RECLAMATION

Managing Water in the West

Value Planning
Final Report

St. Mary Diversion and Headworks Infrastructure Replacement Addressing ESA Compliance

A10-D015-4990-002-00-0-0

Conducted in Cooperation with Blackfeet Nation, National Park Service, US Fish and Wildlife Service, Milk River Joint Board of Control, St. Mary Rehabilitation Working Group, Montana Department of Natural Resources and Conservation, Bureau of Indian Affairs, and Bureau of Reclamation, Great Plains Region

U.S. Department of Interior
Bureau of Reclamation
Technical Resources Office
Design, Estimating, and Construction (DEC)
Oversight and Value Program Office
Denver, Colorado

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Executive Summary

The Value Study Team (Team) first met May 10 through 13, 2010, and then on June 29 and 30, 2010, for a Value Planning Study of the St. Mary Diversion and Headworks Infrastructure Replacement addressing the Endangered Species Act (ESA) compliance as it pertains to bull trout (*Salvelinus Confluentus*). The Team adopted, as the baseline, Concept Two from the report entitled "St. Mary Diversion Dam and Canal Headworks Concept Design Study" dated May 2003. The Team then developed two proposed alternatives which are summarized below. These alternatives do not reduce cost, but add functionality to improve fish protection, operation and maintenance (O&M) to satisfy the requirements identified by project stakeholders.

Baseline Proposal: Single sluiceway diversion dam with rockramp fish passage. The estimated cost of this proposal is $11,000,000 in 2010 dollars. The baseline proposal includes replacement of the existing diversion dam and intake structure with a new concrete diversion dam and intake structure and a vertical fish screen.

Proposed Alternative One: Dual Sluiceway Diversion Dam with Traditional Concrete Fish Ladder. The estimated additional cost of this proposal is $3,500,000 (as compared to the baseline) before adding study and/or implementation costs.

Proposed Alternative Two: Add Adjustable Crest Gate. The estimated additional cost of this proposal is $4,500,000 (as compared to the baseline) before adding study and/or implementation costs. This option increases the ability to recapture winter water losses from Lake Sherburne. Additionally, it would increase flexibility in storage and river discharge management.

Other Ideas: The Team identified 72 additional ideas for consideration, which are listed in the "Disposition of Ideas" table on pages 22 through 25.

The Team reviewed the 2002 Value Planning and 2003 Concept Design Study reports and the current design documents dealing with the Lake Sherburne Low Flow Bypass Project. No additional proposals for that project were developed by this Value Planning Team. The Team agreed to support the current low flow bypass design. Potential mitigation strategies were identified but it was decided they were outside the scope of this study. These strategies are included in this report as Appendices.

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Acknowledgement of Design Team and Consultation Assistance

The Value Study Team (Team) wishes to express their thanks and appreciation to the project stakeholders and the members of the Design Team, who fully and cordially provided all requested information and consultation on the conceptual design. The Team would not have been as successful without the Design Team's cooperation and assistance.

The Value Study Team wishes also to express thanks and appreciation to those listed on the Consultation Record of this report. Their cooperation and help contributed significantly to the technical foundation and scope of the Team's investigation and final proposals.

The goal of the value method is to achieve the most appropriate and highest value solution for the project. It is only through the efforts of a diverse, high-performing team, including all those involved, that this goal can be achieved. This study is the product of such an effort.

Value Method Process

The Value Method is a decision-making process, originally developed in 1943 by Larry Miles, to creatively develop alternatives that satisfy essential functions at the highest value. It has many applications but is used most often as a management or problem-solving tool.

The study process follows a Job Plan that provides a reliable, structured approach to the conclusion. Initially, the Team examined the component features of the program, project or activity to define the critical functions (performed or desired), governing criteria and associated costs. Using creativity (brainstorming) techniques, the Team suggested alternative ideas and solutions to perform those functions, consistent with the identified criteria, at a lower cost or with an increase in long-term value. The ideas were evaluated, analyzed and prioritized, and the best ideas were developed to a level suitable for comparison decision-making and adoption.

This report is the result of a "formal" Value Study by a Team comprised of people with the diversity, expertise, and independence needed to creatively scrutinize the issues. The Team members bring a depth of experience and understanding to the disciplines they represent; and an open and independent inquiry of the issues under study, to creatively solve the problems at hand. The Team applied the Value Method to the issues and supporting information, and took a "fresh" look at the problems to create alternatives that fulfill the client's needs at the greatest value.

Current Description

Background: The St. Mary Diversion Dam and Canal are part of the Milk River Project located in north-central Montana. The project was among the first projects authorized under the Reclamation Act of 1902. St. Mary Diversion Dam (also referred to as the St. Mary Diversion Works) is located about 0.75 miles downstream from Lower St. Mary Lake and about 42 miles northwest of Browning, Montana, within the external boundaries of the Blackfeet Reservation. The purpose of the St. Mary Diversion Dam is to divert water from the St. Mary River into the St. Mary canal, which carries the diverted water from the Saint Mary's River (which drains into the Hudson Bay) across the Hudson Bay Divide to the North Fork of the Milk River. The water supply for the project originates in the St. Mary River watershed in Glacier National Park. Runoff from the Swiftcurrent Creek drainage is stored in Lake Sherburne for controlled release into the St. Mary River.

The St. Mary River flows north from the east side of Glacier National Park into Canada. In November 1999, the U.S. Fish and Wildlife Service (FWS) listed bull trout (*Salvelinus Confluentus*) as a threatened species under the Endangered Species Act. The listing of bull trout prompted Reclamation to evaluate methods that would prevent entrainment of fish within canal diversions, allow fish to move upstream past the St. Mary Diversion Dam, and provide winter flows in Swiftcurrent Creek downstream from Sherburne Dam.

The canal downstream of the diversion follows the left bank of the river for about nine miles before crossing above the river through an inverted siphon. The dam is used to divert water into the canal from late March through September. During the non-diversion period, the sluiceways are open (See Figures 1 and 2).

The canal was designed to convey 850 cubic foot per minute (ft^3/s); however, the condition of the canal limits diversion to less than the original capacity. The typical maximum diversion is about 650 ft^3/s. During late March and early April, all river flow in excess of about 100 ft^3/s is typically diverted. From June to August, diversions often reach 75 percent of total river flow. Diversion decreases sharply in late August and September.

The outlet to Lower Saint Mary Lake is located about .75 miles upstream of the existing headworks. The outlet elevation of lower St. Mary Lake is controlled by the remnants of a rock and concrete sill that was constructed about 200 feet (ft) upstream of the present day US Highway 89 bridge (personal correspondence from Jerry Moore, Reclamation Montana Area Office). The sill was constructed to provide a river crossing prior to completion of the St. Mary Diversion Dam Bridge in 1915 (now abandoned). The elevation of the sill is approximately the same as the elevation of the St. Mary Diversion Dam weir crest.

Facility Condition and Operation: The diversion dam, headworks and canal are approaching 100 years old. Recent exams of the diversion dam and headworks revealed substantial freeze-thaw damage to exposed concrete surfaces. Concrete core samples taken from the diversion dam and headworks indicated very poor concrete exists where concrete has been exposed to ice and frequent freeze thaw action. Therefore, to meet ESA compliance and continue to meet project purposes, replacement of these facilities is considered by the Team to be the only viable solution.

Figure 1 - Photo of St. Mary Canal Intake

Figure 2 - Photo of Sluiceway Structures

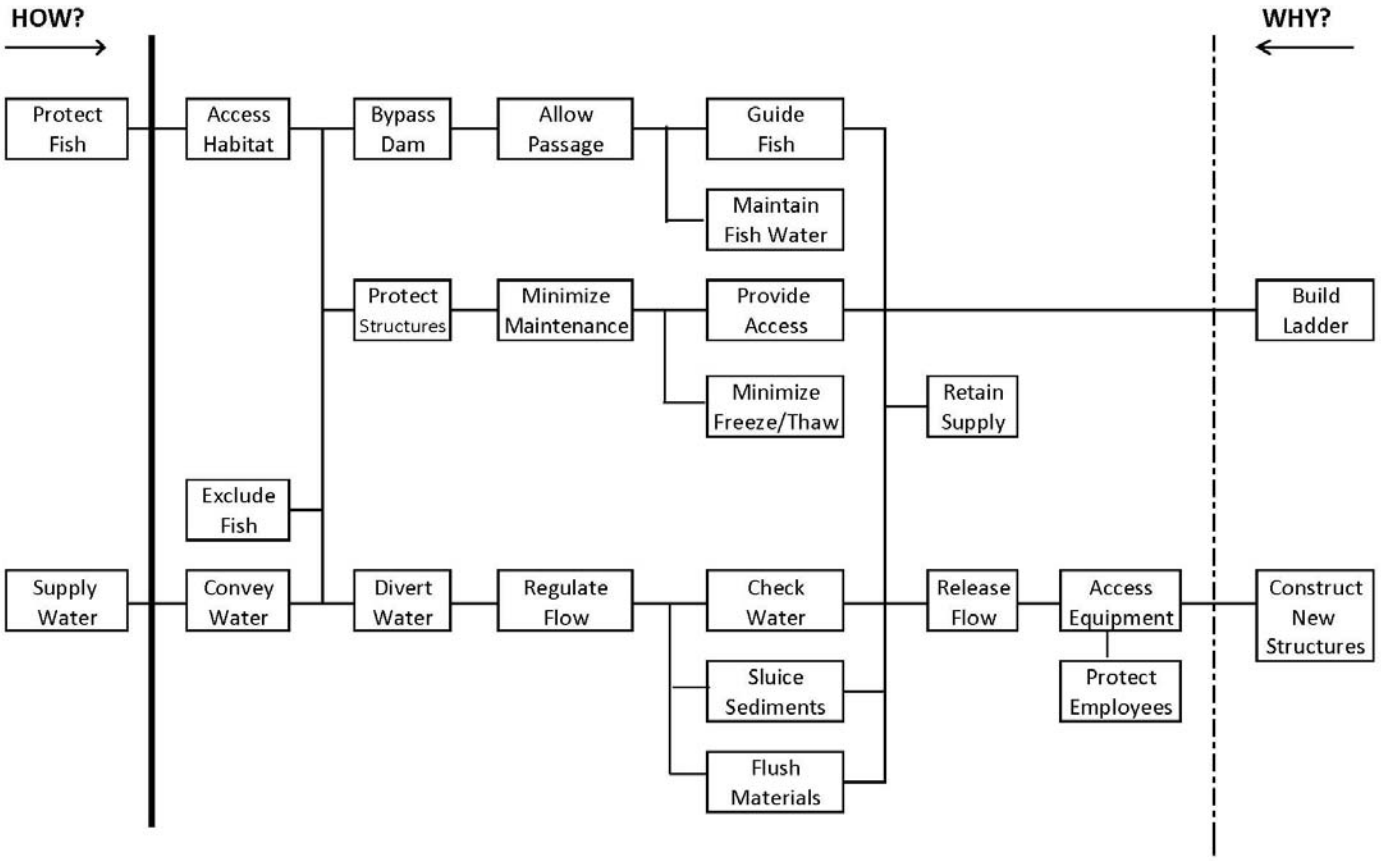
Owner, Users, and Stakeholders List Identification and Issues Determination	
Owner (Identification of the owner or owners)	Owner Issues (Identification of issues important to every Owner)
Bureau of Reclamation	Water Management, ESA Compliance, Maintenance, Tribal Trust, Worker and Public Safety, Cost
User (Identification of the user or users)	User Issues (Identification of issues important to every user)
Irrigators	Reliable Water Supply, Cost, Future O&M Costs, Economic Stability
Tribe	Fisheries, Wildlife, Water Rights, Environmental Impact, Impacts to Landowners, Impacts to Swiftcurrent Creek Restoration Projects, Cultural Impacts, Socioeconomic Impact, Invasive/Exotic Species, Water Based Recreation
Municipalities	Reliable Water Supply, Cost, Future O&M Costs, Economic Stability
General Public	Water Based recreation, Access, Fish and Wildlife, Aesthetics, Economics
Stakeholder (Identify of the stakeholder or stakeholders)	Stakeholder Issues (Identification of issues important to every Stakeholder)
National Park Service	Water Based Recreation, Visitor and Maintenance Access, Natural Resource Impacts and Benefits, Aesthetics, Water Quality and Quantity, Physical Habitat and Connectivity, Ecosystem Impacts, Invasive/Exotic Species
General Public	Water Based Recreation, Access, Fish and Wildlife, Aesthetics, Economics
Montana Department of Natural Resources and Conservation	Reliable water supply for irrigators and communities, Functional St. Mary canal system
US Fish & Wildlife Service	ESA Regulatory Responsibility, Critical Habitat, Natural Resource Impacts and Benefits, Water Quality and Quantity, Physical Habitat and Connectivity, Ecosystem Impacts, Invasive/Exotic Species
Canada	St. Mary - Milk River allocations by International Treaty

Function Analysis System Technique (FAST)

The Value Study Team used the function analysis process to generate a Function Analysis System Technique (FAST) diagram (See Figure 3), designed to describe the present solution from a functional point of view. The FAST diagram helped the Team identify those design features that support critical functions and those that satisfy noncritical objectives. The FAST diagram helped the Team focus on a common understanding of how project objectives are met by the present solution.

Component	Active Verb	Measurable Noun
Fish Screens/Guides/Supports	Guide	Fish
	Exclude	Fish
Trash Rake/Brush	Minimize	Maintenance
	Protect	Structures
	Maintain	Fish water
Radial Gates/Hoists	Allow	Passage
	Convey	Water
	Regulate	Flow
	Check	Water
	Sluice	Sediments
	Flush	Materials
	Release	Flow
	Minimize	Freeze/Thaw
	Build	Ladder
Concrete for Structures	Bypass	Dam
	Protect	Fish
	Supply	Water
	Divert	Water
	Provide	Access
	Retain	Supply
	Protect	Employees
	Construct	Structures

Figure 3 - St. Mary FAST Diagram

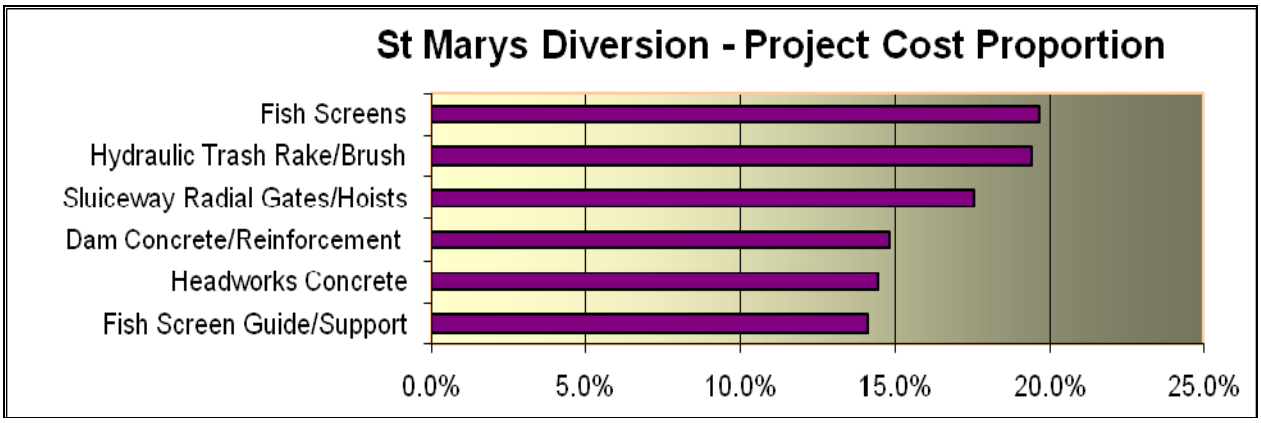


Cost Model and Estimate Information

The Value Study Team cost model is based on the conceptual design estimates provided by the Design Team for the baseline project design. The cost model was developed to focus on features with the greatest potential for improvement (See Figure 4). Unit prices were reviewed by the Cost Estimator and Value Study Team members to ensure reliability and applicability.

Note: The cost estimates prepared for this study have been developed for the sole purpose of comparing costs of proposals to the functional equivalent in the baseline concept. The value study schedule dictates the time and resources allowed for preparation of cost estimates for each proposal alternative. Therefore, these cost estimates are not recommended to be used for budgeting or construction purposes. At final specification, the Design Team will more accurately quantify any cost avoidances or additions resulting from acceptance of proposals. This information will be reported in the accountability report. If as a result of the Value Study a cost estimate is required for appropriations, we recommend that a new total baseline cost estimate be completed.

Figure 4 - Cost Proportion



Baseline Proposal

St. Mary Diversion – Replacement of existing facilities with single sluiceway diversion with rock ramp fishpass and vertical fish screen in canal downstream of new intake.

Alternative Description: All existing structures would be demolished and removed after the new facilities are complete and operational. A new concrete weir with ogee crest would be constructed across the river. The crest of the weir is set at elevation 4472.5 to provide diversion head similar to the existing diversion weir with the weir-boards installed. The weir length is approximately 200 feet. A sluiceway with two bays, each controlled by a 10-ft-wide by 16-ft-high radial gate, is positioned on the left weir abutment. The canal diversion and head-works is located on the left riverbank immediately upstream of the sluiceway. The canal diversion head-works, new canal section and new fish screen structure are shown in Figure 5. A rock ramp fishpass would be constructed along the right riverbank with a slope of 3.5 percent, representative of a more natural stream channel. A shallow "V" shaped channel in the center of the ramp provides a low-flow fish pass. Under progressively higher river flows, fishway flow spills over the fishway left bank providing increased attraction and access to the fishway.

Critical Items to Consider: The rock ramp will provide more natural fish passage. A new diversion dam and intake structure will be needed to properly support features required for ESA compliance and to maintain water delivery during construction.

New Concrete Dam would include: An ogee spillway crest set at elevation 4472.5. One sluice way located on the left riverbank.

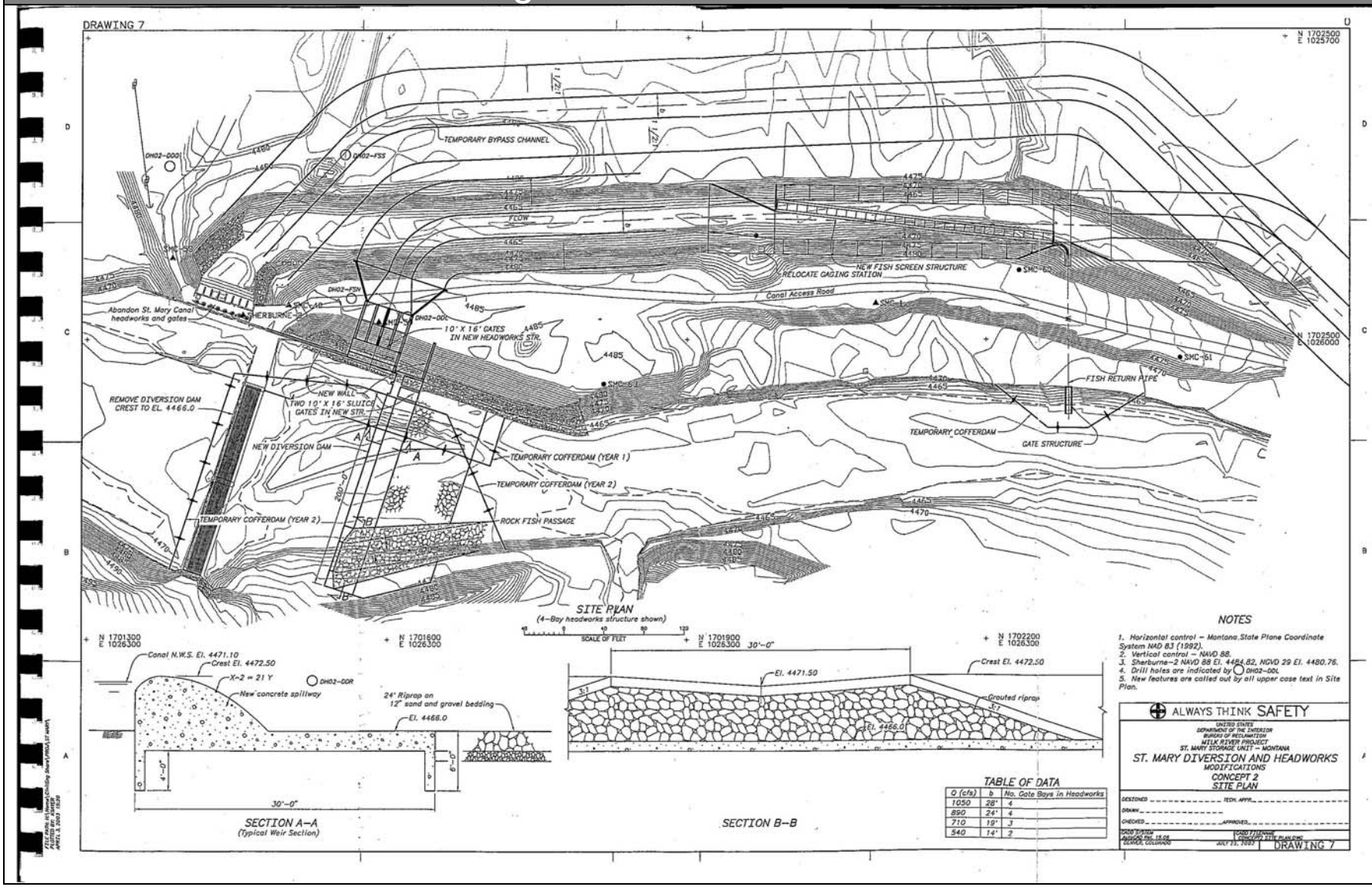
New Canal Intake would include: Four-bay intake with head gate sill at elevation 4468. Adjustable log-boom debris deflector in front of the head gate opening and attached between sluiceway bays to guide floating debris out through the top-release sluice gate.

Additional Structures (Not included in cost estimate):

- Shop and structures to house control panels, tools, equipment, and maintenance items.
- Flow gauging station in St. Mary River to monitor flows immediately downstream of diversion structure.
- When canal diversions are low and St. Mary River flows are high, a check structure may be required to allow the vertical fish screen to properly return fish to the river. The location of pipe/structure for return flows for fish may need to be evaluated during design stage.

Cost Item	Nonrecurring Costs
Baseline Proposal	$ 11,000,000

Figure 5 - Baseline Site Plan



Proposed Alternative One

St. Mary Diversion – Dual Sluiceway Diversion with Low Gradient Fish Ladder

Alternative Description: The proposed alternative includes a number of elements from the original Baseline Design, including the 890 cubic foot per second (cfs) diversion, which allows for the original 850 cfs irrigation allocation and the additional 40 cfs required for fish return channel/pipe of fish screen. It also includes a concrete dam, low-gradient fishway, sluiceway, and head gate structure much like the original design. Sherburne Dam winter release concept would be retained as proposed. (See Figures 6, 7, and 8).

The low-gradient concrete fishway is a step-pool design with dual vertical slot baffles capable of passing a broad range of species and life stages. A trapping facility will be incorporated for monitoring and non-native species exclusion purposes.

The new diversion dam consists of a cantilevered crest to block upstream fish passage. With new information on the potential threat of non-native walleye invasion from St. Mary Reservoir (downstream in Alberta), the Team felt that passage should only be permitted to native species. Invasion by a non-native, top-end predator species such as walleye could have catastrophic effects on native fish populations. For example, Lake Trout, another top-predator introduced in other areas of Bull Trout range has had serious impacts on native populations including significant impacts on Bull Trout west of the divide in Glacier National Park.

Additions would be included to the sluiceways to help ensure that fish do not move upstream while gates are open during periods of sluicing (i.e. winter). A second sluiceway was added to the opposite side of the dam to aid in dam and head gate maintenance and provides additional flows when needed to help guide fish to the ladder opening. A walking bridge was added to the concept to ensure access to the fish ladder and sluiceway on the east (river right) side of the channel.

Critical Items to Consider: Realizing that a rock ramp may provide more natural fish passage, the Team is recommending the use of this low-gradient, dual-baffled fishway. This choice provides a balance between maximizing fish passage effectiveness and efficiency and reducing the potential for non-native species to pass the facility.

The Team feels confident that the ladder will pass all bull trout (our target species), while giving us the ability to selectively remove threatening non-native species. The proposed ladder allows capture of all upstream passing fish if desired by collecting them in a crowding hamber or trap box. This is important to monitor the populations of interest and the success of the ladder.

A detailed survey of private landowner property is required to establish stage limitations for Lower St. Mary Lake. Lake stage elevations for high flow events will have to be modeled to determine anticipated elevation levels for full pool of Lower St. Mary Lake shoreline and upstream river system.

The need for a water right, for operating bypass flows for the fish screen, should be considered.

New Concrete Dam would include:

1. Permanent crest is set at the existing 4472.50-foot (ft) elevation, and allows for attachment of Optional Adjustable Crest to upper surface (see next proposal).
2. Dual sluiceways with one on each side of the river. The river-left sluiceway will consist of two bays. One bay will be opened (sluiced) from the bottom and the other bay will be opened (sluiced) from the top to aid in removal of bottom sediment and floating debris. The river-right sluiceway will consist of one bottom-release bay to aid in fish attraction at the ladder entrance.
3. Sluiceway invert elevations will be raised from 4466 to approximately 4468 with cantilevered lip (overhang) fish-barrier at downstream edge of sluiceway. Drop and overall length of downstream concrete apron must be adequate to provide velocity barriers to fish passage.
4. Entrance to headworks will be raised, but will not reduce water delivery to the canal.
5. Concrete Fish Ladder constructed on river right abutment (east side) and a crowding/collection/trap box at upstream end to allow for monitoring and selective fish passage.
6. Access bridge (walking bridge/catwalk) constructed across dam.

New Canal Head Gates Design: Designed as planned in baseline concept with new sluiceway head gates sill at or above new sluiceway elevation of 4468. Adjustable elevation log-boom debris deflector hung in front of head gates opening and attached between sluiceway bays to guide floating debris out through the top-release sluicegate.

Additional Structures (Note: not included in cost estimate):

1. Shed or shop to house power, tools, fisheries equipment, maintenance items, etc.
2. Flow Gauging Station established in St. Mary River to monitor flows immediately downstream of diversion structure.
3. When canal water level is low, a check structure or rehab of Kennedy Creek check structure may be needed to operate return fish passage.

Advantages	Disadvantages
• Provides ability to exclude non-native fish species • Improved Access • Improved Maintenance • Eases Monitoring for fish population • Reduced chance of fish moving over diversion dam in the event of high flows • Added range of operational choices (sluicing capability, debris control, dewatering for off-season maintenance) • Ability to add adjustable crest	• Has potential to increase annual O&M expense

Potential Risks

It is possible that some fish species will be limited in their ability to pass upstream over the structure.

Cost Item	Nonrecurring Costs
Baseline Concept	$ 11,000,000
Value Concept	$ 14,500,000
Value Study Cost	$ 60,000
Net Additional Cost	$ 3,560,000

Figure 6 - Diversion Dam and Headworks Replacement Site Plan

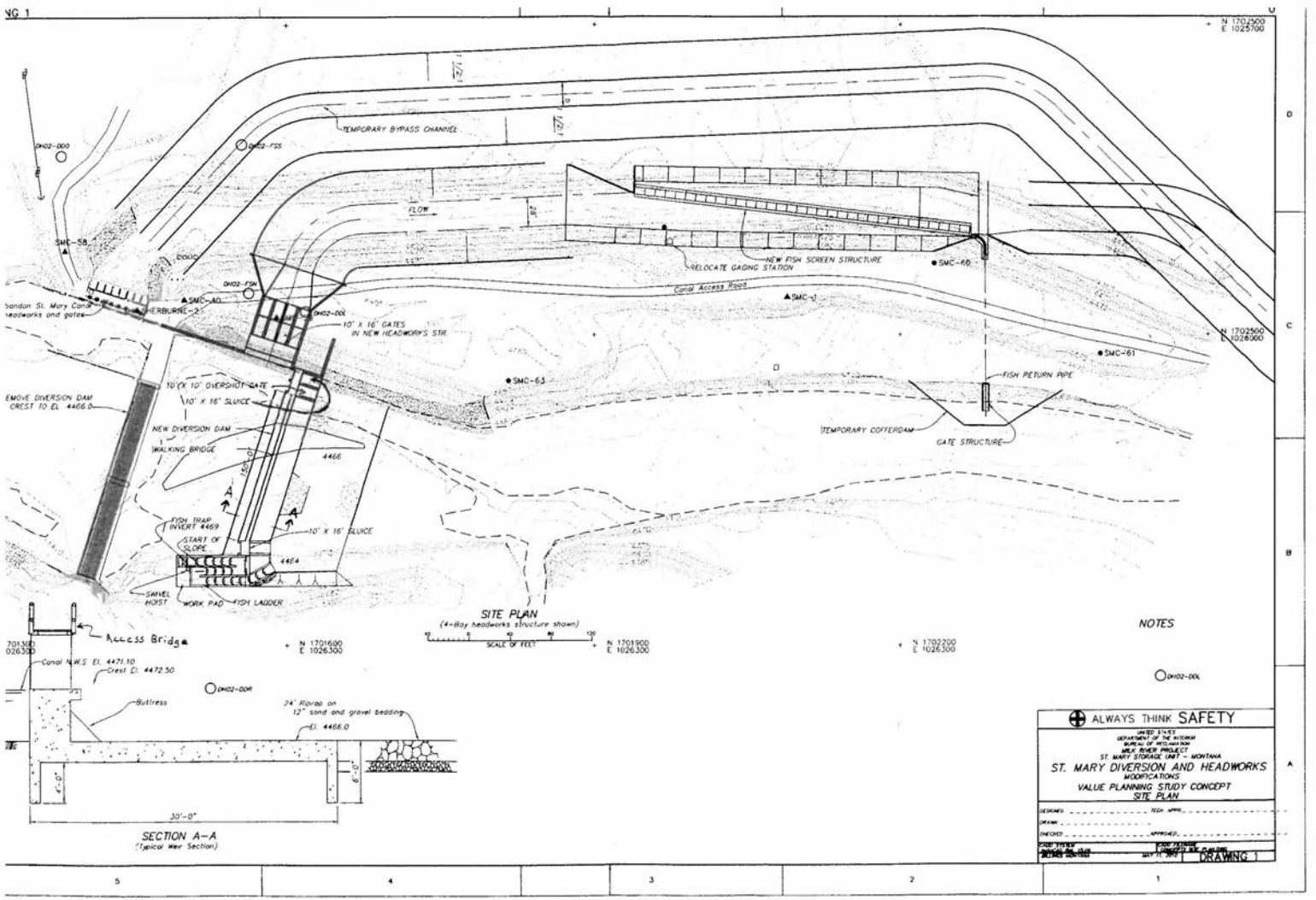


Figure 7 - Diversion Headworks Plans and Sections

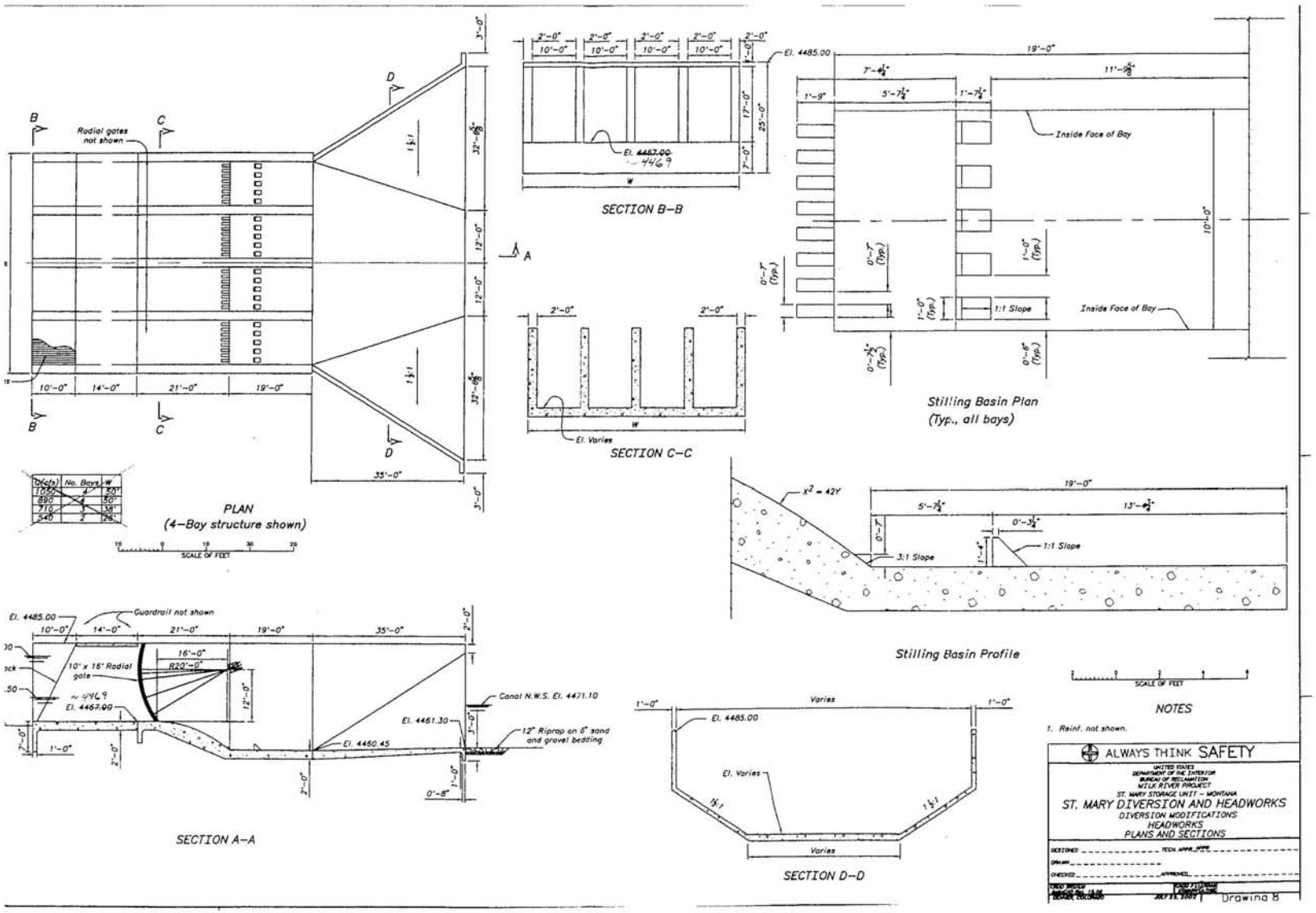
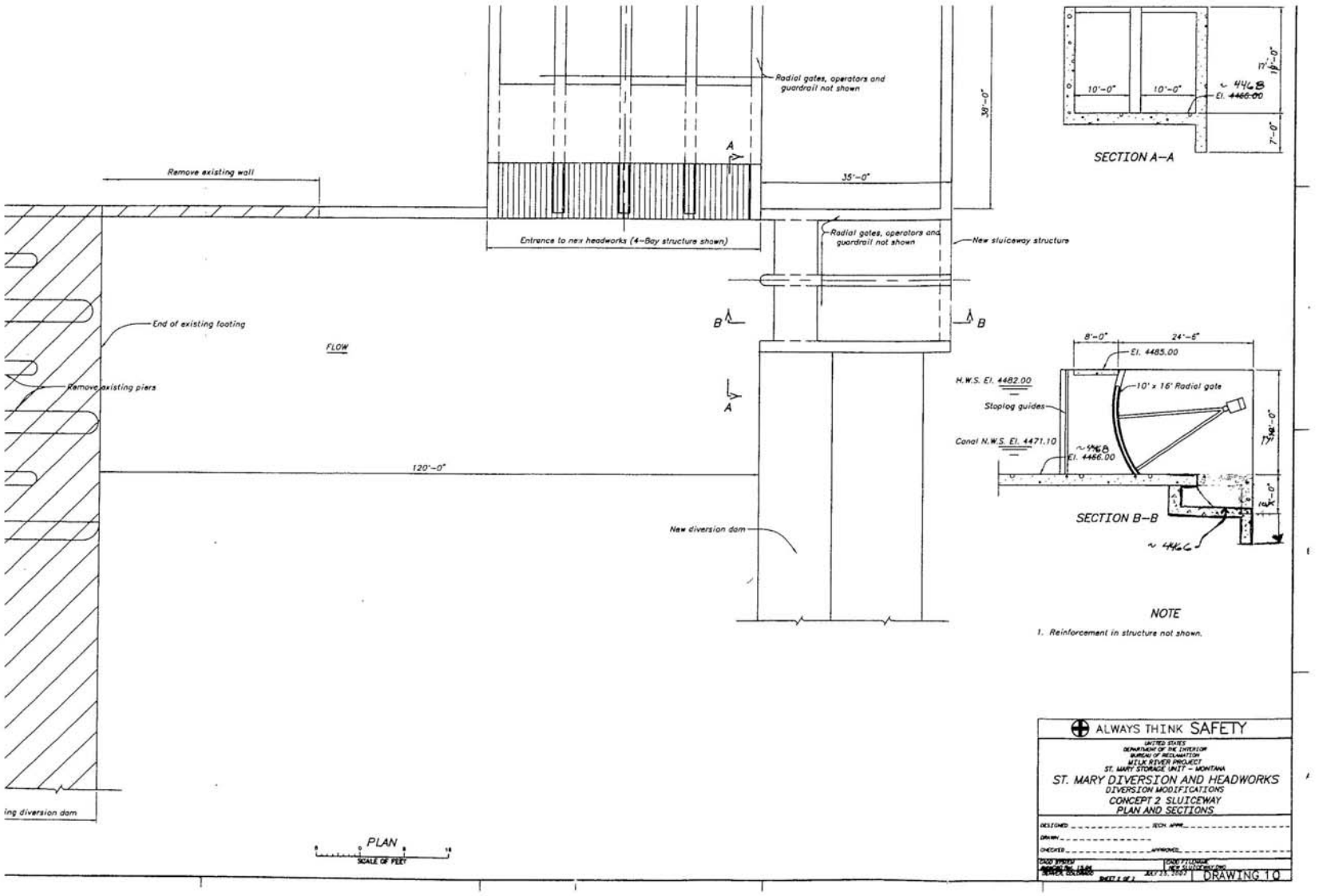


Figure 8 - Sluiceway Plan and Sections



Proposed Alternative Two

Adjustable Crest Gate installed on top of concrete dam to allow for future additional storage and regulation of Lower St. Mary Lake levels.

Proposal Description: This option includes all the structural and non-structural components of the Proposed Alternative One described previously. An adjustable crest gate would add the flexibility to manage Lower St. Mary Lake as a storage facility (See Figure 9).

Critical Items to Consider: Concrete Fish Ladder constructed within the main channel on river right (east) side that includes multiple upstream outlet elevations that may compensate for additional elevation created by adjustable crest, and a crowding/collection/trap box at upstream end to allow for monitoring and selective fish passage.

Ways to Implement: Develop SOP. The goal would be to manage the lake level so it will not exceed the natural high water mark. If proposal is accepted, include within final design. The purpose of this proposal is to at least partially develop the Blackfeet Reserved water right in the St. Mary River. It is not required to provide passage or reduce entrainment of bull trout as an ESA compliance measure

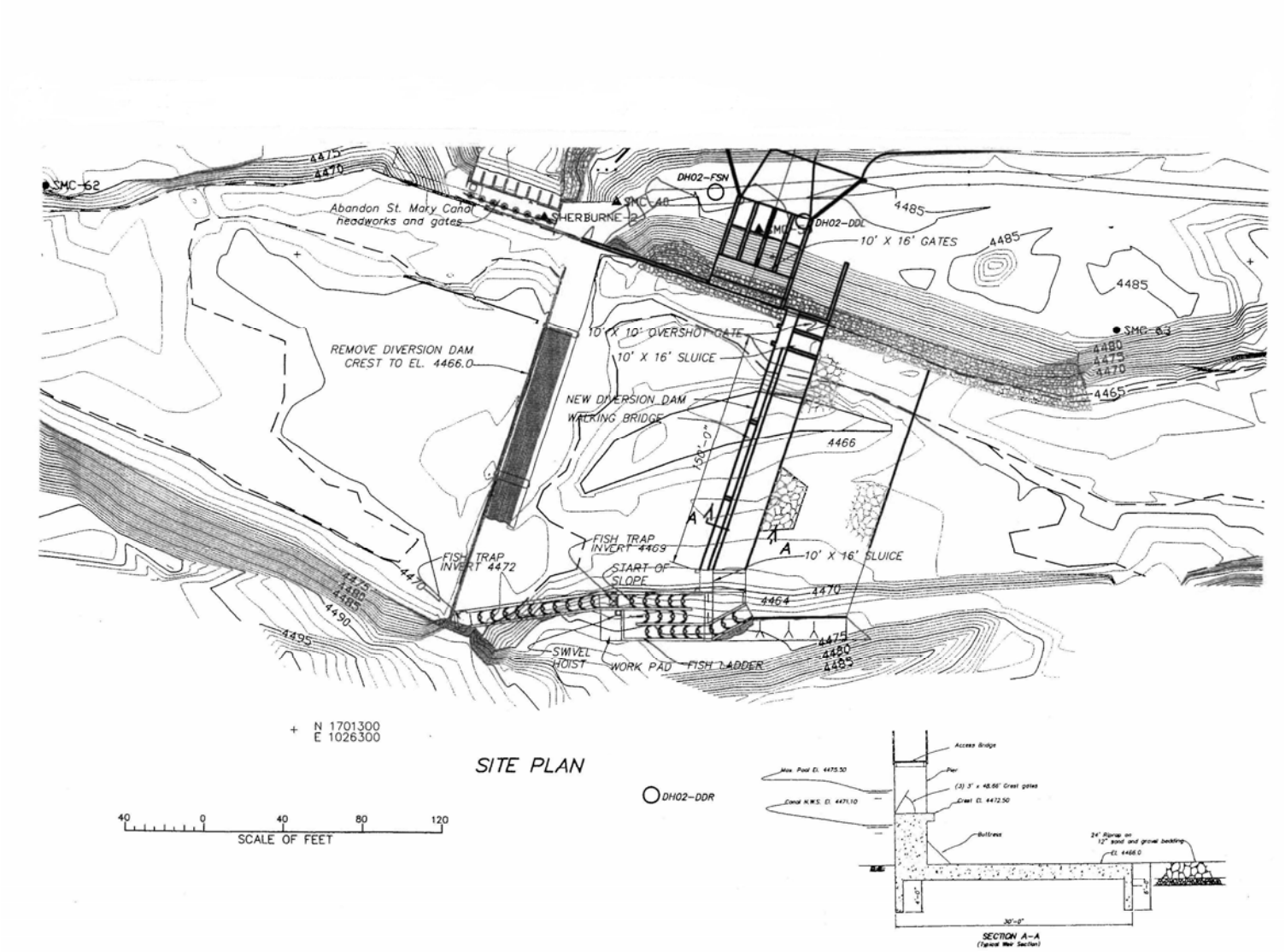
Advantages	Disadvantages
• Provides for lake level control • Provides ability to exclude non-native fish species • Improved Access • Improved Maintenance • Eases Monitoring for fish population • Reduced chance of fish moving over diversion dam in the event of high flows • Added range of operational choices (sluicing capability, debris control, dewatering for off-season maintenance) • Allows for debris to pass over at lower flows • Could mitigate winter releases from Lake Sherburne • Increased access for US portion of St. Mary water	• Has potential to increase annual O&M expense

Potential Risks

It is possible that some fish species will be limited in their ability to pass upstream over the structure. Increases the opportunity for increased flood flows downstream and backwater flooding upstream. May alter hydrology. May flood riparian habitat.

Cost Item	Nonrecurring Costs
Baseline Concept	$ 11,000,000
Value Concept	$ 15,500,000
Value Study Cost	$ 60,000
Net Additional Cost	$ 4,560,000

Figure 9 - Adjustable Crest Plan and Section



Disposition of Ideas	
Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Lower winter release flows at Fresno Reservoir to 25-35 cfs	See additional information in the Appendix
Enlarge Spider Lake	Has potential, but the Team feels that this idea should be referred to another development team
Run St. Mary Canal year-round to maintain Spider Lake	Has potential, but the Team feels that this idea should be referred to another development team
Buy off water rights	The Study Team felt this idea had little potential
Raise St. Mary Diversion by “X-amount” of feet	Included as a proposal in this report
7000 acre/feet reservoir on Babb Flat	The Study Team felt this idea had little potential
More effective use/management/conservation of water	Has potential, but the team feels that this idea should be referred to another development team
Pipe vs. Canal	The Study Team feels the pipe is cost prohibitive
Remove St. Mary Diversion Dam entirely	Biological concerns over non-native fish
Line St. Mary Canal	Has potential, but should be referred to O&M
Move diversion dam to Boulder Creek	The Study Team felt this idea had little potential
Pipe water from Lake Sherburne Dam	The Study Team felt this idea had little potential
Credit Swiftcurrent Creek winter instream flow release to Canada	See additional information in the Appendix
Salvage fish from Swiftcurrent Creek every year upon Lake Sherburne release shutdown	Biological concerns of unauthorized take of threatened and endangered species & salvage efficiency
Create fish habitat upstream from diversion structure that uses less flow	Not feasible due to sediment instability of Boulder/Swiftcurrent Creek hydrology
Pump water into canal	Non gravity flow system adds significant power cost to project
Infiltration gallery from St. Mary River to Canal	Cost could be prohibitive/inefficient/O&M concerns
Pipe water to Duck or Goose Lake	The Study Team felt this idea had little potential
Tunnel under Duck Lake	The Study Team felt this idea had little potential
Create small sediment ponds in Swiftcurrent Creek	Not feasible due to sediment instability of Boulder/Swiftcurrent Creek hydrology

Disposition of Ideas (continued)

Value Study Elements Considered as Potential Proposals and Their Disposition

Idea	Disposition
Expand Lake Sherburne or Fresno Reservoir	Expansion of Fresno Reservoir has potential but the Team feels that this idea should be referred to another development team. Expansion of Sherburne does not have potential
Use Many Glacier water	The Study Team felt this idea had little potential
Create larger “Gliko Reservoir”	The Study Team felt this idea had little potential
Dam at North Fork Milk River	The Study Team felt this idea had little potential
Dredge Fresno Reservoir	Has potential, but the Team feels that this idea should be referred to another development team
Adjudicate Milk River; Enforce Water Rights/Use; Conserve Water	Has potential, but the Team feels that this idea should be referred to another development team
Use Chain of Lakes for off stream storage	Has potential, but the Team feels that this idea should be referred to another development team
Pump storage (near power lines)	Has potential, but the Team feels that this idea should be referred to another development team
Hydropower	Has potential, but the Team feels that this idea should be referred to another development team
Lined reservoir	Cost prohibitive
Shut-off retaining wall	Concept developed as part of proposals
Use historic stream channel (Swiftcurrent Creek)	The Study Team felt this idea had little potential
Non-mechanical (O&M)	Developed within proposed alternatives
Staggered abutments/point bars above Diversion intake	Used other measures to control sediment and debris
Stop fishing	The Study Team felt this idea had little potential
Truck fish	The Study Team felt this idea had little potential
Onsite trash picker	Trash mitigation is provided by modifying sluiceways
Automatic gates (SCADA)	Could be added, but Team did not develop at this time due to initial and long term expense
Canal bypass system for maintenance	The Study Team felt this idea had little potential
Divert out of Upper St. Mary Lake	The Study Team felt this idea had little potential
Increase storage in Canal	Has potential, but the Team feels that this idea should be referred to another development team

Disposition of Ideas (continued)

Value Study Elements Considered as Potential Proposals and Their Disposition

Idea	Disposition
Move Camp 9	Not discussed by team, but should be considered by Reclamation towards future project operations
Move Canal head gate to Swiftcurrent Creek Dike	Limits the project to diversion of Swiftcurrent flows only
Provide adequate water from other watersheds	Likely to be cost prohibitive
Safe fish passage	Addressed in submitted proposal(s)
Water storage tanks	The Study Team felt this idea had little potential
Increase capacity of river beds	The Study Team felt this idea had little potential
Re-rate St. Mary Canal capacity	The Study Team felt this idea had little potential
Electric shock	Past electronic fish barriers did not adequately prevent fish entrainment
Train fish	The Study Team felt this idea had little potential
Nets/Barriers	Not developed in favor of other diversion dam entrainment/passage/barrier options
Removable debris screens	Has potential, but the team feels that this idea can be pursued further during development of final design
Enforce fishing regulations	Currently enforced by Blackfeet Fish and Wildlife Department/Glacier National Park
Remove non-native fish	Currently in progress by fisheries managers
Light/sound fish barrier	Not developed in favor of other diversion dam entrainment options
Fish hatchery	Cannot sustain the wild native fishery
Underground water storage	The Study Team felt this idea had little potential
Concrete ladder vs. rock ramp	Concrete fish ladder developed for proposal
Pump from river at St. Mary Siphon site	Not developed in favor of other diversion options
No sluice gates - use overflow bladder	Not developed in favor of other diversion options
Radial gates/other gates	Developed for proposal
Build dikes at upper end of Fresno Reservoir (similar to Canyon Ferry Reservoir)	Has potential, but the Team feels that this idea should be referred to another development team
Flow through wetland habitats	The Study Team felt this idea had little potential
Add dams	The Study Team felt this idea had little potential
Back pumping	The Study Team felt this idea had little potential
Build “Babb Dam” downstream of St. Mary Siphon	The Study Team felt this idea had little potential
Build dam upstream of Highway 89 bridge	The Study Team felt this idea had little potential
Pipe water to Fresno Reservoir from Lake Elwell (Tiber)	The Study Team felt this idea had little potential
Flow through wetland habitats	The Study Team felt this idea had little potential

Disposition of Ideas (continued)

Value Study Elements Considered as Potential Proposals and Their Disposition

Idea	Disposition
Fish elevators	The Study Team felt this idea had little potential
Put diversion facilities under protective shelter	Has potential, but not developed. Could be added during design process
Lake pipeline diversion option	Thoroughly discussed, but in the end cost effectiveness and other issues tabled this idea
Farmer's screen	Thoroughly discussed but not developed further in favor of other screening options
Small Obermeyer type-gate	Not developed in favor of other diversion dam options
Pursue Fresno Reservoir Outlet Modifications to reduce winter flow losses	Has potential, but the team feels that this idea should be referred to another development team
Explore Credit Agreement/negotiations with Canada	Has potential, but the Team feels that this idea should be referred to another development team

Data and Documents Consulted	
Title, Author, and Date	**Information**
St. Mary Diversion Dam and Canal Headworks Concept Design Study, Bureau of Reclamation, Technical Service Center, Denver, CO May 2003	General Project Information
Value Engineering Report St. Mary Diversion Dam and Canal Headworks Replacement, Bureau of Reclamation, Technical Service Center, Denver, CO March 2002	Baseline Design
Conceptual Designs for Lake Sherburne Dam Low Flow Bypass and Outlet Works Repairs U.S. Department of the Interior, Bureau of Reclamation , Building Seismic Safety Program, Technical Service Center, Denver, Colorado April 2010	Low Flow Bypass Design
St. Mary Diversion Facilities Feasibility and Preliminary Engineering Report for Facility Rehabilitation, TD&H Engineering Consultants August 2006 (Final) For Montana Department of Natural Resources and Conservation	Project Considerations

Design and Value Study Teams' Presentation Attendance List			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Jennifer Brandon Joint Board of Control Project Manager and Team Member	Milk River Irrigation Project 1445 18th Street Havre, MT 59501 Phone: 406-945-3383 E-mail: brandonj@mtintouch.net	X	X via telephone
Toby Tabor Fisheries Biologist and Team Member	Blackfeet Fish & Wildlife Department 101 Popimi Street Browning, MT 59417 Phone: 406-338-7207 E-mail: ttabor@blackfeetnation.com	X	X
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John Sanders St. Mary Canal Engineer and Team Member	Montana Department of Natural Resources and Conservation 1424 9th Avenue Helena, MT 59620 Phone: 406-444-6796 E-mail: josanders@mt.gov	X	X

Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Larry Mires Executive Director, St. Mary Rehabilitation Working Group and Team Member	St. Mary Rehabilitation Working Group 17 Robertson Court Glasgow, MT 59230 Phone: 406-263-8402 E-mail: smrwg@nemont.net	X	X
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Allan Steiner Supervisor, Facilities and Services Tech and Team Member	Bureau of Reclamation Marias/Milk Rivers Division (MT-940) PO Box 220 Chester MT 59522 Phone: 406-456-3226 E-mail: asteiner@usbr.gov	X	X
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Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Brent Mefford Hydraulic /Fisheries Engineer and Team Member	Bureau of Reclamation, Technical Service Center PO Box 25007 (86-68460) Denver, CO 80225 Phone: 303-445-2149 E-mail: bmefford@usbr.gov	X	X
Ron Billstein DOW HKM Tribe and Team Member	Blackfeet Tribe Representative, DOWL HKM 222 North 32nd Street, Suite 700 Billings, MT 59101 Phone: 406-869-6303 E-mail: rbillstein@dowlhkm.com	X	X
Joseph Weatherwax Team Member	Blackfeet Environmental Office P.O. Box 2029 Browning, MT 59417 Phone: 406-338-7421 E-mail: jweatherwax@3rivers.net	X	X
Miguel Hernandez Civil Engineer	Bureau of Reclamation, Montana Area Office 2900 4th Avenue North (MT-770) Billings, MT 59101 Phone: 406-247-7665 E-mail: mhernandez@usbr.gov		X

Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Christina Lasater Natural Resource Specialist	Bureau of Reclamation, Great Plains Area Office PO Box 36900 (GP-4300) Billings, MT 59107 Phone: 406-247-7753 E-mail: clasater@usbr.gov		X
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Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Jeanne Whiteing Tribal Attorney	Whiteing & Smith 1136 Pearl Street, Suite 203 Boulder, Colorado 80302 Phone: 303-444-2549 E-mail: jwhiteing@whiteingsmith.com		X via telephone
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Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Jeff Baumberger Supervisor/Natural Resource Specialist	Bureau of Reclamation, Montana Area Office 2900 Fourth Avenue North (MT-200) Billings, MT 59101 Phone: 406-247-7314 E-mail: jbaumberger@usbr.gov		X via telephone
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Earling Juel, PE Sr. Geotechnical Engineer	TD&H Engineers 1200 25th Street South Helena, MT 59405 Phone: 406-761-3010 E-mail: earling.juel@tdandh.com		X via telephone
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Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
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Design and Value Study Teams' Presentation Attendance List (continued)

Name/Title/Discipline	Address/Phone/E-mail	Design Team Presentation 5/10/10 – 10:00 a.m.	Value Study Team Presentation 6/30/10 – 10:00 a.m.
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Design and Value Study Teams' Presentation Attendance List (continued)			
Name/Title/Discipline	**Address/Phone/E-mail**	**Design Team Presentation 5/10/10 – 10:00 a.m.**	**Value Study Team Presentation 6/30/10 – 10:00 a.m.**
Tom Cook Value Program Manager, Value Planning Team Facilitator	Bureau of Reclamation, Technical Resources Design, Estimating, and Construction (DEC) Oversight and Value Program Office P.O. Box 25007 (86-62200) Denver, CO 80225 Phone: 303-445-3292 E-Mail: tcook@usbr.gov	X	X

Appendix

Record of discussions on potential mitigation measures described in Disposition of Ideas section:

Modify Fresno Reservoir Outlet to Allow For Decreased Winter Releases: During the winter, Reclamation has a contractual obligation to supply a minimum release of 25 cfs to the Milk River from Fresno Reservoir. However, currently, the minimum winter releases must be in the 40 to 45 cfs range because cavitation damage to the upstream side of the outlet gates will occur if flows fall below this range.

Under this mitigation option, the dam outlet works would be modified to allow for lower releases. This would involve tapping into the two existing outlet conduits, installing smaller, secondary pipes into them, and then melding these two pipes together to produce a single, gated low-flow outlet. Reducing the winter outflow may result in storage gain of 5,000 to 8,000 acre-feet increasing the efficiency of the overall winter releases from Fresno Reservoir.

Under this option, the potential reduction in releases from Fresno Reservoir is comparable to the potential increase in winter releases from Sherburne Reservoir. Preliminary modeling indicates this has the potential to mitigate reductions in water supply due to winter releases from Sherburne.

Negotiate an arrangement for the United States to receive "credit" for the increased winter releases:

Unless the flows were recaptured in the U.S., increased winter releases from Sherburne Reservoir ultimately would flow into Canada and be captured in the St. Mary Reservoir by Alberta. Because Canadian irrigators would ultimately benefit from at least some of these winter flows, it might be possible to negotiate with the Canadians for the U.S. to receive a "credit" for these new winter releases. The U.S. could then draw on this credit by taking more than its share of St. Mary River flows during the irrigation season.

The current apportionment procedures with Canada allow for a semi-monthly balancing of flow volumes. In other words, the daily surplus and deficits of St. Mary River deliveries to Canada must be balanced over each two-week period. The current procedures do allow for some deviation from the semi-monthly balancing through an agreement called the "Letter of Intent".

Modifying the Letter of Intent might be one way of giving the U.S. a mechanism to reclaim some of the Sherburne winter releases lost to Canada. Another option might be extending the current semi-monthly balancing period to allow for seasonal or annual balancing. Any of these options would require agreement by Alberta, and approval by the International Joint Commission.

Sherburne Winter Releases and Possible Mitigation Strategies: There currently are no minimum instream flow releases from Sherburne Reservoir during the winter (November

through early March period). The reservoir outlet is entirely shut off shortly following the shutdown of the St. Mary Canal each fall. To protect and enhance the habitat for wintering Bull Trout and other fishes, a winter instream release in Swift Current Creek below the dam will be required in the future. The exact flow needed during the winter has not been precisely identified, but it is thought the release might be from 15 to 20 cubic feet per second. The current outlet works at Sherburne Dam do not allow for low-flow winter releases.

Reclamation has developed a plan to modify the existing outlet structure at Sherburne Dam to allow for low-flow winter releases. This would require the installation of bypass conduits and control gates, modifications to the inner and outer walls of the gate tower, and heating units to prevent winter freezing between the inner and outer walls.

Assuming a 15 to 20 cfs minimum release, there would be about 5,000 to 7,000 acre feet of water released from the reservoir in the future that was not released during the past. This entire volume of winter release would not necessarily be lost to the Milk River project the following irrigation season, but there would be reductions to irrigation deliveries. A worst-case scenario might be about a 5,000 acre-foot seasonal reduction in irrigation deliveries during a drier year.