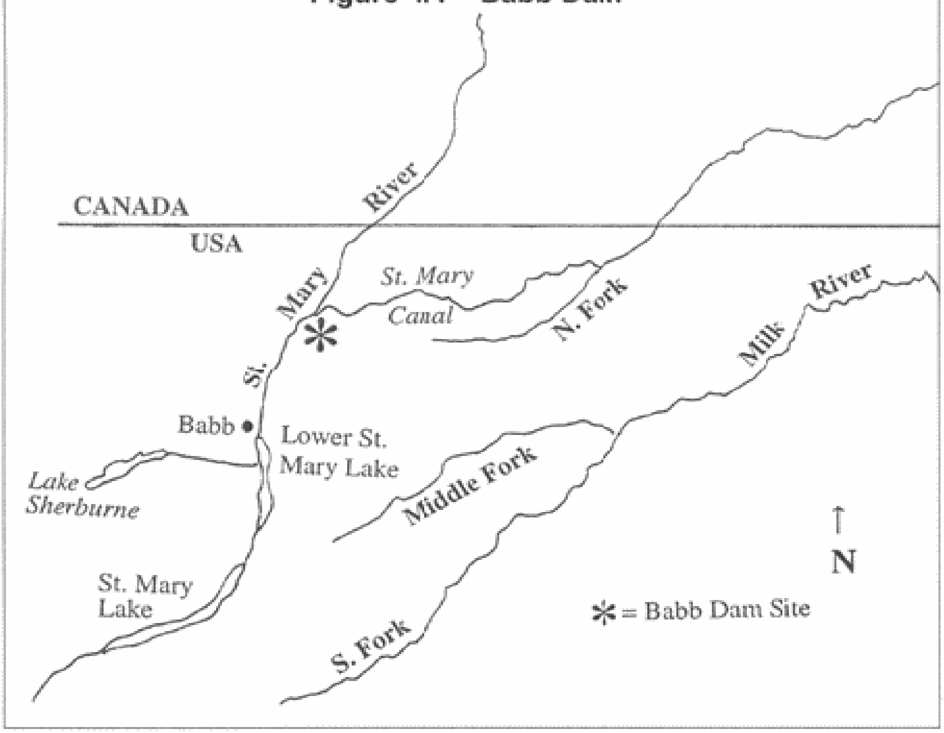
The dam would be operated in accordance with the Boundary Waters Treaty. Operation of the dam and the St. Mary Canal would allow for fuller utilization of the St. Mary River, resulting in less surplus water entering Canada.

The dam and reservoir would be located entirely on the Blackfeet Reservation. Without the Tribe's support, this alternative wouldn't be considered.

***Description***

The dam—about 220 feet high and 3,600 feet long—would be located about 2,000 feet downstream from the St. Mary River Siphon (Figure 4.4). It would include an emergency spillway in the left abutment which would release flood flows into the river about ½ mile downstream of the dam. The 297,000 AF reservoir formed behind the dam (at maximum) would include Spider Lake, which would be diked on the east side. Passage for bull trout around the dam would be provided. The St. Mary Canal would be rehabilitated for its last 20 miles to 850-cfs capacity; the first 9 miles would be abandoned.

Figure 4.4 – Babb Dam




***Water Supply Contribution***

Total water delivered to farm headgates would be 27.30 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 15.48 inches/acre annually (Table 4.1). It would deliver less than the 29 inches/acre needed for full crop production. This alternative would add slightly to the water supply in the St. Mary River, significantly to the water supply in the Milk River.

### *Issues*

This alternative could provide the largest contribution to the water supply in the basin of the alternatives in this report, benefitting MR&I supplies as well. It would have a significant effect on bull trout without a fish passage, as the area of the new reservoir would be in the heart of bull trout winter habitat. On the other hand, it would improve conditions for the piping plover in Nelson. Water quality in the Milk would be slightly improved because more water would be left in the river. This alternative would benefit implementation of the Fort Belknap Compact, and would also present an opportunity to provide a significant volume of water towards settlement of the Blackfeet Tribe's reserved water rights. Water could be provided more consistently to Bowdoin. River habitat in the St. Mary River basin would be lost, while lake habitat were gained. The new reservoir might create favorable habitat for non-native species which could move into the river system and out-compete native species. More water in the river would improve fish and wildlife habitat, riparian areas, and wetlands in the Milk River basin. Recreational opportunities would be improved as water levels in Fresno and Nelson reservoirs could be kept higher later in the season. The opportunity for hydro-power would be significant.

### *Economic Benefits*

Incremental crop yields would increase 1.58 tons/acre annually or 238,988 tons/year basin wide(Table 4.1). This would equate to annual economic benefits of $20,553,000.

### *Costs*

Total investment costs would be $228,734,000 and annual OM&R costs $212,200. Energy costs were not estimated (Table 4.1). Total annual costs would be $14,441,200. The benefit/cost ratio would be 1.4.

## Enlarge Fresno Reservoir

Fresno's active conservation storage level could be enlarged by modifying or replacing the concrete-crest overflow spillway to accommodate gates. Modification of the spillway would allow more water to be stored in the reservoir. Design storage capacity of the reservoir was 130,000 AF; a recent survey, however, showed present capacity to be 93,000 AF, a loss of 37,000 AF of storage between 1937-1999, or about 500 AF/year.

### *Description*

Raising the crest 5 feet to elevation 2580 feet would increase storage to 95,400 AF, raising it 10 feet would increase storage to 129,200 AF, and raising the crest 20 feet would increase storage to 217,400 AF. All three possibilities were examined for this report. In addition, Reclamation is conducting a flood routing study to determine if raising the spillway crest would require other spillway modifications to handle floods safely.

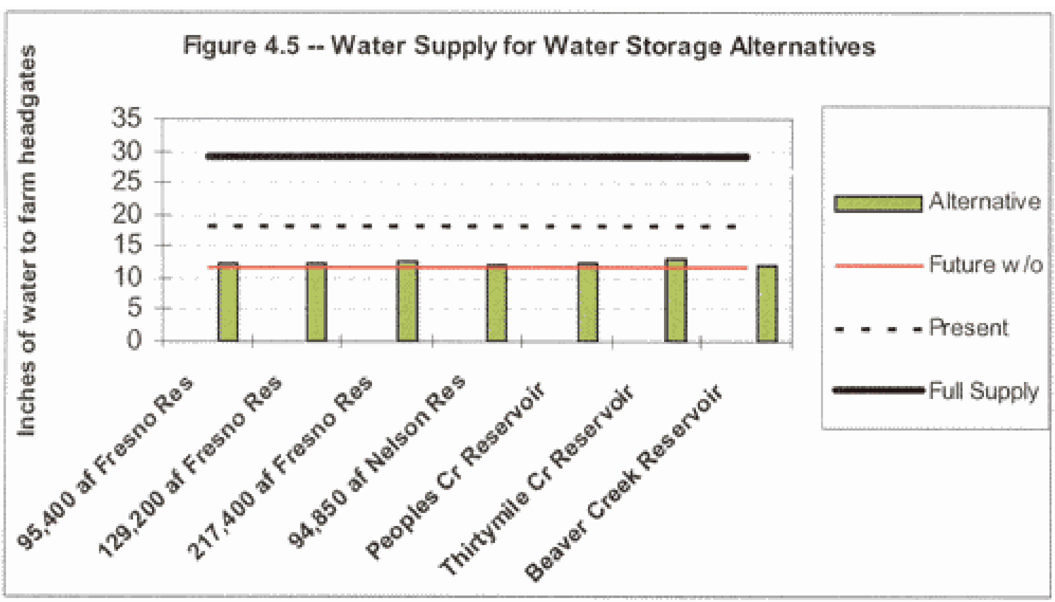
Little or no modification of the dam—besides the spillway and perhaps installation of seepage and piping protective measures on the downstream face— would be required.

### *Water Supply Contribution*

Total water delivered to farm headgates would vary from 12.20 inches/acre annually for the 95,400 AF capacity reservoir to 12.57 inches/acre annually for 217,400 AF capacity reservoir. In comparison to 11.82 inches/acre annually in the Future Without, this would mean an incremental benefit of from 0.38-0.75 inches/acre, respectively. This alternative would deliver less than the 29 inches/acre required for full crop production. Table 4.1 displays all three capacities, while Figure 4.5 shows the water supply for all alternatives in this category.

### *Issues*

All three reservoir capacities would have similar—and modest—effect in the Future Without the Project. By improving water supply in the Milk, this alternative would slightly improve the possibility that water would be available for MR&I supplies. Water quality in the Milk would be slightly improved by the slim increase in stream flows and less frequent dewatering. This alternative could contribute to implementation of the Fort Belknap Compact. Water could be provided somewhat more consistently to Bowdoin. Fisheries in Fresno would improve from more water if the reservoir were operated to realize this benefit. The alternative would slightly improve fish and wildlife habitat downstream by providing more flows more often, but peak spring flows might be reduced, adversely affecting fish species depending on these flows to cue spawning . The larger reservoir would improve recreational and hydro-power opportunities.




### *Economic Benefits*

Incremental crop yields would range from an increase of 0.04 tons/acre annually for the 95,400 AF capacity reservoir to 0.08 tons/acre annually for the 217,400 AF capacity reservoir, respectively. The 95,400 AF capacity would increase yields 5,867 tons/year basin wide, the 217,400 AF capacity 11,579 tons/year basin wide. This would equate to annual economic benefits of $505,000 for the smaller capacity, $996,000 for the largest capacity (Table 4.1).

### *Costs*

Storage capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are shown below.  Table 4.1 compares the alternatives in these respects.

| Storage Capacity | Total Investment | Annual OM&R | Annual Costs | Crop Yields | Annual Economic Benefits | B/C Ratio |
|---|---|---|---|---|---|---|
| 95,400 AF | $5,361,000 | $44,000 | $340,000 | 5,867 | $505,000 | 1.5 |
| 129,200 AF | $8,149,000 | $45,000 | $495,000 | 9,726 | $836,000 | 1.7 |
| 217,400 AF | $42,899,000 | $51,000 | $2,421,000 | 11,579 | $996,000 | 0.4 |

**Enlarge Nelson Reservoir**

Since more water is needed for users downstream of Nelson Reservoir, a means of storing additional water would be beneficial.

***Description***

This alternative would provide about 16,000 AF of additional storage in Nelson Reservoir, adding capacity by a dike at the upper end of the reservoir and adding riprap to the dike both on the upstream and downstream faces   The earthen dike would be located about 2,000 feet downstream of Dodson South Canal's discharge point into the reservoir at elevation 2245 feet.  It would span from the south ridge below the canal to the opposite ridge, thus creating an impoundment within the south drainage wash.  A 20-foot wide roadway on the crest of the dike and a 48-inch diameter outlet would be included in the facilities.  Normal downstream water elevation would be elevation 2222 feet, upstream maximum elevation 2240 feet.

***Water Supply Contribution***

Total water delivered to farm headgates in this alternative would be 11.87 inches/acre annually, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.05 inches/acre annually (Figure 4.5 and Table 4.1).  This would be less than the 29 inches/acre required for full crop production.

***Issues***

Because this alternative assumes that no St. Mary River water would be unavailable, it would provide only a small benefit to water supplies and little improvement to reliability of MR&I supplies in the basin.  It would provide operational flexibility at Nelson Reservoir, with good opportunity to improve habitat for the piping plover although water for Bowdoin would be provided somewhat less consistently.  This alternative would contribute slightly to implementation of the Fort Belknap Compact.  The Nelson fishery could benefit from more water if the reservoir were better managed for that purpose. Peak spring flows in the river might be reduced, adversely affecting fish species depending on this to cue spawning.  The larger reservoir might improve recreational opportunities in and around Nelson.

***Economic Benefits***

Incremental crop yields would increase 0.01 tons/acre annually, 772 tons/year basin wide.  This would equate to annual economic benefits of $66,000 (Table 4.1).

### *Costs*

Total investment costs were estimated to be $19,300,000, annual OM&R costs $30,000, with energy costs not estimated. Total annual costs would be $1,097,000. The benefit/cost ratio would be 0.1 (Table 4.1).

## Storage Reservoir on Peoples Creek

Three sites on tributaries of the Milk River—Peoples Creek, Thirty Mile Creek, and Beaver Creek—were examined as possible sites for storage reservoirs (Figure 4.6). Stored water would be released during the irrigation season.

### *Description*

Peoples Creek dam site is on the Fort Belknap Reservation southwest of Dodson. An earth fill dam 1,010-feet long, it would have a concrete-lined chute service spillway and a grass-lined auxiliary spillway. Crest height would be at elevation 2445 feet, the outlet at elevation 2330 feet. The reservoir behind the dam would cover 974 acres. This alternative would provide 34,900 AF of storage in the new reservoir.

### *Water Supply Contribution*

Total water delivered to farm headgates would be 12.27 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without. The incremental benefit would be 0.45 inches/acre annually (Figure 4.5 and Table 4.1). This would be less than the 29 inches/acre needed for full production.

### *Issues*

Any of the storage reservoir alternatives would contribute only modestly to water supplies in the basin, allowing for some more flexibility in project operations—with possible higher storage levels in Fresno and Nelson reservoirs—and improved reliability of MR&I supplies. Operational flexibility would allow improvement of Nelson operations to benefit the piping plover. By adding to water supplies, this alternative could contribute to implementation of the Fort Belknap Compact. Water could be provided more consistently to Bowdoin. The new reservoir could be managed for the fishery (and recreation) but perhaps at the expense of the native fishery in the river. This alternative would store spring runoff, thereby reducing peak spring flows, adversely affecting fish species depending on this to cue spawning. Water levels could be maintained higher in Fresno and Nelson later in the season, slightly improving recreational opportunities.

### *Economic Benefits*

Incremental crop yields would increase 0.05 tons/acre annually, 6,947tons/year basin wide. This would equate to annual economic benefits of $597,000 (Table 4.1).

### *Costs*

Total investment costs would be $37,608,000, annual OM&R costs $35,400. Energy costs were not estimated. Total annual costs would be $2,113,400. The benefit/cost ratio would be 0.3 (Table 4.1).

## Storage Reservoir on 30 Mile Creek

### *Description*

The dam on 30 Mile Creek would be situated about 9 miles upstream of Harlem, Montana, in Blaine County (Figure 4.6). An earth fill dam at this point would be 2,550 feet or 3,250 feet long, depending on whether the dam crest height was at elevation 2650 feet (the maximum height to avoid flooding a country road and bridge at the upper end of the reservoir) or 2665 feet (the maximum height obtainable at this site). Both crest heights were examined for this report. The spillway would be similar to that for Peoples Creek. A 36-inch diameter hand-operated concrete pipe would serve as the outlet. The reservoir behind the dam would cover 1,548 acres or 1,964 acres at maximum, depending on the crest height. Storage volume of the new reservoir would be 47,850 AF or 80,490 AF at maximum.

### *Water Supply Contribution*

Total water delivered to farm headgates in this alternative would be 12.92 inches/acre annually. It would be more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 1.10 inches/acre annually (Figure 4.5 and Table 4.1). This alternative would deliver less than the 29 inches/acre needed for full crop production.

### *Issues*

Issues would be similar to those described for a storage reservoir on Peoples Creek.

### *Economic Benefits*

Incremental crop yields would increase 0.11 tons/acre annually, 16,982 tons/year basin wide. This would equate to annual economic benefits of $1,460,000 (Table 4.1). This alternative would have flood control benefits also, but this is outside the scope of the present report.

### *Costs*

Total investment costs would be $44,011,000, annual OM&R costs $36,000, with energy costs not estimated. Total annual costs would be $2,468,000. The benefit/cost ratio would be 0.6 (Table 4.1).

## Storage Reservoir on Beaver Creek

### *Description*

The dam on Beaver Creek would be about 13 miles south of U.S. Highway 2 in Phillips County (Figure

4.6). Crest height of the earth fill dam would be at elevation 2255 feet, length 3,400 feet. The spillway would be similar to that for Peoples Creek, while a 24-inch diameter concrete pipe with hand-operated gate would serve at the outlet. The reservoir impounded by the dam would cover 1,290 acres at maximum. Storage volume in the new reservoir would be a maximum of 9,800 AF.

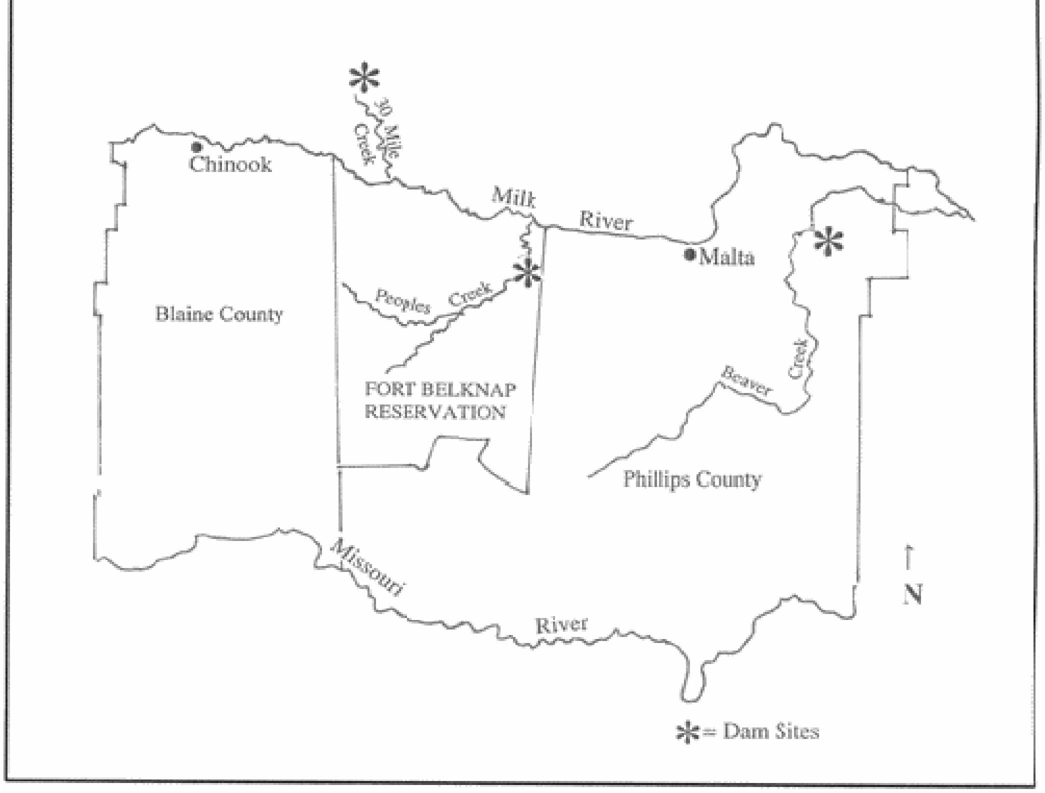
***Water Supply Contribution***

Total water delivered to farm headgates would be 12.09 inches/acre annually in this alternative, more than the 11.82 inches/acre annually in the Future Without, an incremental benefit of 0.27 inches/acre annually (Figure 4.5 and Table 4.1). It would be less than the 29 inches/acre needed for full crop production.

***Issues***

Issues would be similar to those described for a storage reservoir on Peoples Creek.

Figure 4.6 - Dam Sites on the Tributaries




***Economic Benefits***

Incremental crop yields would increase 0.03 tons/acre annually, 4,168 tons/year basin wide. This would equate to annual economic benefits of $358,000 (Table 4.1).

***Costs***

Total investment costs would be $17,814,000, annual OM&R costs $24,000. Energy costs were not estimated for this report. Total annual costs would be $1,008,000. The benefit/cost ratio would be 0.4 as shown in Table 4.1.

# WATER AUGMENTATION ALTERNATIVES

This category includes an alternative to enhance the St. Mary System, alternatives to construct a canal from the Missouri River to the Milk River via two different routes, and an alternative to construct a pipeline from Tiber Reservoir to Fresno Reservoir.

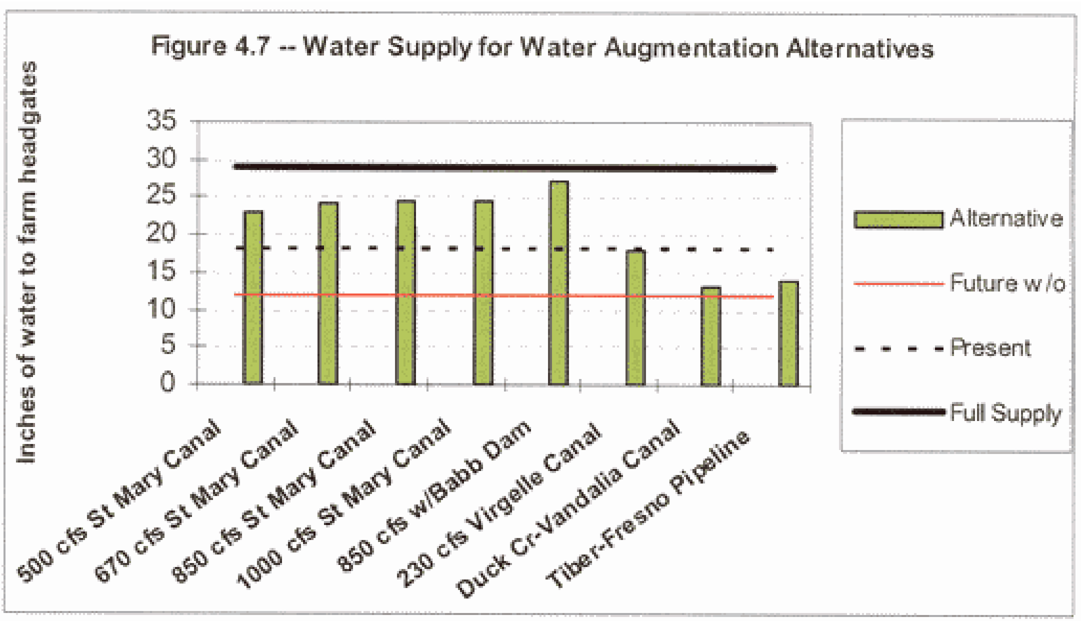
## St. Mary System Enhancements

### *Description*

Rehabilitation of existing facilities is the districts' O, M, & R responsibility. This alternative assumes that the canal system has been rehabilitated, that there are new facilities to keep bull trout out of the canal and add winter flows to Swiftcurrent Creek for benefit of the species. It also includes a small dam at Spider Coulee to flood part of the canal.

Two different canal capacities were examined: 500 cfs and 1,000 cfs, in addition to the present condition capacity and the original design capacity (Figure 4.7). In addition to enlarging or maintaining canal capacity, this alternative would include other work as well:

- Building a low flow outlet at Sherburne Dam
- Stabilizing of Swiftcurrent Creek's banks
- Building a fish passage around the diversion dam
- Building a fish screen at the canal intake
- Building new headworks




Building a dam at Willow Creek is a possibility, depending on the interest of the Blackfeet Tribe. It would flood a section of the St. Mary Canal. The new reservoir would be about 3 miles long (back to the upper end of Spider Lake) ¼-mile wide at its widest point. Storage at maximum water elevation of 4436 feet would be 5,080 AF, with a surface area of 235 acres.

### *Water Supply Contribution*

Total water delivered to farm headgates in the Milk River basin would vary from 23.02 inches/acre annually for the 500-cfs capacity canal to 24.58 inches/acre annually for the 1,000-cfs capacity (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of from 11.20-12.76 inches/acre annually for the 500-cfs and1,000-cfs capacities, respectively. This would be less than the 29 inches/acre needed for full crop production.

The flows in the St. Mary River would slightly decrease with the 850-cfs and 1,000-cfs capacity canals as more water would be diverted to the Milk.

Figure 4.7 shows the water supply for all of the alternatives in this category.

### *Issues*

All canal capacities including the existing and original design capacities would provide a significant contribution to water supplies in the Milk River basin. Reliability of MR&I supplies would significantly improve. Water would be available to allow for better management of the piping plover. Water quality in the Milk would be improved because more water would be left in the river. This alternative would benefit the Fort Belknap Compact and would also provide an opportunity to provide water towards settlement of the reserved water rights of the Blackfeet Tribe. Water could be provided more consistently to Bowdoin, and more water could be left in the Milk River and in the reservoirs to improve fish and wildlife habitat. Recreational opportunities would be improved as water levels in Fresno and Nelson reservoirs could be kept higher later in the season. The opportunity for economical hydro-power development at the St. Mary Canal drops and at Fresno Dam may improve.

Flows in the St. Mary River could be reduced, with potential adverse effects on the bull trout and other fish. Screening of the canal intake and a fish passage at the dam may be necessary to reduce these effects. Wildlife which use the canal and surrounding area as a travel corridor may be affected. Canal seepage would contribute to nearby wetlands, benefitting wildlife.

### *Economic Benefits*

Incremental crop yields would range from an increase of 1.14 tons/acre annually for the 500-cfs capacity canal to1.30 tons/acre annually for the 1,000-cfs capacity canal (Table 4.1) The 500-cfs capacity would increase yields 172,911 tons/year basin wide, the 1,000-cfs capacity 199,995 tons/year basin wide. This would equate to annual economic benefits of $14,870,000 for the smaller capacity, $16,942,000 for the largest capacity.

### *Costs*

Canal size in relation to costs, basin-wide increases in crop yields (in tons of alfalfa), annual economic benefits, and benefit-cost ratios can be summarized as follows:

| Canal Capacity | Total Investment | Annual OM&R | Annual Costs | Crop Yields | Annual Economic Benefits | B/C Ratio |
|---|---|---|---|---|---|---|
| 500 cfs | $82,000,000 | $136,000 | $4,666,000 | 172,900 | $14,870,000 | 3.2 |
| 670 cfs | $92,600,000 | $150,000 | $5,265,000 | 189,600 | $16,304,000 | 3.1 |
| 850 cfs | $102,000,000 | $165,000 | $5,800,000 | 195,600 | $16,822,000 | 2.9 |
| 1,000 cfs | $140,800,000 | $170,00 | $7,950,000 | 197,000 | $16,942,000 | 2.1 |

## Virgelle-Milk River Canal

Two earlier plans to convey Missouri River water to the Milk River were updated for the present report.

### *Description*

The Virgelle-Milk River Alternative would convey water from Virgelle on the Missouri River to the Milk River near Havre. The alternative would include a pumping plant at Virgelle (of a 175-cfs, 200-cfs, or 230-cfs capacity) about ½ mile upstream of Boggs Island (Figure 4.8). The pumping plant would draw water from the river via an infiltration gallery in the river bottom and convey it by a 66-inch diameter pipeline to a surge tank on the bluff, a static lift of 200 feet. From this point the water would flow into a 46-mile long canal following the old Northern

Figure 4.8 – Virgelle-Milk Canal Route and Tiber-Fresno Pipeline Route

Pacific Railroad's right-of-way. The canal would be about 12-feet wide at the bottom, 42-feet wide at the top, and 7½-feet deep. The drop into the Milk near Havre would be by a 60-inch diameter pipe abut 850 feet long after the water emptied into an energy-dissipating stilling basin.

#### *Water Supply Contribution*

Total water delivered to farm headgates would vary from 16.63 inches/acre annually for the 175-cfs capacity canal to 17.97 inches/acre annually for the 230-cfs capacity (Table 4.1 displays all three canal capacities). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of from 4.81-6.15 inches/acre annually for the 175-cfs and 230-cfs capacities, respectively (Table 4.1). This would be less than the 29 inches/acre needed for full crop production.

#### *Issues*

Effects would be similar for all three canal capacities. This alternative would significantly improve water supplies in the basin, benefitting irrigation and MR&I uses. Water levels could be kept higher in Fresno and Nelson Reservoirs, allowing for opportunities to benefit the piping plover. Due to high arsenic concentrations in Missouri River water, this alternative would probably violate State water quality standards. This alternative could contribute significantly to implementation of the Fort Belknap Compact and would also provide an opportunity to provide water towards settlement of reserved water rights of the Blackfeet Tribe. Water could be provided more consistently to Bowdoin. Higher water levels would improve fish and wildlife habitat in and around the reservoirs, and increased flows would improve fish and wildlife habitat in and along the Milk River. Wildlife would benefit from increased crop production.

Recreational opportunities would be improved with higher water levels in the reservoirs and greater stream flows in the river.

#### *Economic Benefits*

Incremental crop yields would range from an increase of 0.49 tons/acre annually for the 175-cfs capacity canal to 0.63 tons/acre annually for the 230-cfs capacity pumps (Table 4.1). The 175-cfs capacity would increase yields 74,259 tons/year basin wide, the 230-cfs capacity 94,947 tons/year basin wide. This would equate to annual economic benefits of $6,386,000 for the smaller capacity pumps, $8,165,000 for the largest capacity.

#### *Costs*

Canal capacities in relation to costs, crop yields, annual economic benefits, and benefit-cost ratios are show below. Table 4.1 compares the alternatives in all respects.

| Canal Capacity | Total Investment | Annual OM&R | Annual Costs | Crop Yields | Annual Economic Benefits | B/C Ratio |
|---|---|---|---|---|---|---|
| 175 cfs | $65,807,000 | $700,200 | $4,337,200 | 74,259 | $6,386,000 | 1.5 |
| 200 cfs | $72,015,000 | $873,400 | $4,853,400 | 84,140 | $7,236,000 | 1.5 |
| 230 cfs | $78,224,000 | $938,800 | $5,261,800 | 94,947 | $8,165,000 | 1.6 |

**Duck Creek-Vandalia Canal**

The other Missouri-River-Milk River route would convey water from Duck Creek in Fort Peck Reservoir to Vandalia near the end of the Milk River system.

***Description***

The Duck Creek-Vandalia Canal would divert Missouri River water from the South Fork Duck Creek Arm of Fort Peck Reservoir through the Vanadalia area to the Milk River (Figure 4.9). A channel about 100-feet long in the South Fork Duck Creek Arm would be needed. The 100-cfs canal would be 31 miles long.

A pumping plant would be included in the facilities in case the water level at Fort Peck fell below the canal elevation at 2200 feet.

The possibility of placing part—or all—of the route into pipe is also being investigated.

***Water Supply Contribution***

Total water delivered to farm headgates would be 13.13 inches/acre annually (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of 1.31 inches/acre annually. This would be less than the 29 inches/acre needed for full crop production.

***Issues***

Issues in this alternative would be similar to those of the Virgelle-Milk River Canal but lesser in degree. Due to high arsenic concentrations in Missouri River water, this alternative might violate State water quality standards as well.

***Economic Benefits***
Incremental crop yields would increase 0.13 tons/acre annually, an increase in yield of 20,224 tons/year basin wide (Table 4.1) This would equate to annual economic benefits of $1,739,000.

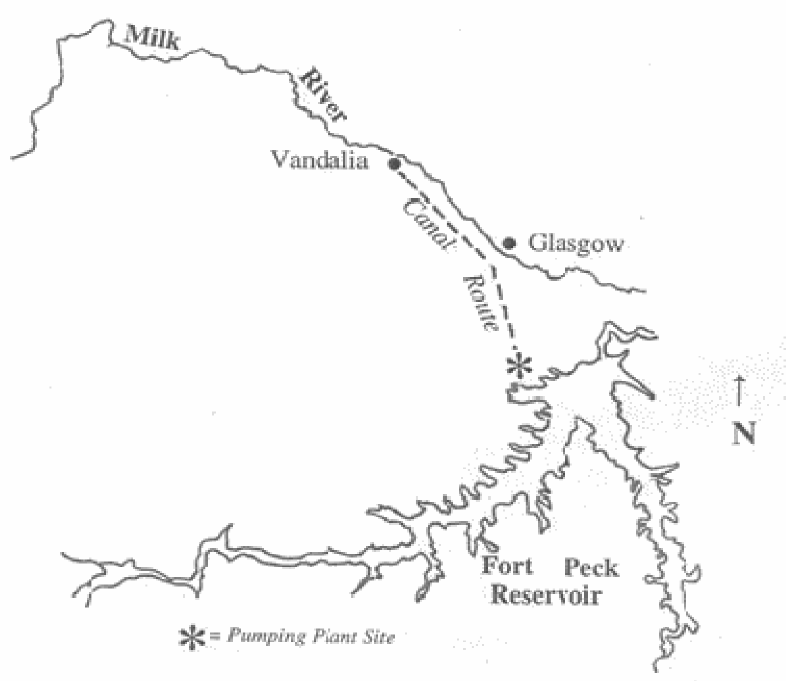


Figure 4.9 – Duck Creek-Vandalia Canal Route

***Costs***
Total investment costs would be $17,448,000, OM&R costs $33,000, and energy costs $193,000 (Table 4.1). Total annual costs would be $1,190,000. The benefit/cost ratio would be 1.5.

**Tiber-Fresno Reservoirs Pipeline**

Water would be piped from Tiber Reservoir on the Marias River to Fresno Reservoir on the Milk in this alternative (Figure 4.8)

***Description***
A pumping plant near Tiber Dam housing 4 500-hp pumps would lift water 60 feet from the reservoir's active conservation storage (elevation 2993-2966 feet). Total dynamic head would be 272 feet. From this point, water would be conveyed to just east of Chester, Montana. Here a booster pumping plant housing 4 450-hp pumps, would pump the water up a 200-foot high ridge. Total dynamic head of the water at this plant would be 221 feet.

From the booster plant, the 54-inch diameter pipeline would parallel U.S. Highway 2 for most of its 59.1 mile length. At Fresno Reservoir, it would empty into Grand Coulee. Capacity of the pipeline would be 50 cfs.

### *Water Supply Contribution*

Total water delivered to farm headgates in the Milk River basin would be 13.95 inches/acre annually (Table 4.1). In comparison to 11.82 inches/acre annually in the Future Without, this alternative would deliver an incremental benefit of 2.13 inches/acre annually. This alternative would have a slight negative effect on the water supply of the Marias. It would deliver less than the 29 inches/acre needed for full crop production.

### *Issues*

This alternative would improve water supplies in the basin, benefitting irrigation and MR&I uses. A greater water supply would allow water levels to be kept higher in the reservoirs later in the season, providing opportunities to better manage Nelson for the piping plover. Water quality in the Milk would be slightly improved by good quality water from Tiber allowing for higher streamflows in the Milk during the irrigation season, making dewatering less frequent. This alternative would contribute to implementation of the Fort Belknap Compact but would mean less water would be available from Tiber for settlement of reserved water rights of the Blackfeet Tribe. Water could be provided somewhat more consistently to Bowdoin. Higher water levels in the reservoirs later in the season would improve fish and wildlife habitat and greater flows would improve river fish and wildlife habitat. Recreational opportunities would be improved for the same reasons.

### *Economic Benefits*

Incremental crop yields would increase 0.22 tons/acre annually, an increase in yield of 32,884 tons/year basin wide (Table 4.1). This would equate to annual economic benefits of $2,828,000.

### *Costs*

Total investment costs would be $119,987,000, OM&R costs $220,000, and energy costs $1,032,000 (Table 4.1). Total annual costs would be $7,883,000. The benefit/cost ratio would be 0.4.

## ALTERNATIVES TO REDUCE DEMANDS

Non-structural alternatives seek to meet needs in the region by reducing demands. Two were developed for this report: buying irrigated lands to take them out of production and water marketing.

### Buying Lands

This alternative would entail buying lands presently irrigated and removing them from irrigated production. Data was gathered from the 1992 *Census of Agriculture*; Farm Credit Publications; interviews with county assessors, extension agents and agricultural credit institutions in Blaine, Phillips, and Valley counties for this analysis.

The *Census of Agriculture* recorded values for land and buildings of $170, $145 and $190/acre for Blaine, Phillips, and Valley County, respectively. Telephone conversations with Farm Credit appraisers in Glasgow and Lewistown, responsible for appraisals in the three counties, developed a more localize range of values for the Milk River area of from $480-$1,000/acre. Again, this was influenced by location and quality of both land and buildings. Also, lands closer to Glasgow showed some influence from the recreational values at Fort Peck Reservoir. Out in the Milk River valley where agricultural production is the primary influence, values ran from $480-$580/acre.

***Description***

This alternative would buy 80,000 acres of irrigated land. Irrigated acreage in the basin at present and the acreage in the Fort Belknap Compact total about 150,000 acres. The water supply in the Future Without could to this full acreage, but these lands would be receiving much less water than they are receiving at present. It would be inefficient as well as extremely difficult to deliver a small volume of water to these 150,000 acres. Irrigated acreage in the basin would need to be reduced to 70,000 acres in order for these acres to receive a water supply comparable to the present. Thus, 80,000 acres would need to be bought out of irrigation.

Blaine, Phillips, and Valley counties had 48,690, 42,443 and 38,699 acres of irrigated land, respectively, in the 1992 census on total farm sizes of 774,144, 730,203 and 654,082, acres, respectively. In total for the three counties, irrigation of 128,132 acres takes place on 6% of the 2,158,429 acres of farmland in irrigated farms in the counties.

***Water Supply Contribution***

This alternative would contribute to the water supply by reducing irrigation demand.

***Issues***

While not adding to the water supplies in the basin, this alternative might improve reliability of MR&I supplies if enough irrigated lands were taken out of production and water allocated specifically for this use. Effects on threatened and endangered species and water quality couldn't be estimated without knowing which lands would be bought. This alternative could contribute to implementation of the Fort Belknap Compact if enough lands were taken out of production and water allocated specifically for the purpose. Nelson could be out of operation in this alternative, so effects on water for Bowdoin couldn't be estimated. Water levels in Fresno would remain higher later in the season, benefitting reservoir fish and wildlife habitat. Recreational opportunities could be improved at Fresno.

***Economic Benefits***

This alternative could significantly affect the regional economy by reducing irrigated acres.

***Costs***

To remove 80,000 acres of irrigation from production would require purchasing a total of 1,360,000 acres at $182/acre, or $247,520,000. Reselling lands at the composite rate of $168/acre would yield $228,480,000. The net cost, exclusive of transactions costs which could be 6-10% of sales, would thus be $19,040,000.  Adding transaction costs of  $22,848,000 would bring the total to $41,888,000, or about $31/acre.

These costs presume lands could be bought at the average price, unlikely because transactions of this magnitude would drive up prices once the program were underway.  This would be particularly true in the three county area which has limited sales activity.  As the land were resold, the value of dryland farmland would fall, so the net spread could be considerably larger.

One outstanding fact ran across all of the comments of those contacted: land tenure in the valley was relatively stable with very little turnover of land.  In areas where agriculture is the prime influence, sales were usually estates sold to neighboring farmers.  This suggests that, while buying irrigated lands could be pursued, it might be difficult to find willing sellers.

**Water Marketing**

An alternative not given much consideration to this point is to let the marketplace equate water supply to demand.  This approach has been used successfully in other regions to solve water shortage and allocation problems (Anderson and Snyder, 1997).  Water marketing facilitates the selling/leasing of water rights between willing buyers and willing sellers.  Properly structured, a water market allocates the resource.

The Milk River basin would be a good location for water marketing because:

- Water rights in Montana are guided by *Prior Appropriation*, which gives the owner exclusive rights to use a given volume of water at a certain place and time, including the right to transfer this water right to others.  They are defined property rights that can be sold with the land or separately from it, leased, or changed in use. The State has recently allowed conversion to non-consumptive uses such as instream flow

- The Milk River basin has many right holders, with some already being traded but only under provision of Montana law, not in a directed market.  Water selling within an irrigation district might take place, but it would require further examination under what rules—district, Federal or State—it would apply

- The Milk River itself serves as a conveyance system, in addition to the facilities of the project

- Water is currently over-appropriated in the basin.  Settling reserved water rights and adjudicating other rights would leave some— if not most— junior water right holders with no quantified rights

- Alternatives to import water into the basin remain significantly more expensive than purchasing water from willing sellers.  Other possible sources of supply might create water quality concerns (the Missouri River) or might be limited in their ability to meet future needs (Tiber-Fresno Pipeline)

- Most water is used to grow irrigated hay and barley as feed for cattle

- Differences in crops, growing conditions and efficiency lead to different values attached to irrigation water in agricultural production. These differentials could lead to an incentive to lease water. For example, a farmer irrigating a small acreage of marginal land could find it advantageous to sell/lease his water right to a farmer with higher productivity land. Also there is demand for instream flows and recreational uses of water. Thus, agricultural water could be sold/leased for these purposes.

One necessity for the alternative to succeed would be to restructure or eliminate institutional barriers and establish institutions that facilitate water leasing or permanent transfer.

***Description***

Water user organizations and resource advocacy groups exist in the basin: the irrigation districts, which have also formed a Joint Board of Control; the Milk River International Alliance; Tribes; and possibly other groups. Probably none of these groups should run the water marketing program, but representatives could make up a committee (or committees) to direct input from the organizations to a controlling authority, or be part of a smaller committee for more localized exchange of information, etc.

Water Marketing in Idaho is run by the Idaho Water Resources Board, similar to DNRC (Idaho Department of Water Resources, 2002). There are two distinct categories of water in the Idaho Water Supply Bank: first, are natural flow rights which are controlled directly by the Board. The second category is stored water, which is in "rental pools" operated by local committees.

Within the framework of current Montana Law, water rights could be sold/leased, changed in their point of diversion, etc., as discussed above. Thus, for natural flow rights at least, part of the existing laws are similar to Idaho's. There is no formal water bank structure at DNRC, necessary for the formation of a directed market in both natural flow and storage rights. While no injury rules and other rules for marketing water rights would be applicable within the water bank at present, formation of the bank would allow water rights to be sold/leased and held in the bank for future sale or lease. Currently there is no mechanism for the State to collectively hold water rights for future sale/lease.

The only storage for the Milk River Project is Federal reservoirs: conceivably, one or more local rental pools could be developed around this storage.

Enabling legislation could help mesh the operation of a water market with existing rules for water rights. It would need to contain all necessary provision for deposit of water into the bank, payment for the water, charges for the water, including administrative costs, and so on. It should also make clear that operation of the banks or rental pools in no way restricted the marketing of rights between people outside of the bank, other than such transactions would still be subject to the State's approval.

The water bank or local rental pools would only be successful if the property rights to water sold/leased could be protected by precise measurement. In that respect, structural plans should take into consideration how system improvements might impact or aid operation of a water marketing system.

***Water Supply Contribution***

This alternative wouldn't contribute to the water supply.

### *Issues*

This alternative would allow the market to determine water use in the Milk River basin. Thus, more water could be available for any use, depending on the readiness of the government, Tribes, or private interests to pay for it. Effects of this alternative on any issues couldn't be estimated.

### *Economic Benefits*

Water marketing would probably provide economic benefits, but these couldn't be estimated at this point.

### *Costs*

Costs for this alternative were not estimated but might be investigated should this alternative be recommended for further study.

## MATRIX TABLE

Table 4.1 displays the alternatives in this chapter in a matrix, with alternatives listed down the left hand of the page. The first five columns show costs: *Total Construction Cost*, *Total Investment Costs*, *Annual OM&R Costs*, and *Annual Energy Costs*. The fifth column is the *Total Annual Cost* of the alternative, the sum of the other three costs annualized over the 50-year period of analysis. The next three columns present water delivered to *canal headgates* in an alternative, the same for the Future Without, and the incremental benefit of an alternative at the canal headgates, all in AF.

The three columns thereafter list the water delivered to the *farm headgates* in an alternative, the Future Without, and the incremental benefit of an alternative, all in acre/inches. Water delivered to the farm headgates was determined by comparing total water delivered to the farm headgate with an alternative to the Future Without, assuming a canal efficiency of 50% for all the alternatives except the Canal Efficiency Improvements Alternative, where 60% of water diverted at the canal headgates would be delivered to the farm headgates. The on-farm efficiency is listed in the next column.

The next three columns show incremental crop yield (in tons of alfalfa/acre/year), incremental basin-wide crop yield (tons/year), and incremental annual economic benefits ($). The incremental crop yield was determined by comparing the additional water made available to the crop root zone by an alternative to the same for the Future Without. This column assumes 50% on-farm efficiency except for the On-Farm Efficiency Improvement Alternative, where the efficiency is 55%. To determine incremental annual crop yield, additional water provided to farm headgates by an alternative was converted to tons of alfalfa. Based on agronomy and local climate, it takes about 4.9 inches of water available to the plant to produce a ton of alfalfa/acre (Bauder, 2002). Water available to the crop at farm headgates was reduced by 50% to account for on-farm inefficiencies. The basin wide crop yield was determined by multiplying per acre increases by the total number of acres in the basin.

**Table 4.1**

## Preliminary Appraisal Matrix of Alternatives for North Central Montana Study

| Alternative | Total Construction Cost ($) | Total Investment Cost ($) | Annual Construction Costs ($/yr) | Annual Operation, Maintenance and Replacement Costs ($/yr) | Annual Energy Costs ($/yr) 50 mil | Total O&M ($/yr) | Total Annual Costs ($/yr) | Total delivered to Canal Headgate (ac-ft) | Future without a Project Water Delivery (ac-ft) | Incremental Benefits: Water Delivered @ Canal Headgate (ac-ft) | Total delivered to Farm Headgate (in/ac) | Future without a Project Water Delivery (in/ac) | Incremental Benefits: Water Delivered @ Farm Headgate (in/ac) | On-farm Efficiency | Incremental Crop Yield (ton/ac/yr) | Incremental Basin-Wide Crop Yield (tons/year) | Incremental Annual Economic Benefits | Benefit/Cost Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Present Base-Line | | | | | | | | XXXXX | | | 18.12 | | | 0.43 | | | | |
| Future without a Project | | | | | | | | | 216,172 | | | 11.82 | | 0.50 | | | | |
| **Improve Water Operations and Management** | | | | | | | | | | | | | | | | | | |
| 5% On-Farm Eff. Impro. | $ 10,600,000 | $ 10,600,000 | $ 586,000 | $ 61,162 | $ 57,240 | $ 118,402 | $ 704,402 | 203,291 | 216,172 | -12,881 | 11.19 | 11.82 | -0.63 | 0.55 | 0.05 | 7,549 | $ 649,000 | 0.9 |
| River Operation Impro. | $ 100,000 | $ 100,000 | $ 6,000 | $ 245,000 | | $ 245,000 | $ 251,000 | | | | | | | | | | | |
| Canal System Eff. Impro. | $ 12,920,000 | $ 12,920,000 | $ 714,000 | $ 34,800 | $ 66,000 | $ 100,800 | $ 814,800 | 207,803 | 216,172 | -8,369 | 12.50 | 11.82 | 0.68 | 0.50 | 0.07 | 10,498 | $ 903,000 | 1.1 |
| Nelson Reservoir Management | | | | | | | | | | | | | | | | | | |
| 6-CFCS Pumping Plant | $ 2,907,000 | $ 3,046,000 | $ 168,000 | $ 3,400 | $ 21,000 | $ 24,400 | $ 192,400 | 219,190 | 216,172 | 3,018 | 11.95 | 11.82 | 0.13 | 0.50 | 0.01 | 2,007 | $ 173,000 | 0.9 |
| 25-CFS Pumping Plant | $ 3,800,000 | $ 3,907,000 | $ 216,000 | $ 18,700 | $ 55,600 | $ 74,300 | $ 290,300 | 220,827 | 216,172 | 4,655 | 12.02 | 11.82 | 0.20 | 0.50 | 0.02 | 3,088 | $ 266,000 | 0.9 |
| 50-CFS Pumping Plant | $ 4,995,000 | $ 5,136,000 | $ 284,000 | $ 24,300 | $ 80,600 | $ 104,900 | $ 388,900 | 225,352 | 216,172 | 9,180 | 12.30 | 11.82 | 0.48 | 0.50 | 0.05 | 7,410 | $ 637,000 | 1.6 |
| 75-CFS Pumping Plant | $ 5,922,000 | $ 6,089,000 | $ 336,000 | $ 27,300 | $ 90,500 | $ 117,800 | $ 453,800 | 228,786 | 216,172 | 12,614 | 12.47 | 11.82 | 0.65 | 0.50 | 0.07 | 10,035 | $ 863,000 | 1.9 |
| 100-CFS Pumping Plant | $ 7,411,000 | $ 7,620,000 | $ 421,000 | $ 30,400 | $ 106,000 | $ 136,400 | $ 557,400 | 231,796 | 216,172 | 15,624 | 12.63 | 11.82 | 0.81 | 0.50 | 0.08 | 12,505 | $ 1,075,000 | 1.9 |
| 150-CFS PumpingPlant | $ 9,189,000 | $ 9,449,000 | $ 522,000 | $ 35,300 | $ 131,000 | $ 166,300 | $ 688,300 | 236,391 | 216,172 | 20,219 | 12.86 | 11.82 | 1.04 | 0.50 | 0.11 | 16,056 | $ 1,381,000 | 2.0 |
| Dodson South Canal Enhancements | | | | | | | | | | | | | | | | | | |
| 600-CFS Canal | $ 5,200,000 | $ 5,347,000 | $ 295,000 | $ 7,000 | | $ 7,000 | $ 302,000 | 223,090 | 216,172 | 6,918 | 12.13 | 11.82 | 0.31 | 0.50 | 0.03 | 4,786 | $ 412,000 | 1.4 |
| 700-CFS Canal | $ 10,500,000 | $ 10,797,000 | $ 597,000 | $ 7,300 | | $ 7,300 | $ 604,300 | 226,071 | 216,172 | 9,899 | 12.29 | 11.82 | 0.47 | 0.50 | 0.05 | 7,256 | $ 624,000 | 1.0 |
| 800-CFS Canal | $ 16,500,000 | $ 16,966,000 | $ 938,000 | $ 7,700 | | $ 7,700 | $ 945,700 | 227,942 | 216,172 | 11,770 | 12.38 | 11.82 | 0.56 | 0.50 | 0.06 | 8,646 | $ 744,000 | 0.8 |
| | | | | | | | | | | | | | | | | | 0 | |
| Vandalia Re-Regulation Reservoir | $ 1,400,000 | $ 1,400,000 | $ 77,000 | $ 9,200 | $ 2,100 | $ 11,300 | $ 88,300 | 215,367 | 216,172 | -805 | 11.94 | 11.82 | 0.12 | 0.50 | 0.01 | 1,853 | $ 159,000 | 1.8 |
| **Non-Structural** | | | | | | | | | | | | | | | | | | |
| Purchase Water Rights | | $ - | $ - | | | | $ - | | | | | | | | | | 0 | |
| Water Market | | $ - | $ - | | | | $ - | | | | | | | | | | 0 | |
| **Improve Water Storage** | | | | | | | | | | | | | | | | | | |
| Enlarge Fresno Reservoir | | | | | | | | | | | | | | | | | | |
| 95,400 Acre Feet | $ 5,000,000 | $ 5,361,000 | $ 296,000 | $ 44,000 | | $ 44,000 | $ 340,000 | 223,780 | 216,172 | 7,608 | 12.20 | 11.82 | 0.38 | 0.50 | 0.04 | 5,867 | $ 505,000 | 1.5 |
| 129,200 Acre Feet | $ 7,600,000 | $ 8,149,000 | $ 450,000 | $ 45,000 | | $ 45,000 | $ 495,000 | 228,789 | 216,172 | 12,617 | 12.45 | 11.82 | 0.63 | 0.50 | 0.06 | 9,726 | $ 836,000 | 1.7 |
| 217,400 Acre Feet | $ 40,000,000 | $ 42,889,000 | $ 2,370,000 | $ 51,000 | | $ 51,000 | $ 2,421,000 | 231,339 | 216,172 | 15,167 | 12.57 | 11.82 | 0.75 | 0.50 | 0.08 | 11,579 | $ 996,000 | 0.4 |
| Nelson Enlargement | $ 18,000,000 | $ 19,300,000 | $ 1,067,000 | $ 30,000 | | $ 30,000 | $ 1,097,000 | 216,293 | 216,172 | 121 | 11.87 | 11.82 | 0.05 | 0.50 | 0.01 | 772 | $ 66,000 | 0.1 |
| Tributary Storage | | | | | | | | | | | | | | | | | | |
| Peoples Creek Dam | $ 35,890,000 | $ 37,608,000 | $ 2,078,000 | $ 35,400 | | $ 35,400 | $ 2,113,400 | 225,091 | 216,172 | 8,919 | 12.27 | 11.82 | 0.45 | 0.50 | 0.05 | 6,947 | $ 597,000 | 0.3 |
| 30 Mile Creek Dam | $ 42,000,000 | $ 44,011,000 | $ 2,432,000 | $ 36,000 | | $ 36,000 | $ 2,468,000 | 238,282 | 216,172 | 22,110 | 12.92 | 11.82 | 1.10 | 0.50 | 0.11 | 16,982 | $ 1,460,000 | 0.6 |
| Bever Creek Dam | $ 17,000,000 | $ 17,814,000 | $ 984,000 | $ 24,000 | | $ 24,000 | $ 1,008,000 | 221,616 | 216,172 | 5,444 | 12.09 | 11.82 | 0.27 | 0.50 | 0.03 | 4,168 | $ 358,000 | 0.4 |
| **Augment Water Supply** | | | | | | | | | | | | | | | | | | |
| St. Mary's Enhancements | | | | | | | | | | | | | | | | | | |
| 500 CFS | $ 75,150,000 | $ 81,973,000 | $ 4,530,000 | $ 136,000 | | $ 136,000 | $ 4,666,000 | 444,049 | 216,172 | 227,877 | 23.02 | 11.82 | 11.20 | 0.50 | 1.14 | 172,911 | $ 14,870,000 | 3.2 |
| 670 CFS | $ 84,850,000 | $ 92,554,000 | $ 5,115,000 | $ 150,000 | | $ 150,000 | $ 5,265,000 | 465,779 | 216,172 | 249,607 | 24.10 | 11.82 | 12.28 | 0.50 | 1.25 | 189,584 | $ 16,304,000 | 3.1 |
| 850 CFS | $ 90,550,000 | $ 101,932,000 | $ 5,633,000 | $ 165,000 | | $ 165,000 | $ 5,798,000 | 473,413 | 216,172 | 257,241 | 24.49 | 11.82 | 12.67 | 0.50 | 1.29 | 195,605 | $ 16,822,000 | 2.9 |
| 1000 CFS | $ 125,050,000 | $ 140,768,000 | $ 7,779,000 | $ 170,000 | | $ 170,000 | $ 7,949,000 | 475,071 | 216,172 | 258,899 | 24.58 | 11.82 | 12.76 | 0.50 | 1.30 | 196,995 | $ 16,942,000 | 2.1 |
| Babb Dam with a 850 cfs Canal | $ 228,734,000 | $ 257,485,000 | $ 14,229,000 | $ 212,200 | | $ 212,200 | $ 14,441,200 | 531,812 | 216,172 | 315,640 | 27.30 | 11.82 | 15.48 | 0.50 | 1.58 | 238,988 | $ 20,553,000 | 1.4 |
| Virgelle Canal | | | | | | | | | | | | | | | | | | |
| 175 cfs | $ 58,459,000 | $ 65,807,000 | $ 3,637,000 | $ 181,000 | $ 519,200 | $ 700,200 | $ 4,337,200 | 314,247 | 216,172 | 98,075 | 16.63 | 11.82 | 4.81 | 0.50 | 0.49 | 74,259 | $ 6,386,000 | 1.5 |
| 200 cfs | $ 63,974,000 | $ 72,015,000 | $ 3,980,000 | $ 191,000 | $ 682,400 | $ 873,400 | $ 4,853,400 | 327,339 | 216,172 | 111,167 | 17.27 | 11.82 | 5.45 | 0.50 | 0.56 | 84,140 | $ 7,236,000 | 1.5 |
| 230 cfs | $ 69,489,000 | $ 78,224,000 | $ 4,323,000 | $ 197,000 | $ 741,800 | $ 938,800 | $ 5,261,800 | 341,773 | 216,172 | 125,601 | 17.97 | 11.82 | 6.15 | 0.50 | 0.63 | 94,947 | $ 8,165,000 | 1.6 |
| Duck Ck. -Vandalia | $ 15,500,000 | $ 17,448,000 | $ 964,000 | $ 33,000 | $ 193,000 | $ 226,000 | $ 1,190,000 | 242,210 | 216,172 | 26,038 | 13.13 | 11.82 | 1.31 | 0.50 | 0.13 | 20,224 | $ 1,739,000 | 1.5 |
| Tiber-Fresno Pipeline | $ 110,000,000 | $ 119,987,000 | $ 6,631,000 | $ 220,000 | $ 1,032,000 | $ 1,252,000 | $ 7,883,000 | 258,945 | 216,172 | 42,773 | 13.95 | 11.82 | 2.13 | 0.50 | 0.22 | 32,884 | $ 2,828,000 | 0.4 |

Incremental basin-wide crop yield was computed by multiplying the increase in crop yield/acre for an alternative by the total number of acres in the basin for each alternative, assuming a total of 151,300 irrigated acres in the basin including full development of the Fort Belknap Compact. The last column is a comparison of the benefits estimated for an alternative in relation to the costs of the alternative, the benefit/cost ratio.

## ALTERNATIVES CONSIDERED BUT DROPPED

### Bowdoin National Wildlife Refuge

Bowdoin National Wildlife Refuge has a storage capacity of about 26,000 AF in various ponds and impoundments. Part of that storage could be used to store project water, both to the benefit of Bowdoin and project irrigators. Reclamation developed preliminary costs for rehabilitation of existing facilities and construction of additional facilities to help manage water in the refuge. Costs were estimated to be $4,500,000.

This alternative was dropped due to a conflict with management goals of the refuge. To maximize food production for waterfowl, electrical conductivity of 5,000 µS/cm (micro-Siemens/centimeter) of the water is required. This conductivity level is above that acceptable for discharging water from Lake Bowdoin into Beaver Creek. If the refuge was a storage reservoir operated at under 1,000 µS/cm, water use and production probably would drop significantly because of the lack of preferred food.

At present, Bowdoin is prohibited by DEQ from discharging water from the refuge because of the high concentrations of salts in the impoundments.

### Storage Reservoir at Willow Creek

Construction of a storage reservoir in the Willow Creek drainage in Valley County was suggested by residents. This alternative was dropped from consideration due to the highly erodible soils in the watershed. Previous studies conducted by the USGS have measured sediment yields in the basin ranging from 0.09-2.00 AF/square mile/year. The value of a reservoir would rapidly decrease as available storage space were filled with sediment. Treatment of uplands and the river channel would be required in order to make the reservoir feasible.

### Dredging Fresno Reservoir

Dredging Fresno Reservoir to regain lost storage was suggested as an alternative for this study. Average loss of reservoir storage due to sediment is about 500 AF, or about 807,000 cubic yards of material, a year. While no specific analysis was done on costs of dredging and disposing of the material, it is believed that the annual economic cost would far outweigh the benefits.

# PROMISING ALTERNATIVES
# Chapter 5

This study found no single alternative in this report would meet irrigation demands of the Milk River Project and MR&I (municipal, rural, and industrial) needs of north central Montana, mitigate for reserved water rights, and allow the opportunity to provide irrigation for junior water right holders, threatened and endangered species, water quality, fish and wildlife, recreation, and hydro-power development. Six of the alternatives, however, could improve the irrigation water supply and benefit related issues. These are included in the "Promising Alternatives" section below, with costs and benefits summarized in Table 5.1 at the end of this chapter.

Four of the alternatives appear worthy of further consideration but won't be carried forward in the present study because they don't solve the irrigation water supply needs of the Milk River basin. Implementation of these alternatives should be considered by local interests.

The rest of the alternatives would neither contribute to the irrigation water supply or benefit issues in relation to their costs. These alternatives can be found in "Alternatives Dropped from Consideration" section.

Following the "Promising Alternatives" section, these alternatives are also shown in combination as examples of how they could complement one another. Combinations of alternatives were developed from the alternatives that appeared to fit together best. Further work would be required to determine if other combinations of alternatives were more worthwhile. Table 5.2 at the end of the chapter shows costs and benefits of the combined alternatives.

## PROMISING ALTERNATIVES

Based on updated hydrological modeling, benefits, and costs, six of the alternatives in this study show the most potential for meeting irrigation water supply needs. The effect of the alternatives to address the issues is discussed in Chapter 6.

### Irrigation Water Supply

The hydrology model was updated with the latest crop water use and canal information to evaluate the alternatives. Water delivered to the crops with current irrigation practices in the basin was determined to be 10 in/ac, or 23.8 in/ac at the farm headgates when on-farm efficiencies are factored in. Revision of crop water use and canal efficiencies changed the water supply from the Future Without the Project Condition described in Chapter 4. The Future Without assumed water users should have an opportunity to deliver a full water supply to the crop, or about 17.5 in/ac to the crop, 34.8 in/ac to the farm headgates. This is considerably more than the 29 in/ac at farm headgates discussed in Chapter 4.

Canal efficiencies were determined to range from 50-65%. Canal efficiencies in the Future Without were assumed to be 60% unless presently operated at a higher efficiency. Canals with a present efficiency of 65% were assumed to have no increase.

Water delivered to the farm headgates in the Future Without is 13.1 in/ac, about half the volume delivered for current irrigation practices in the basin and about 40% of the full crop demand. Average annual water shortage is 63% of the average annual diversion requirement. All of the 10 year periods exceeded the water shortage criteria explained in Chapter 3. The shortage criteria was exceeded about two-thirds of the time for current irrigation practices.

Values of the alternatives are comparable within a chapter, but water estimated to be delivered to farm headgates or to crops in Chapter 4 isn't comparable to these values in Chapter 5.

**Benefits**

The farm budget method was used to estimate irrigation benefits for this study, as with the *North Central Montana Alternatives Scoping Document* (U.S. Bureau of Reclamation, 2003). With this method, two farm enterprise budgets were done: one represented the typical full time farm in the region without irrigation, while the other showed the same farm with irrigation. The budget for the "Without Irrigation" farm had a different cropping pattern than the "With Irrigation" farm. Land investment remained the same–the farms were the same size–but some machinery was sold when the land returned to dryland farming. Total benefits were $38.87/acre.

Initial farm budgets in Chapter 4 showed $85.96/acre benefits of irrigation. The $47.09/acre change is attributable to changes in total expenses of the without irrigation farm in comparison to the with irrigation farm. This caused agricultural benefits for water to decline substantially.

Only agricultural benefits were estimated; other direct and indirect economic benefits such as MR&I and recreation were not quantified in this study, although they would probably add to net economic benefits.

**Costs**

Estimated costs of these alternative have been refined since the costs displayed in Chapter 4. Changes are a result of the refinement of the earlier estimates, revisions of unit costs for components, and a more consistent approach for the costs of mobilization, unlisted items, contingencies, and other costs. Costs are in 2003 dollars. Total investment cost is based on an interest rate of 5.875%.

Except for one exception, cost estimates don't include mitigation for environmental effects that might be experienced since the NEPA (National Environmental Policy Act) compliance has not been done. The exception is the St. Mary System Enhancements Alternative: it includes modifications necessary to accommodate the bull trout.

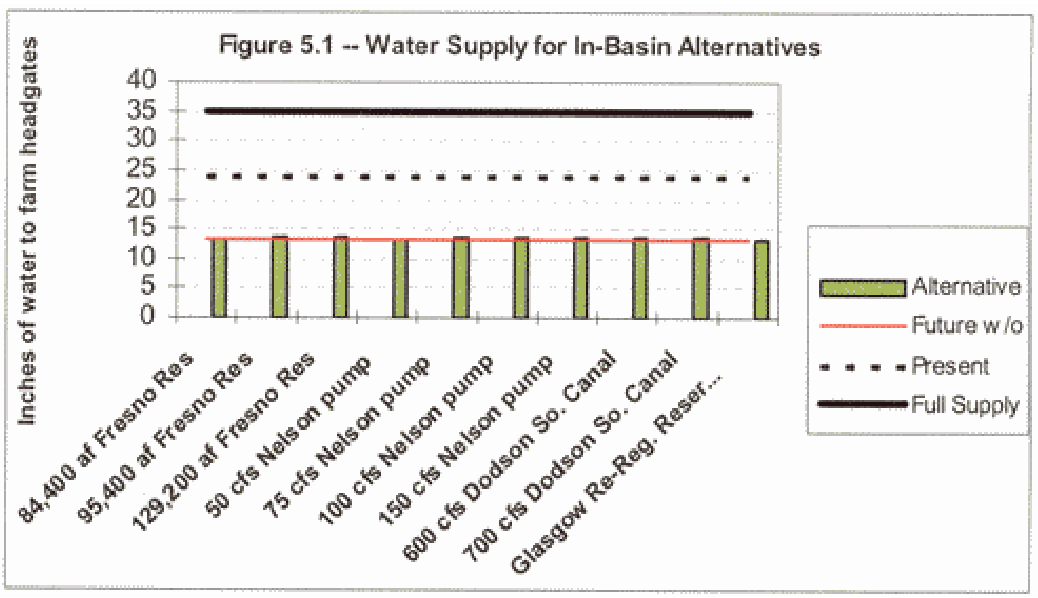
**Nelson Pumping Plant**

This alternative by itself would provide only a modest improvement in the water supply, another 4,600-9,700 AF annually at the canal headgates for pump sizes from 50-150 cfs (Figure 5.1). Costs and benefits of the different pumping plant capacities are shown below (negative numbers in red). Table 5.1 summarizes costs and benefits.

| | Total Investment | Annual OM&R | Annual Costs | Annual Economic Benefits | Net Economic Benefits |
|---|---|---|---|---|---|
| 50 cfs Pumping Plant | $5,146,000 | $104,900 | $407,900 | $139,000 | ($268,900) |
| 75 cfs Pumping Plant | $6,101,000 | $117,800 | $477,800 | $197,000 | ($280,000) |
| 100 cfs Pumping Plant | $7,635,000 | $136,400 | $586,400 | $238,000 | ($348,400) |
| 150 cfs Pumping Plant | $9,467,000 | $166,300 | $724,300 | $313,000 | ($411,300) |

**Dodson South Canal Enhancements**

Enlarging the Dodson South Canal from 500 cfs to 600 or 700 cfs would provide modest improvement to water supplies in the basin, an average of about 4,500-9,100 AF annually at the canal headgates (Figure 5.1).



Costs and benefits of the various canal capacities are shown below, with negative numbers in red. Table 5.1 summarizes costs and benefits.

| | Total Investment | Annual OM&R | Annual Costs | Annual Economic Benefits | Net Economic Benefits |
|---|---|---|---|---|---|
| 600 cfs Canal | $5,556,000 | $7,000 | $335,000 | $133,000 | ($202,000) |
| 700 cfs Canal | $11,344,000 | $7,300 | $676,300 | $296,000 | ($380,300) |

Unit costs for excavation and backfill compaction remained the same as in the *Alternatives Scoping Document*, while costs for mobilization and non-contract items were changed.

**Glasgow Irrigation District**
**Re-Regulation Reservoir**

Although this alternative would contribute little to water supplies in the basin (Figure 5.1), it would improve delivery efficiency and crop production in the Glasgow Irrigation District. Based on new survey information, the reservoir was enlarged to 32 surface acres (from 18 acres in the *Alternatives Scoping Document*), containing 180 AF of storage (from 130 AF). The costs of $1,650,000 reflect a feasibility level estimate for this alternative. This alternative would decrease the canal headgate diversions by 1,200 AF, attributable to a decrease in need due to the increased efficiency this alternative would provide.

Table 5.1 summarizes costs and benefits.

**Enlarge Fresno Reservoir**

This alternative by itself would provide a modest improvement in the basin's water supply, another 4,700-12,500 AF annually at the canal headgates (Figure 5.1). Benefits would increase significantly when combined with St. Mary System Enhancements, however. Costs and benefits of the various heights of raising the crest of the dam are shown below. Negative figures are shown in red.

| | Total Investment | Annual OM&R | Annual Costs | Annual Economic Benefits | Net Economic Benefits |
|---|---|---|---|---|---|
| 3 foot raise | $2,694,000 | $43,000 | $202,000 | $139,000 | ($63,000) |
| 5 foot raise | $10,774,000 | $44,000 | $679,000 | $220,000 | ($459,000) |
| 10 foot raise | $14,545,000 | $45,000 | $902,000 | $377,000 | ($525,000) |

Costs for Fresno Enlargement are based on the ability to maintain the integrity of the dam while allowing the modification. A flood frequency analysis was done, but the risk analysis hasn't been completed to determine if a shorter occurrence interval than the PMF (probable maximum flood) would be acceptable. Estimated costs based on the shorter occurrence interval would probably be less than on the PMF. A feasibility level analysis of this alternative would have to be done.

Thousand-year, ten thousand-year, and fifty thousand-year floods were modeled through the reservoir to determine effects of the 3-foot, 5-foot, and 10-foot raises of the dam's ogee crest. The 3-foot raise would pass all three floods without overtopping the dam and would pass the 1,000 year and 10,000 year floods without hitting the spillway bridge. The 5-foot raise would pass the 1,000 year and 10,000 year floods without overtopping the dam. It would pass the 1,000 year flood without hitting the spillway bridge. The 10-foot raise would pass the 1,000 year flood without overtopping but not without hitting the spillway bridge.

Costs and benefits of this alternative are summarized in Table 5.1.

**St. Mary System Enhancements**

This alternative—regardless of the canal capacity ultimately chosen—would provide the most significant improvement to the MIlk River basin water supply, along with the greatest increase in economic benefits to the region (Figure 5.2). Another 223,000-256,000 AF (acre-feet) of water annually would be available for diversion at canal headgates. Costs and benefits for the various canal capacities are shown below. Costs for all four include a low flow outlet at Sherburne Dam, stabilization of Swiftcurrent Creek, and control of sediment entering Lower St. Mary Lake. Replacement of existing St. Mary Canal system structure is the districts' O, M, & R responsibility. The costs are shown for comparison purposes.

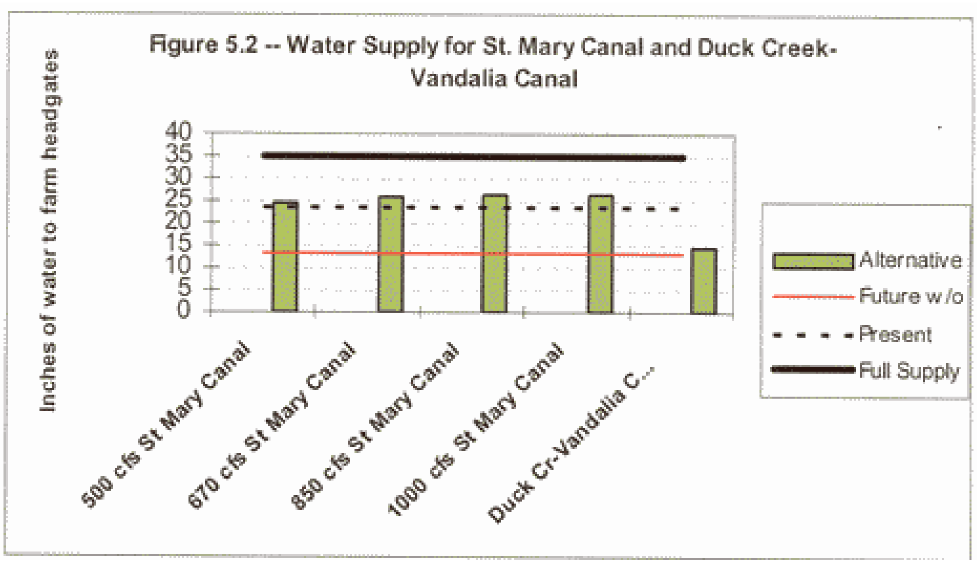
| | Total Investment | Annual OM&R | Annual Costs | Annual Economic Benefits | Net Economic Benefits |
|---|---|---|---|---|---|
| 500 cfs Canal | $88,030,000 | $136,000 | $5,325,00 | $6,754,000 | $1,429,000 |
| 670 cfs Canal | $95,734,000 | $150,000 | $5,793,000 | $7,490,000 | $1,697,000 |
| 850 cfs Canal | $109,331,000 | $165,00 | $6,610,000 | $7,681,000 | $1,071,000 |
| 1,000 cfs Canal | $119,951,000 | $170,000 | $7,241,000 | $7,733,000 | $492,000 |

Costs for this alternative were revised from Chapter 4. Changes include modification of costs for the Sherburne Dam low-flow outlet, Swiftcurrent Creek stabilization, and Lower St. Mary Lake sedimentation abatement.

The storage system features costs levels are at an appraisal level. Feasibility level cost estimates were prepared for delivery system features. These cost estimates were based on additional information collected from geology investigations, fisheries studies, and engineering studies. Details can be found in the separate appendix volume.

Costs and benefits are summarized in Table 5.1.

**Duck Creek-Vandalia Canal**




This alternative would provide a modest improvement in the water supply, providing an average of 28,600 AF annually for diversion at the canal headgates (Figure 5.2).

Cost revisions include changes to the unit cost of pipe, common excavation, and backfill, as well as how mobilization and non-contract costs were computed. The appraisal level estimate for this alternative is $22,625,000.

**Alternatives Worthy of Local Consideration**

While these four alternatives might be worthy of further consideration, they are being dropped from consideration in the present study. The On-Farm Efficiency Improvements, River Operations Improvements, Canal Efficiency Improvements, and Water Marketing alternatives would contribute to improved water management, irrigation productivity, regional economy, water quality, and fish and wildlife. Implementation of these alternatives should be considered by local interests.

A significant cause of irrigation water supply shortages in the basin is the limited capacity of the canals and laterals, restricting delivery of water to farms during periods of peak demand. This results in reduced crop production. On-farm and canal efficiency improvements would substantially reduce this bottleneck.

Photo 5.1 - Canal lining project in the Zurich Irrigation District.

Farmers electing to invest in on-farm or canal efficiency improvements could expect to see greater crop production from better use of water and fertilizer. It's generally expected that interests that invest time and money in efficiency improvements will probably use the saved water to increase production on their lands. Similarly, irrigation districts whose members choose to invest in delivery system improvements would probably expect greater water deliveries to their farm headgates.

Since the basin is typically short of water, with irrigation demands seldom, if ever, being met, water saved by efficiency improvements would be used by crops rather than returning to the river to be used by others, resulting in depletion of water, and since the limited opportunity to implement improvements would produce unequal benefits to water users in the basin, they won't be considered further in this study.

Improvements in river operations have been implemented and will probably continue independent of this study.  More gauging stations have been installed in the basin, and present stations have been upgraded to provide accurate, "real-time" water delivery and river flows information.  A full time river manager to guide further implementation is being pursued independently.

The Water Marketing Alternative would allow the marketplace to match water supply with water demands in the basin.  It has been successful in other parts of the country.  By facilitating the selling or leasing of water rights between willing sellers and buyers, water marketing might contribute substantially to the basin economy, providing incentives to lease water to lands of higher productivity, higher value crops, or for uses other than irrigation.  Since water is over-appropriated and since adequate storage and delivery facilities exist, the Milk River basin would be a good candidate for the first formal water market in Montana.  Implementation would require continued improvements in river operations and removal of institutional barriers in the law like Federal land classification regulations to allow the market to fully function.  Water marketing could be implemented exclusive of other alternatives.

**Alternatives Dropped from Further Consideration**

The other canal route alternative, the Virgelle-Canal, could significantly contribute to the water supply, but it's not likely that it would be built.  It would provide another 100,000-125,000 AF annually to canal headgates (5-6 inches to the farm headgates), with an incremental annual economic benefit of from $6,000,000-$8,000,000.  It would transport Missouri River water high in  arsenic to the MIlk River basin where arsenic concentrations are negligible.  The difference is so great that it's unlikely the State would grant an exemption.  Thus, this alternative won't be evaluated further.

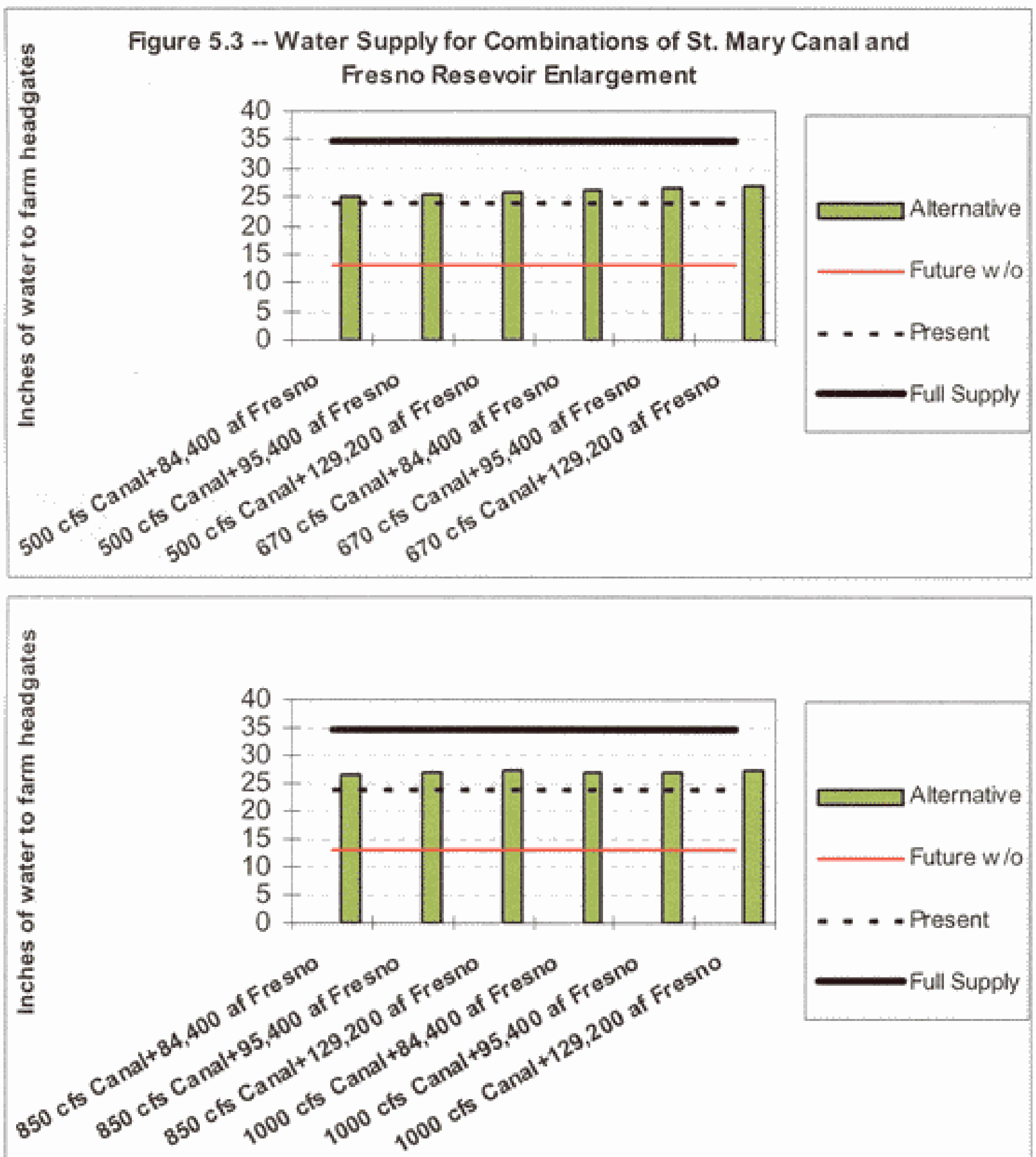
The Babb Dam, Enlarge Nelson Reservoir, and Tiber-Fresno Reservoirs, and Buying Lands alternatives are being dropped because they wouldn't contribute significantly to water supplies in the basin, wouldn't significantly benefit the issues, and the costs would exceed the estimated benefits.  The Storage Reservoir on Peoples Creek, Storage Reservoir on 30 Mile Creek, and Storage Reservoir on Beaver Creek alternatives were dropped because costs would exceed benefits.

## COMBINED ALTERNATIVES

Average annual shortage in the basin for all of the combined alternatives is 160,000 AF.  About 6,000 AF results from canal capacities limiting the volume of water diverted, about  4% of the total shortage.  If even more water supply became available, canal limitations would become an increasing concern. Annual water shortages due to canal capacity limits would average about 66,000 AF as available water approached the average annual water requirement of 650,000 AF.

**Combination A: St. Mary System Enhancements/**
**Enlarge Fresno Reservoir**

At designed capacity of 850 cfs, the St. Marys System would increase the water supply by an average of 255,000 AF annually at the canal headgates (Figure 5.3), providing another 13.25 inches/acre at the farms headgates. A 3-foot rise in crest of Fresno Dam would increase the water supply by an average of 4,700 AF annually, an increase of 0.38 inches/acre at the farm headgates. Combining these would thus provide an average water supply of 261,000 AF annually in the basin, or an increase of 13.57 inches/acre to farm headgates. They would provide about 1,000 AF more water supply to canal headgates that they would individually.




Average annual diversions for all mainstem diversions in the basin is 491,300 AF, with a St. Mary system of a 850 cfs canal and a 3 feet raise in the crest of Fresno Dam. This would represent an average annual shortage of 23%, about the same as the present shortage but significantly less than the 63% shortage in the Future Without. Thirty-two of the 10 year periods exceeded the shortage criteria, a slight improvement from the present.

The shortage of the other combined alternatives would be similar to the shortage for Combination A.

Total volume of water diverted for the other combined alternatives would be within about 4% of the diversion for Combination A.

Incremental crop yields would increase 1.38 tons/acre annually or 209,500 tons/year basin wide. Total investment costs would be $112,025,000, annual OM&R $208,000, and energy costs undetermined (Table 5.2). Annual costs would be $6,811,000.

Water delivery to the farm headgates and net economic benefits for various canal capacities and dam raises are shown below.

| St. Mary Canal Capacity | Fresno Dam Crest Raise and Total Storage | | | | | |
|---|---|---|---|---|---|---|
| | 3 feet, 84,400 AF | | 5 feet, 95,400 AF | | 10 feet, 129,200 AF | |
| | WATER | BENEFIT | WATER | BENEFIT | WATER | BENEFIT |
| 500 cfs | 25.17 in/ac | $1,464,000 | 25.4 in/ac | $1,121,000 | 25.89 in/ac | $1,227,000 |
| 670 cfs | 26.34 in/ac | $1,675,000 | 26.48 n/ac | $1,279,000 | 26.88 in/ac | $1,288,000 |
| 850 cfs | 26.68 in/ac | $,1056,000 | 26.83 in/ac | $665,000 | 27.21 in/ac | $662,000 |
| 1,000 cfs | 26.76 in/ac | $471,000 | 26.93 in/ac | $92,000 | 27.29 in/ac | $77,000 |

**Combination B: St. Mary System Enhancements/**
**Enlarge Fresno Reservoir /Dodson South Canal Enhancements**

Combination of a St. Mary system with 850 cfs canal, a 3-foot raise of the crest of Fresno Dam, and a 600 cfs Dodson South Canal would increase the water supply in the basin to an average of 264,000 AF, or an increase of 14.09 inches/acre to farm headgates (Table 5.2). Figure 5.4 compares water supply of the combined alternatives.

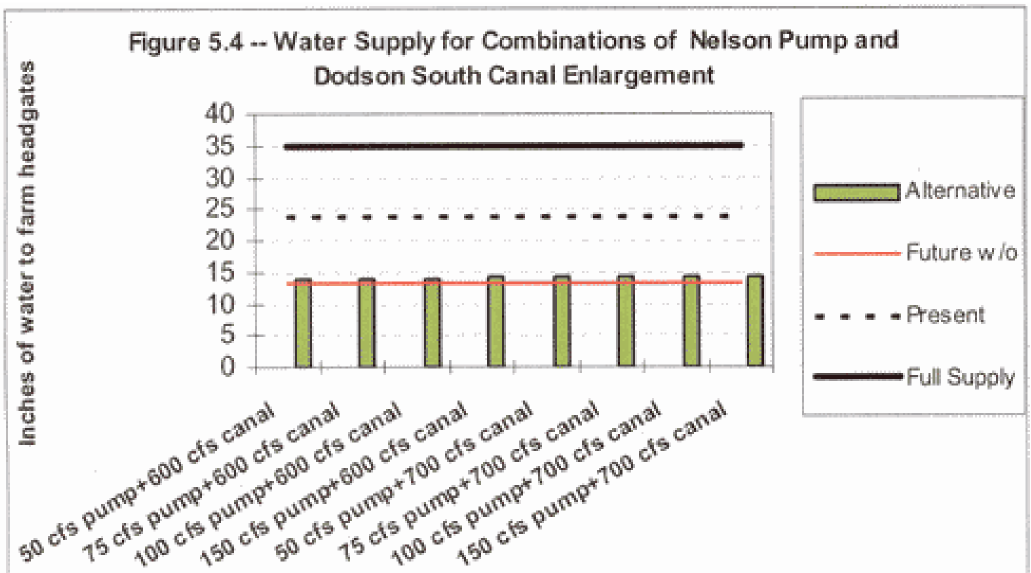
Incremental crop yields would increase 1.40 tons/acre annually, 212,400 tons/year basin wide (Table 5.2). This would increase economic benefits annually by $879,000, but it would provide net loss of economic benefits of $218,000 from Combination A.

Total investment costs would be $117,581,000, annual OM&R $208,000 (Table 5.2). Annual costs would be $7,139,000.

**Combination C: St. Mary System Enhancements/**
**Enlarge Fresno Reservoir/Nelson Pumping Plant**

Adding a 75 cfs pumping plant at Nelson Reservoir to a St. Mary system with a 850 cfs canal, 3-foot raise of the crest of Fresno Dam, and a 75-cfs pumping plant at Nelson Reservoir would increase the water supply in the basin to an average of 270,000 AF, or an increase of 14.09 inches/acre to farm headgates (Table 5.2).

Incremental crop yields would increase 1.44 tons/acre annually, 217,500 tons/year basin wide (Table 5.2). This would increase net economic benefits annually by $879,200. This would, however, provide a net loss of economic benefits of $176,800 from Combination A.




Total investment costs would be $118,126,000, annual OM&R $325,800 (Table 5.2). Annual costs would be $7,288,800.

**Combination D: St. Mary System at 850 cfs/**
**Enlarge Fresno Reservoir/**
**Nelson Pumping Plant/Dodson South Canal Rehabilitation**

The combination of a St. Mary system with 850 cfs canal, a 3-foot raise of the crest of Fresno Dam, a 75-cfs pumping plant at Nelson Reservoir, and a 600 cfs Dodson South Canal would increase the water supply to an average of 272,000 AF in the basin (Table 5.1). This would equate to an increase of 14.21 inches/acre at farm headgates. Figure 5.5 shows the water supply.

Incremental crop yields would increase 1.45 tons/acre annually, 219,400 tons/year basin wide (Table 5.2). This would increase net economic benefits annually by $615,200, a net loss of economic benefits of $440,800 from Combination A.

Below is a comparison of costs/benefits for various capacities of the Nelson Pumping Plant and the Dodson South Canal, with negative numbers shows in red. The figures are an increase over the Future Without the Project Condition. Figure 5.4 shows water supply for the combination

| Nelson Pumping Plant Capacity | Dodson South Canal Total Capacity | | | |
|---|---|---|---|---|
| | 600 cfs | | 700 cfs | |
| 50 cfs | 13.79 in/ac | ($348,900) | 14.11 in/ac | ($504,200) |
| 75 cfs | 13.88 in/ac | ($365,000) | 14.20 in/ac | ($521,100) |
| 100 cfs | 13.95 in/ac | ($434,400) | 14.26 in/ac | ($595,700) |
| 150 cfs | 14.07 in/ac | ($502,000) | 14.35 in/ac | ($681,000) |

Total investment costs would be $123,682,000, annual O, M,&R $332,800 (Table 5.2). Annual costs would be $7,662,800.

**Combination E: St. Mary System Enhancements/**
**Enlarge Fresno Reservoir /Duck Creek-Vandalia Canal**

Combining a St. Mary system with 850 cfs canal, a 3-foot raise of the crest of Fresno Dam, and the Duck Creek-Vandalia Canal would increase the water supply in the basin to an average of 271,000 equivalent to an increase of 14.13 inches/acre at farm headgates (Table 5.1).

Incremental crop yields would increase 1.44 tons/acre annually, 218,100 tons/year basin wide (Table 5.2). This would decrease economic benefits annually by $180,000, $1,236,000 in comparison to Combination A.

Total investment costs would be $132,230,000, annual O, M,&R $278,500, and energy costs $285,600 (Table 5.2). Annual costs would be $6,680,100.

**Combination F: St. Mary System Enhancements/Enlarge**
**Fresno Reservoir /Nelson Pumping Plant/Dodson South**
**Canal Enhancements/Duck Creek-Vandalia Canal**

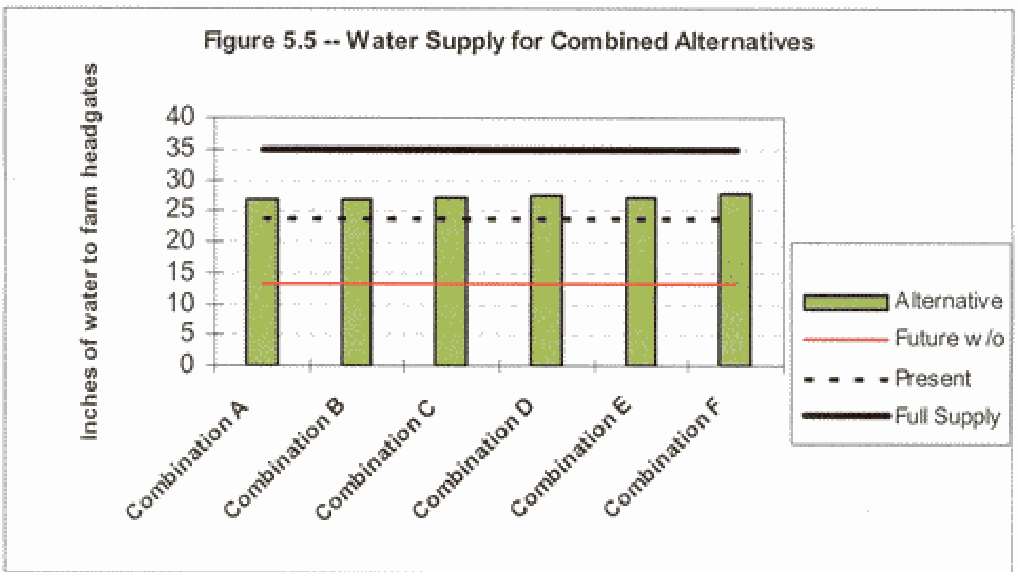
Combining a St. Mary system with 850 cfs canal, a 3-foot raise of the crest of Fresno Dam, a 75 cfs pumping plant at Nelson Reservoir, a 600 cfs Dodson South Canal, with the Duck Creek-Vandalia Canal would increase the water supply in the basin to an average of 281,999, equivalent to an increase of 14.73 inches/acre at farm headgates (Table 5.2).

Incremental crop yields would increase 1.5 tons/acre annually, 227,400 tons/year basin wide (Table 5.2). Annual net economic benefits would decrease by $643,000, $1,700,000 in comparison to Combination A.

Total investment costs would be $146,307,000, annual O, M,&R $558,800 (Table 5.2). Annual costs would be $9,182,800.

**Combination Alternatives Water Supply Comparison**

Water supplied by the combination alternatives is displayed in Figure 5.5



| Alternative /1 | Total Construction Cost ($) | Total Investment Cost ($) | Annual Construction Costs ($/yr) | Annual Operation, Maintenance and Replacement Costs ($/yr) | Annual Energy Costs ($/yr) 50 mil | Total O&M ($/yr) | Total Annual Costs ($/yr) | Total delivered to Canal Headgate (ac-ft) | Future without a Project Water Delivery (ac-ft) | Incremental Benefits: Water Delivered @ Canal Headgate (ac-ft) | Total delivered to Farm Headgate (in/ac) | Future without a Project Water Delivery (in/ac) | Incremental Benefits: Water Delivered @ Farm Headgate (in/ac) | Incremental Crop Yield (ton/ac/yr) | Incremental Basin-Wide Crop Yield (tons/year) | Incremental Annual Economic Benefits | Net Economic Benefit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 230,766 | | | 13.11 | | **4.90** | **151,297** | **$ 38** | |
| **Improve Water Operations and Management** | | | | | | | | | | | | | | | | | |
| Nelson Reservoir Management | | | | | | | | | | | | | | | | | |
| 50-CFS Pumping Plant | $ 4,995,000 | $ 5,146,000 | $ 303,000 | $ 24,300 | $ 80,600 | $ 104,900 | $ 407,900 | 235,442 | 230,766 | 4,676 | 13.35 | 13.11 | 0.24 | 0.02 | 3,705 | $ 139,000 | -268,900.0 |
| 75-CFS Pumping Plant | $ 5,922,000 | $ 6,101,000 | $ 360,000 | $ 27,300 | $ 90,500 | $ 117,800 | $ 477,800 | 237,189 | 230,766 | 6,423 | 13.45 | 13.11 | 0.34 | 0.03 | 5,249 | 197,000 | -280,800.0 |
| 100-CFS Pumping Plant | $ 7,411,000 | $ 7,635,000 | $ 450,000 | $ 30,400 | $ 106,000 | $ 136,400 | $ 586,400 | 238,282 | 230,766 | 7,516 | 13.52 | 13.11 | 0.41 | 0.04 | 6,330 | 238,000 | -348,400.0 |
| 150-CFS PumpingPlant | $ 9,189,000 | $ 9,467,000 | $ 558,000 | $ 35,300 | $ 131,000 | $ 166,300 | $ 724,300 | 240,497 | 230,766 | 9,731 | 13.65 | 13.11 | 0.54 | 0.06 | 8,337 | 313,000 | -411,300.0 |
| | | | | | | | | | | | | | | | | | |
| Dodson South Canal Rehab | | | | | | | | | | | | | | | | | |
| 600-CFS Canal | $ 5,393,000 | $ 5,556,000 | $ 328,000 | $ 7,000 | | $ 7,000 | $ 335,000 | 235,287 | 230,766 | 4,521 | 13.34 | 13.11 | 0.23 | 0.02 | 3,551 | 133,000 | -202,000.0 |
| 700-CFS Canal | $ 11,011,000 | $ 11,344,000 | $ 669,000 | $ 7,300 | | $ 7,300 | $ 676,300 | 239,876 | 230,766 | 9,110 | 13.62 | 13.11 | 0.51 | 0.05 | 7,874 | 296,000 | -380,300.0 |
| | | | | | | | | | | | | | | | | | |
| Vandalia Re-Regulation Reservoir | $ 1,650,000 | $ 1,778,000 | $ 105,000 | $ 9,200 | $ 2,100 | $ 11,300 | $ 116,300 | 229,602 | 230,766 | -1,164 | 13.20 | 13.11 | 0.09 | 0.01 | 1,389 | 52,000 | -64,300.0 |
| | | | | | | | | | | | | | | | | | |
| **Improve Water Storage** | | | | | | | | | | | | | | | | | |
| Enlarge Fresno Reservoir | | | | | | | | | | | | | | | | | |
| 3 ft (84,400 AF) | $ 2,500,000 | $ 2,694,000 | $ 159,000 | $ 43,000 | | $ 43,000 | $ 202,000 | 235,444 | 230,766 | 4,678 | 13.35 | 13.11 | 0.24 | 0.02 | 3,705 | 139,000 | -63,000.0 |
| 5 ft (95,400 Acre Feet) | $ 5,000,000 | $ 5,387,000 | $ 318,000 | $ 44,000 | | $ 44,000 | $ 362,000 | 238,096 | 230,766 | 7,330 | 13.49 | 13.11 | 0.38 | 0.04 | 5,867 | 220,000 | -142,000.0 |
| 10 ft (129,200 Acre Feet) | $ 7,600,000 | $ 8,188,000 | $ 483,000 | $ 45,000 | | $ 45,000 | $ 528,000 | 243,247 | 230,766 | 12,481 | 13.76 | 13.11 | 0.65 | 0.07 | 10,035 | 377,000 | -151,000.0 |
| **Augment Water Supply** | | | | | | | | | | | | | | | | | |
| St. Mary's Rehab** | | | | | | | | | | | | | | | | | |
| 500 CFS | $ 80,232,000 | $ 88,030,000 | $ 5,189,000 | $ 136,000 | | $ 136,000 | $ 5,325,000 | 453,605 | 230,766 | 222,839 | 24.76 | 13.11 | 11.65 | 1.19 | 179,858 | 6,754,000 | 1,429,000.0 |
| 670 CFS | $ 87,254,000 | $ 95,734,000 | $ 5,643,000 | $ 150,000 | | $ 150,000 | $ 5,793,000 | 478,910 | 230,766 | 248,144 | 26.03 | 13.11 | 12.92 | 1.32 | 199,465 | 7,490,000 | 1,697,000.0 |
| 850 CFS | $ 96,347,000 | $ 109,331,000 | $ 6,445,000 | $ 165,000 | | $ 165,000 | $ 6,610,000 | 485,340 | 230,766 | 254,574 | 26.36 | 13.11 | 13.25 | 1.35 | 204,560 | 7,681,000 | 1,071,000.0 |
| 1000 CFS | $ 105,706,000 | $ 119,951,000 | $ 7,071,000 | $ 170,000 | | $ 170,000 | $ 7,241,000 | 486,794 | 230,766 | 256,028 | 26.45 | 13.11 | 13.34 | 1.36 | 205,949 | 7,733,000 | 492,000.0 |
| | | | | | | | | | | | | | | | | | |
| Duck Ck. -Vandalia | $ 20,621,000 | $ 22,625,000 | $ 1,334,000 | $ 33,000 | $ 193,000 | $ 226,000 | $ 1,560,000 | 259,316 | 230,766 | 28,550 | 14.69 | 13.11 | 1.58 | 0.16 | 24,393 | 916,000 | -644,000.0 |

/1 This is the short list of alternatives that appear to be the most promising to address the issues in the study area. For a complete list of alternatives examined as part of this study, refer to table 4.1

**Table 5.2 Combined Alternatives**

| Alternative | Total Construction Cost ($) | Total Investment Cost ($) | Annual Construction Costs ($/yr) | Annual Operation, Maintenance and Replacement Costs ($/yr) | Annual Energy Costs ($/yr) 50 mil | Total O&M ($/yr) | Total Annual Costs ($/yr) | Total delivered to Canal Headgate (ac-ft) | Future without a Project Water Delivery (ac-ft) | Incremental Benefits: Water Delivered @ Canal Headgate (ac-ft) | Total delivered to Farm Headgate (in/ac) | Future without a Project Water Delivery (in/ac) | Incremental Benefits: Water Delivered @ Farm Headgate (in/ac) | Incremental Crop Yield (ton/ac/yr) | Incremental Basin-Wide Crop Yield (tons/year) | Incremental Annual Economic Benefits | Net Economic Benefit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **St Mary Canal Rehabilitation and Fresno Enlargement** | | | | | | | | | | | | | | | | | |
| 500 cfs canal + 3 ft Fresno Raise | $ 82,732,000 | $ 90,724,000 | $ 5,348,000 | $ 179,000 | $ - | $ 179,000 | $ 5,527,000 | 461,589 | 230,766 | 230,823 | 25.17 | 13.11 | 12.06 | 1.23 | 186,188 | $ 6,991,000 | $ 1,464,000 |
| 500 cfs canal + 5 ft Fresno Raise | $ 90,232,000 | $ 98,804,000 | $ 5,824,000 | $ 180,000 | $ - | $ 180,000 | $ 6,004,000 | 466,086 | 230,766 | 235,320 | 25.40 | 13.11 | 12.29 | 1.25 | 189,739 | $ 7,125,000 | $ 1,121,000 |
| 500 cfs canal + 10 ft Fresno Raise | $ 93,732,000 | $ 102,575,000 | $ 6,046,000 | $ 136,000 | $ - | $ 136,000 | $ 6,182,000 | 475,697 | 230,766 | 244,931 | 25.89 | 13.11 | 12.78 | 1.30 | 197,304 | $ 7,409,000 | $ 1,227,000 |
| 670 cfs canal + 3 ft Fresno Raise | $ 89,754,000 | $ 98,428,000 | $ 5,802,000 | $ 193,000 | $ - | $ 193,000 | $ 5,995,000 | 484,937 | 230,766 | 254,171 | 26.34 | 13.11 | 13.23 | 1.35 | 204,251 | $ 7,670,000 | $ 1,675,000 |
| 670 cfs canal + 5 ft Fresno Raise | $ 97,254,000 | $ 106,508,000 | $ 6,278,000 | $ 194,000 | $ - | $ 194,000 | $ 6,472,000 | 487,373 | 230,766 | 256,607 | 26.48 | 13.11 | 13.37 | 1.36 | 206,412 | $ 7,751,000 | $ 1,279,000 |
| 670 cfs canal + 10 ft Fresno Raise | $ 100,754,000 | $ 110,279,000 | $ 6,500,000 | $ 195,000 | $ - | $ 195,000 | $ 6,695,000 | 494,932 | 230,766 | 264,166 | 26.88 | 13.11 | 13.77 | 1.41 | 212,588 | $ 7,983,000 | $ 1,288,000 |
| 850 Canal + 3 ft Fresno Raise | $ 98,847,000 | $ 112,025,000 | $ 6,603,000 | $ 208,000 | $ - | $ 208,000 | $ 6,811,000 | 491,305 | 230,766 | 260,539 | 26.68 | 13.11 | 13.57 | 1.38 | 209,500 | $ 7,867,000 | $ 1,056,000 |
| 850 Canal + 5 ft Fresno Raise | $ 106,347,000 | $ 120,105,000 | $ 7,080,000 | $ 209,000 | $ - | $ 209,000 | $ 7,289,000 | 494,006 | 230,766 | 263,240 | 26.83 | 13.11 | 13.72 | 1.40 | 211,816 | $ 7,954,000 | $ 665,000 |
| 850 Canal + 10 ft Fresno Raise | $ 109,847,000 | $ 123,876,000 | $ 7,302,000 | $ 210,000 | $ - | $ 210,000 | $ 7,512,000 | 501,246 | 230,766 | 270,480 | 27.21 | 13.11 | 14.10 | 1.44 | 217,682 | $ 8,174,000 | $ 662,000 |
| 1000 Canal + 3 ft Fresno Raise | $ 108,206,000 | $ 122,645,000 | $ 7,229,000 | $ 213,000 | $ - | $ 213,000 | $ 7,442,000 | 492,545 | 230,766 | 261,779 | 26.76 | 13.11 | 13.65 | 1.39 | 210,735 | $ 7,913,000 | $ 471,000 |
| 1000 Canal + 5 ft Fresno Raise | $ 115,706,000 | $ 130,725,000 | $ 7,706,000 | $ 214,000 | $ - | $ 214,000 | $ 7,920,000 | 495,751 | 230,766 | 264,985 | 26.93 | 13.11 | 13.82 | 1.41 | 213,360 | $ 8,012,000 | $ 92,000 |
| 1000 Canal + 10 ft Fresno Raise | $ 119,206,000 | $ 134,496,000 | $ 7,928,000 | $ 215,000 | $ - | $ 215,000 | $ 8,143,000 | 502,726 | 230,766 | 271,960 | 27.29 | 13.11 | 14.18 | 1.45 | 218,917 | $ 8,220,000 | $ 77,000 |
| **Nelson Reservoir Management** | | | | | | | | | | | | | | | | | |
| 600 cfs Canal + 50 cfs pumping plant | $ 10,388,000 | $ 10,702,000 | $ 631,000 | $ 31,300 | $ 80,600 | $ 111,900 | $ 742,900 | 242,759 | 230,766 | 11,993 | 13.79 | 13.11 | 0.68 | 0.07 | 10,498 | $ 394,000 | $ (348,900) |
| 600 cfs Canal + 75 cfs pumping plant | $ 11,315,000 | $ 11,657,000 | $ 687,000 | $ 34,300 | $ 90,500 | $ 124,800 | $ 811,800 | 244,487 | 230,766 | 13,721 | 13.88 | 13.11 | 0.77 | 0.08 | 11,888 | $ 446,000 | $ (365,800) |
| 600 cfs Canal + 100 cfs pumping plant | $ 12,804,000 | $ 13,191,000 | $ 778,000 | $ 37,400 | $ 106,000 | $ 143,400 | $ 921,400 | 245,663 | 230,766 | 14,897 | 13.95 | 13.11 | 0.84 | 0.09 | 12,968 | $ 487,000 | $ (434,400) |
| 600 cfs Canal + 150 cfs pumping plant | $ 14,582,000 | $ 15,023,000 | $ 886,000 | $ 42,300 | $ 131,000 | $ 173,300 | $ 1,059,300 | 247,710 | 230,766 | 16,944 | 14.07 | 13.11 | 0.96 | 0.10 | 14,821 | $ 557,000 | $ (502,300) |
| 700 cfs Canal + 50 cfs pumping plant | $ 16,006,000 | $ 16,490,000 | $ 972,000 | $ 31,600 | $ 80,600 | $ 112,200 | $ 1,084,200 | 248,513 | 230,766 | 17,747 | 14.11 | 13.11 | 1.00 | 0.10 | 15,438 | $ 580,000 | $ (504,200) |
| 700 cfs Canal + 75 cfs pumping plant | $ 16,933,000 | $ 17,445,000 | $ 1,028,000 | $ 34,600 | $ 90,500 | $ 125,100 | $ 1,153,100 | 250,135 | 230,766 | 19,369 | 14.20 | 13.11 | 1.09 | 0.11 | 16,828 | $ 632,000 | $ (521,100) |
| 700 cfs Canal + 100 cfs pumping plant | $ 18,422,000 | $ 18,979,000 | $ 1,119,000 | $ 37,700 | $ 106,000 | $ 143,700 | $ 1,262,700 | 251,092 | 230,766 | 20,326 | 14.26 | 13.11 | 1.15 | 0.12 | 17,754 | $ 667,000 | $ (595,700) |
| 700 cfs Canal + 150 cfs pumping plant | $ 20,200,000 | $ 20,811,000 | $ 1,227,000 | $ 42,600 | $ 131,000 | $ 173,600 | $ 1,400,600 | 252,695 | 230,766 | 21,929 | 14.35 | 13.11 | 1.24 | 0.13 | 19,144 | $ 719,000 | $ (681,600) |
| **General Combinations** | | | | | | | | | | | | | | | | | |
| 850 cfs St Mary Canal + 3 ft Fresno raise + 600 cfs Dodson South Canal | $ 104,240,000 | $ 117,581,000 | $ 6,931,000 | $ 208,000 | $ - | $ 208,000 | $ 7,139,000 | 494,870 | 230,766 | 264,104 | 26.87 | 13.11 | 13.76 | 1.40 | 212,433 | $ 7,977,000 | $ 838,000 |
| 850 cfs St Mary Canal + 3 ft Fresno raise + 75 cfs Nelson Pumping Plant | $ 104,769,000 | $ 118,126,000 | $ 6,963,000 | $ 235,300 | $ 90,500 | $ 325,800 | $ 7,288,800 | 501,108 | 230,766 | 270,342 | 27.20 | 13.11 | 14.09 | 1.44 | 217,528 | $ 8,168,000 | $ 879,200 |
| 850 cfs St Mary Canal + 3 ft Fresno raise + 600 cfs Dodson South Canal + 75 cfs Nelson Pumping Plant | $ 110,162,000 | $ 123,682,000 | $ 7,290,000 | $ 242,300 | $ 90,500 | $ 332,800 | $ 7,622,800 | 503,094 | 230,766 | 272,328 | 27.32 | 13.11 | 14.21 | 1.45 | 219,381 | $ 8,238,000 | $ 615,200 |
| 850 cfs St Mary Canal + 3 ft Fresno raise + Duck Creek/Vandalia Canal | $ 119,468,000 | $ 134,650,000 | $ 7,937,000 | $ 241,000 | $ 193,000 | $ 434,000 | $ 8,371,000 | 501,439 | 230,766 | 270,673 | 27.24 | 13.11 | 14.13 | 1.44 | 218,146 | $ 8,191,000 | $ (180,000) |
| 850 cfs St Mary Canal + 3 ft Fresno raise + 600 cfs Dodson South Canal + 75 cfs Nelson Pumping Plant + Duck Creek/Vandalia Canal | $ 130,783,000 | $ 146,307,000 | $ 8,624,000 | $ 275,300 | $ 283,500 | $ 558,800 | $ 9,182,800 | 512,765 | 230,766 | 281,999 | 27.84 | 13.11 | 14.73 | 1.50 | 227,409 | $ 8,539,000 | $ (643,800) |

# *FINDINGS*
# Chapter 6

This chapter reports the findings of this study in the form of an evaluation of the six promising alternatives—Nelson Reservoir Pumping Plant, Dodson South Canal Enhancements, Glasgow Irrigation District Re-Regulation Reservoir, Enlarge Fresno Reservoir, and St. Mary System Enhancements (see Chapter 5). As with Chapters 4 and 5, the alternatives are compared to the Future Without the Project Condition (defined in Chapter 4).

Cost and benefit information discussed in Chapter 5 is included in the table, as well as a rating of the effects of an alternative on the issues identified in Chapter 4: Milk River irrigation water supply; MR&I (municipal, rural, and industrial) water supply; threatened and endangered species; water quality; water to implement the Fort Belknap Compact;; Blackfeet Reservation reserved water rights; water supply for the Bowdoin National Wildlife Refuge; fish and wildlife; recreation; and hydro-power. Table 6.1 at the end of the chapter summarizes these findings.

## COSTS AND BENEFITS

Except for the rating of issues, Table 6.1 displays information similar to that displayed in Table 4.1 (for all alternatives) and Table 5.1 (full costs/benefits of the promising alternatives). Costs listed in Table 6.1 are total construction, total investment, annual construction, annual O, M,&R (operations, maintenance, and replacement), and total annual costs for the six promising alternatives. These costs, it should be noted, don't include the cost of environmental mitigation that could be required after compliance with NEPA (National Environmental Policy Act).

The next two columns to the right of the costs are water to canal headgates and water to the farm headgates delivered by an alternative in AF (acre-feet). Incremental annual crop yield (in tons/acre) and incremental annual basin-wide crop yields (in tons) provided by an alternative make up the next two columns.

The last two columns of numbers are the incremental annual economic benefits and annual net economic benefits provided by an alternative (with negative net benefits listed in red). Only agricultural benefits were estimated; other direct and indirect benefits were not included.

## ISSUES

The rating system for the issues requires explanation. While no analysis to comply with NEPA or other environmental laws and regulations was done for this study, some existing information and information from continuing fishery studies was available. From this information, resource specialists made qualitative judgments which supplied the issues ratings.

Adapted from a popular magazine, the rating uses symbols to indicate the effects of an alternative on an issue, as follows:

- ● — Positive Effect

◆ — Slightly positive effect
○ —No effect
◆ — Slightly negative effect
● — Negative effect.

Ratings are specific to a particular issue: it's possible for an alternative with a negative rating for one issue to be rated positive in relation to another. Thus, the Nelson Reservoir Pumping Plant Alternative (for all capacities) is rated “slightly negative” for the water quality issue but “slightly positive” for the fish and wildlife issue.

The rationale for the ratings of each issue of each of the alternatives is discussed below. The ratings are summarized in Table 6.1.

**Nelson Reservoir Pumping Plant Alternative**

***Milk River Irrigation Water Supply***

All capacities of pumps in a pumping plant at Nelson would reduce irrigation water supply shortages and allow more flexibility in water operations. Water to the canal headgates would increase about 4,700 AF (50 cfs pumps), 6,400 AF (75 cfs pumps), 7,500 AF (100 cfs pumps), or 9,700 AF (150 cfs pumps). This caused the alternative to be rated

◆— slightly positive effect.

***MR&I Water Supply***

Although this alternative would improve the overall water supply in the basin compared to the Future Without, it wouldn't improve the reliability of an MR&I water supply during periodic droughts. Rating:

○ —no effect.

***Threatened and Endangered Species***

Less water in Nelson Reservoir and no St. Mary supply would expose more gravel shoreline and islands for nesting piping plovers. Plovers may begin nesting before the reservoir fills, however, resulting in nests being flooded as the water level rises. A pumping plant would allow reservoir levels to be kept higher in the spring, causing plovers to build nests higher on the shoreline, avoiding flooding. This alternative wouldn't change conditions for the black-footed ferret, mountain plover, and bald eagle. Rating:

◆— slightly positive effect.

***Water Quality***

Reduction of Milk River flows during the irrigation season or during droughts would mean less water would be available for dilution, further degrading water quality. During operation, flows below the pumping plant would be somewhat reduced, with the possibility of negative thermal effects and less water for dilution, degrading remaining river flows. More sediment might be delivered to Nelson Reservoir from the river. The pumping plant would leave a minimum of 30 cfs (cubic-feet/second) in the river when in operation. More water for irrigation could result in an increase of return flows, with corresponding effects on water quality. These effects might be offset by greater water releases from Nelson to the Vandalia Canal during low flow periods. Rating:

◆ — slightly negative effect

***Fort Belknap Reserved Water Rights***

This alternative would contribute to implementation of the Fort Belknap Compact by making more water available to canal headgates: about 4,700 AF (50 cfs pumps), 6,400 AF (75 cfs pumps), 7,500 AF (100 cfs pumps), or 9,700 AF (150 cfs pumps). This caused the alternative to be rated

◆— slightly positive effect.

***Blackfeet Reserved Water Rights***

By contributing to implementation of the Fort Belknap Compact, this alternative could leave opportunities for implementing settlement with the Blackfeet Tribe. However, it would probably have little, if any, effect. Rating:

○ —no effect.

***Water for Bowdoin National Wildlife Refuge***

Water could be provided more consistently to Bowdoin since water normally diverted to fill Nelson Reservoir could go the refuge when available. Rating:

◆— slightly positive effect.

***Fish and Wildlife Species***

Water levels in Nelson could be better controlled and coordinated with the DFWP (Montana Department of Fish, Wildlife, and Parks) to improve fish production. Pumping high flows from the river during spring floods could negatively affect spring migratory spawning fish, however, like sauger, blue sucker, and paddlefish that rely on high peak flows to cue spawning. On average, reservoir water levels would be maintained from 1-3 feet higher than in the Future Without, depending on capacity. Flows in the lower Milk would be reduced by an average of 1,500 AF during the peak flow month of April, about 1% of average April runoff. During 13 years of the 62-year period of record (or about 1 out of every 5 years), April runoff exceeded 200,000 AF. Average annual flows of about 435,000 AF would be reduced by about 1,700 AF, or about 0.4%. Meanwhile, during the low flow period of July-January for these years, flows would increase from 3-13%, depending on the month. Considering the tradeoffs, this alternative was rated:

◆— slightly positive effect.

***Recreation***

Recreational opportunities at Nelson would probably increase as water levels were maintained higher most of the year, especially if the levels were better controlled and coordinated with DFWP to improve fish production. Recreational opportunities at Fresno Reservoir would be unaffected. Rating:

◆— slightly positive effect.

***Hydro-Power***

No effects on hydro-power development. Rating:

○ —no effect.

**Dodson South Canal Enhancements Alternative**

***Milk River Irrigation Water Supply***

Enlarging the capacity of the canal from 500 cfs to 600-700 cfs would allow Nelson Reservoir to receive additional early spring flows and other flows during the irrigation season. Water deliveries to farm headgates would increase about 4,500 AF (600 cfs canal) or 9,000 AF (700 cfs canal). This caused the alternative to be rated

◆— slightly positive effect.

***MR&I Water Supply***

Although this alternative would improve overall water supply compared to the Future Without, it wouldn't improve the reliability of an MR&I water supply during periodic droughts. Rating:

○ —no effect.

***Threatened and Endangered Species***

This alternative would allow water levels to be kept higher in the spring, causing piping plovers to build nests higher on the shoreline, avoiding flooding. This alternative wouldn't change conditions for the black-footed ferret, mountain plover, and bald eagle. Rating:

◆— slightly positive effect.

***Water Quality***

More river flows would be diverted during high flow periods, with possible negative effects to temperature and the quality of flows remaining in the river. During low flow periods from July-January, flows would be somewhat higher. More water for irrigation could result in an increase of return flows, degrading water quality. Potential effects could be offset by greater water releases from Nelson Reservoir to the Vandalia Canal during low flow periods. Rating:

◆ — slightly negative effect

***Fort Belknap Reserved Water Rights***

This alternative would contribute to implementation of the Fort Belknap Compact by making another 4,700 AF (600 cfs canal) or 9,000 AF (7000 cfs canal) of water available to the canal headgates. This caused the alternative to be rated

◆— slightly positive effect.

***Blackfeet Reserved Water Rights***

By contributing to implementation of the Fort Belknap Compact, this alternative could leave opportunities for implementing settlement with the Blackfeet Tribe. It would probably have little, if any, effect. Rating:

○ —no effect.

***Water for Bowdoin National Wildlife Refuge***

Water could be provided more consistently to Bowdoin in this alternative. A larger capacity canal would provide more opportunity to deliver water to the refuge during high flows and during the irrigation season. Water could also be diverted to Bowdoin when it would previously have gone to filling Nelson Reservoir. Rating:

◆— slightly positive effect.

***Fish and Wildlife Species***

Water levels in Nelson could be better controlled and coordinated with DFWP to improve fish production. Diverting high flows in the spring could affect spring migratory spawning fish that rely on peak flows to cue spawning. For either capacity, average water levels in Nelson would be maintained from 2-3 feet higher from April-June, about 1 foot higher for the rest of the year. Flows in the lower Milk would be reduced by an average of 2,500 AF during the peak flow month of April, about 2% of average April runoff. During low flow months, river flows would be increased by more than 25% in July, tapering down to about 1% by January. Considering the tradeoffs, this alternative was rated:

◆— slightly positive effect.

***Recreation***

Recreational opportunities at Nelson would probably increase as water levels were maintained higher most of the year, especially if the levels were better controlled and coordinated with DFWP to improve fish production. Recreational opportunities at Fresno would be unaffected. Rating:

◆— slightly positive effect.

***Hydro-Power***

No effects on hydro-power development. Rating:

○ —no effect.

**Glasgow Irrigation District Re-Regulation Reservoir Alternative**

***Milk River Irrigation Water Supply***

This alternative would improve delivery efficiencies of the Glasgow Irrigation District, resulting in an annual reduction of about 1,200 AF delivered to the district. This would allow irrigators in the basin to receive 1 inch of additional water at the farm headgates. From a basin perspective, this addition to the water supply would be so small the alternative was rated:

○ —no effect.

***MR&I Water Supply***

This alternative probably wouldn't improve the reliability of an MR&I water supply during periodic droughts. Rating:

○ —no effect.

***Threatened and Endangered Species***

Neither bull trout or piping plovers would be affected by this alternative. Rating:

○ —no effect.

***Water Quality***

This alternative would have no effect on water quality; thus, the rating:

○ —no effect.

***Fort Belknap Reserved Water Rights***

This alternative would be difficult to implement so as to contribute to implementation of the Fort Belknap Compact. Rating:

○ —no effect.

***Blackfeet Reserved Water Rights***

This alternative would probably have little, if any, effect. Rating:

○ —no effect.

***Water for Bowdoin National Wildlife Refuge***

This alternative would probably have little, if any, effect. Rating:

○ —no effect.

***Fish and Wildlife Species***

This alternative would probably have little, if any, effect. Rating:

○ —no effect.

***Recreation***

This alternative would probably have little, if any, effect. Rating:

○ —no effect.

***Hydro-Power***

No effects on hydro-power development. Rating:

○ —no effect.

**Enlarge Fresno Reservoir Alternative**

***Milk River Irrigation Water Supply***

Increasing storage in Fresno by raising maximum water levels 3 feet (84,400 AF), 5 feet (95,400 AF), or 10 feet (129,200 AF) would provide greater water deliveries annually to farm headgates of about 7,000 AF, 9,000 AF, or 12,000 AF, respectively. Rating

◆— slightly positive effect.

***MR&I Water Supply***

This alternative would do little to improve reliability of an MR&I water supply during periodic droughts. Rating:

○ —no effect.

***Threatened and Endangered Species***

This alternative probably wouldn't affect either piping plovers or bull trout. Rating:

○ —no effect.

***Water Quality***

This alternative would have no effect on water quality; thus, the rating:

○ —no effect.

***Fort Belknap Reserved Water Rights***

By increasing water deliveries to the farm headgates 7,000 AF (3- foot rise), 9,000 AF (5-foot rise), or 12,000 AF (10-foot rise), this alternative would contribute to implementation of the Fort Belknap Compact. Thus, the rating of

◆— slightly positive effect.

***Blackfeet Reserved Water Rights***

This alternative probably would have little, if any, effect. Rating:

○ —no effect.

***Water for Bowdoin National Wildlife Refuge***

This alternative probably would have little, if any, effect. Rating:

○ —no effect.

***Fish and Wildlife Species***

Fish and wildlife would probably be little affected by this alternative, even at Fresno since water levels would often be drawn to minimum pool. Rating:

○ —no effect.

### *Recreation*

Recreation would be little affected by this alternative, if affected at all, even in Fresno since water levels wouldn't be affected during average and dry years. Rating:

○ —no effect.

### *Hydro-Power*

No effects on hydro-power development. Rating:

○ —no effect.

## St. Mary System Enhancements Alternative

### *Milk River Irrigation Water Supply*

All capacities of canals would provide a significant contribution to the water supply in the basin. The 500 cfs canal would provide 222,839 AF, the 670 cfs canal 248,144 AF, the 850 cfs canal 254,574 AF, and the 1,000 AF 256,028 AF of water to the basin. Rating:

● — positive effect.

### *MR&I Water Supply*

This alternative would improve the reliability of an MR&I water supply since significantly higher water levels could be maintained in Fresno for MR&I needs throughout the winter, even during droughts. Thus the rating:

● — positive effect.

### *Threatened and Endangered Species*

Threatened and endangered species could be affected in different ways by this alternative. Bull trout would be negatively affected because water would continue to be diverted and the hydrograph altered in comparison to the Future Without. An enhanced St. Mary Canal system, however, would include fish passage and entrainment protection at the diversion site and winter releases of flows from Sherburne Dam, which would mitigate for the effects of current operations on bull trout. Grizzlies could benefit as habitat in the St. Mary basin improved from the enhancement of wetlands and dense brush from canal seepage and possible water delivery after experiencing some temporary effects during construction. Piping plovers might be negatively affected since they could benefit from a depleted water supply at Nelson Reservoir, but a larger St. Mary Canal could provide water to enhance other plover habitat. Pallid sturgeon and other species might benefit from the higher spring flows in the lower section of the river. Applied to the drought of 1983-1988, April flows in the river at Nashua, Montana, would be almost 20% higher with an 850 cfs canal. Rating:

◆— slightly positive effect.

***Water Quality***

This alternative probably would improve waster quality by higher river flows throughout the year lowering contaminant concentrations and by reducing the occurrence of stream dewatering. Rating:

◆— slightly positive effect.

***Fort Belknap Reserved Water Rights***

By increasing deliveries to the farm headgates by from 222,839- 256,028 AF of water, this alternative could contribute towards implementation of the Fort Belknap Compact. Rating:

● — positive effect.

***Blackfeet Reserved Water Rights***

This alternative might preserve and provide opportunity for settlement of water rights of the Blackfeet Tribe. The Tribe could receive water from a rehabilitated canal to serve lands on the reservation in the Milk River drainage and/or they could market their water to other users. Thus, the rating:

● — positive effect.

***Water for Bowdoin National Wildlife Refuge***

The larger capacity canals in this alternative would provide more water to the refuge to more closely match Bowdoin's needs throughout the year and perhaps contribute to a salt management plan. Rating:

● — positive effect.

***Fish and Wildlife Species***

This alternative, especially with the larger capacity canal, would provide significant opportunity to maintain and enhance fish and wildlife in the Milk River basin. Water levels at Fresno and Nelson would probably be kept consistently higher and coordinated with DFWP to improve fish production. River flows would be increased and maintained more consistently. Minimum reservoir and stream levels could be established. Fish species relying on high spring flows to cue spawning might benefit from greater spring flows. Rating:

● — positive effect.

***Recreation***

This alternative, especially with the larger capacity canal, would provide significant opportunity to maintain and enhance recreation both in the river and the reservoirs in the basin. Water levels at Fresno and Nelson probably would be kept consistently higher and could be coordinated and managed to enhance fishing and other recreational activities. Improved river flows would benefit fishing and boating. Rating:

● — positive effect.

***Hydro-Power***

Preliminary hydro-power studies have been done at the St. Mary Canal drop structures and at Fresno Dam. Enhancement of the St. Mary Canal would continue and enhance this opportunity. Rating:

● — positive effect.

**Duck Creek-Vandalia Canal Alternative**

***Milk River Irrigation Water Supply***

By delivering water directly to the Vandalia Canal, this alternative would provide a reliable water supply to the Glasgow Irrigation District, allowing the rest of the Milk River Project to benefit from the existing supply. Deliveries to canal headgates would increase by an annual average of about 29,000 AF. This caused the alternative to be rated

◆— slightly positive effect.

***MR&I Water Supply***

This alternative probably wouldn't improve the reliability of an MR&I water supply during periodic droughts. Rating:

○ —no effect.

***Threatened and Endangered Species***

This alternative probably wouldn't affect either the piping plover nor the bull trout. Rating:

○ —no effect.

***Water Quality***

A greater irrigation water supply could mean more return flows, with a corresponding degradation of water quality. Possible effects to Montana water quality standards from this alternative are beyond the scope of this report. Thus, the rating:

◆ — slightly negative effect

***Fort Belknap Reserved Water Rights***

Making another 29,000 AF of water available annually to the basin would contribute to implementation of the Fort Belknap Compact. This caused the alternative to be rated

◆— slightly positive effect.

***Blackfeet Reserved Water Rights***

This alternative probably would have little, if any, effect. Rating:

○ —no effect.

***Water for Bowdoin National Wildlife Refuge***

This alternative probably would have little, if any, effect. Rating:

○ —no effect.

***Fish and Wildlife Species***

This alternative probably would have some benefit to fish and wildlife by improving water levels in Nelson Reservoir and the lower section of the river below Vandalia Dam. Rating:

◆— slightly positive effect.

***Recreation***

This alternative probably would have little, if any, effect. Rating:

○ —no effect.

***Hydro-Power***

No effects on hydro-power development. Rating:

○ —No effect.

Table 6.1 Promising Alternatives - Individually Listed

| Alternative[1] | Total Construction Cost ($) | Total Investment Cost ($) | Annual Construction Costs ($) | Annual O&M ($) | Total Annual Costs ($) | Incremental Benefits: Water Delivered @ Canal Headgate (AF)[2,3] | Incremental Benefits: Water Delivered @ Farm Headgate (in/ac)[2,4] | Incremental Annual Crop Yield (tons/ac)[2] | Incremental Annual Basin-Wide Crop Yield (tons)[2] | Incremental Annual Economic Benefits[2] | Annual Net Economic Benefit[2] | Milk River Agriculture Water Shortage[2] | Municipal, Rural and Industrial Water Supply[2] | Threatened and Endangered Species[2] | Water Quality[2] | Potential Contribution to Reserved Water Rights Settlement- Fort Belknap Indian Reservation[2] | Potential Contribution to Reserved Water Rights Settlement - Blackfeet Indian Reservation[2] | Water Supply - Bowdoin National Wildlife Refuge[2] | Fish and Wildlife[2] | Recreation[2] | Hydropower[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Improve Water Operations and Management** | | | | | | | | | | | | | | | | | | | | | |
| Nelson Reservoir Pumping Plant | | | | | | | | | | | | | | | | | | | | | |
| 50-CFS Unit | $ 4,995,000 | $ 5,146,000 | $ 303,000 | $ 104,900 | $ 407,900 | 4,676 | 0.24 | 0.02 | 3,705 | $ 139,000 | $ (268,900) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 75-CFS Unit | $ 5,922,000 | $ 6,101,000 | $ 360,000 | $ 117,800 | $ 477,800 | 6,423 | 0.34 | 0.03 | 5,249 | $ 197,000 | $ (280,800) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 100-CFS Unit | $ 7,411,000 | $ 7,635,000 | $ 450,000 | $ 136,400 | $ 586,400 | 7,516 | 0.41 | 0.04 | 6,330 | $ 238,000 | $ (348,400) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 150-CFS Unit | $ 9,189,000 | $ 9,467,000 | $ 558,000 | $ 166,300 | $ 724,300 | 9,731 | 0.54 | 0.06 | 8,337 | $ 313,000 | $ (411,300) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| Dodson South Canal Enhancements | | | | | | | | | | | | | | | | | | | | | |
| 600-CFS Canal | $ 5,393,000 | $ 5,556,000 | $ 328,000 | $ 7,000 | $ 335,000 | 4,521 | 0.23 | 0.02 | 3,551 | $ 133,000 | $ (202,000) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| 700-CFS Canal | $ 11,011,000 | $ 11,344,000 | $ 669,000 | $ 7,300 | $ 676,300 | 9,110 | 0.51 | 0.05 | 7,874 | $ 296,000 | $ (380,300) | Slightly Positive | No Effect | Slightly Positive | Slightly Negative | Slightly Positive | No Effect | Slightly Positive | Slightly Positive | Slightly Positive | No Effect |
| Glasgow Re-Regulation Reservoir | $ 1,650,000 | $ 1,778,000 | $ 105,000 | $ 11,300 | $ 116,300 | -1,164 | 0.09 | 0.01 | 1,389 | $ 52,000 | $ (64,300) | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect | No Effect |
| **Improve Water Storage** | | | | | | | | | | | | | | | | | | | | | |
| Enlarge Fresno Reservoir | | | | | | | | | | | | | | | | | | | | | |
| 3 ft (84,400 AF) | $ 2,500,000 | $ 2,694,000 | $ 159,000 | $ 43,000 | $ 202,000 | 4,678 | 0.24 | 0.02 | 3,705 | $ 139,000 | $ (63,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| 5 ft (95,400 AF) | $ 10,000,000 | $ 10,774,000 | $ 635,000 | $ 44,000 | $ 679,000 | 7,330 | 0.38 | 0.04 | 5,867 | $ 220,000 | $ (459,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| 10 ft (129,200 AF) | $ 13,500,000 | $ 14,545,000 | $ 857,000 | $ 45,000 | $ 902,000 | 12,481 | 0.65 | 0.07 | 10,035 | $ 377,000 | $ (525,000) | Slightly Positive | No Effect | No Effect | No Effect | Slightly Positive | No Effect | No Effect | No Effect | No Effect | No Effect |
| **Augment Water Supply** | | | | | | | | | | | | | | | | | | | | | |
| St. Mary System Enhancements | | | | | | | | | | | | | | | | | | | | | |
| 500 CFS | $ 80,232,000 | $ 88,030,000 | $ 5,189,000 | $ 136,000 | $ 5,325,000 | 222,839 | 11.65 | 1.19 | 179,858 | $ 6,754,000 | $ 1,429,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 670 CFS | $ 87,254,000 | $ 95,734,000 | $ 5,643,000 | $ 150,000 | $ 5,793,000 | 248,144 | 12.92 | 1.32 | 199,465 | $ 7,490,000 | $ 1,697,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 850 CFS | $ 96,347,000 | $ 109,331,000 | $ 6,445,000 | $ 165,000 | $ 6,610,000 | 254,574 | 13.25 | 1.35 | 204,560 | $ 7,681,000 | $ 1,071,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| 1000 CFS | $ 105,706,000 | $ 119,951,000 | $ 7,071,000 | $ 170,000 | $ 7,241,000 | 256,028 | 13.34 | 1.36 | 205,949 | $ 7,733,000 | $ 492,000 | Positive | Positive | Slightly Positive | Slightly Positive | Positive | Slightly Positive | Positive | Positive | Positive | Positive |
| Duck Ck. -Vandalia Canal | $ 20,621,000 | $ 22,625,000 | $ 1,334,000 | $ 226,000 | $ 1,560,000 | 28,550 | 1.58 | 0.16 | 24,393 | $ 916,000 | $ (644,000) | Slightly Positive | No Effect | No Effect | Slightly Negative | Slightly Positive | No Effect | No Effect | Slightly Positive | No Effect | No Effect |

Legend

| Legend | |
|---|---|
| Positive | (green circle) |
| Slightly Positive | (green diamond) |
| No Effect | (empty circle) |
| Slightly Negative | (red diamond) |
| Negative | (red circle) |

[1] This is the short list of alternatives that appear to be the most promising to address the issues in the study area. For a complete list of alternatives examined as part of this study, refer to Table 4.1.

[2] As compared to the Future Without A Project condition as described in Chapter 4.

[3] Average Water delivered to canal headgates for the Future Without A Project Condition is 230,766 Acre-Feet. Incremental amout is in addition to the base amount.

[4] Average Water delivered to farm headgates for the Future Without A Project Condition is 13.11 inches per acre. Incremental amout is in addition to the base amount.

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