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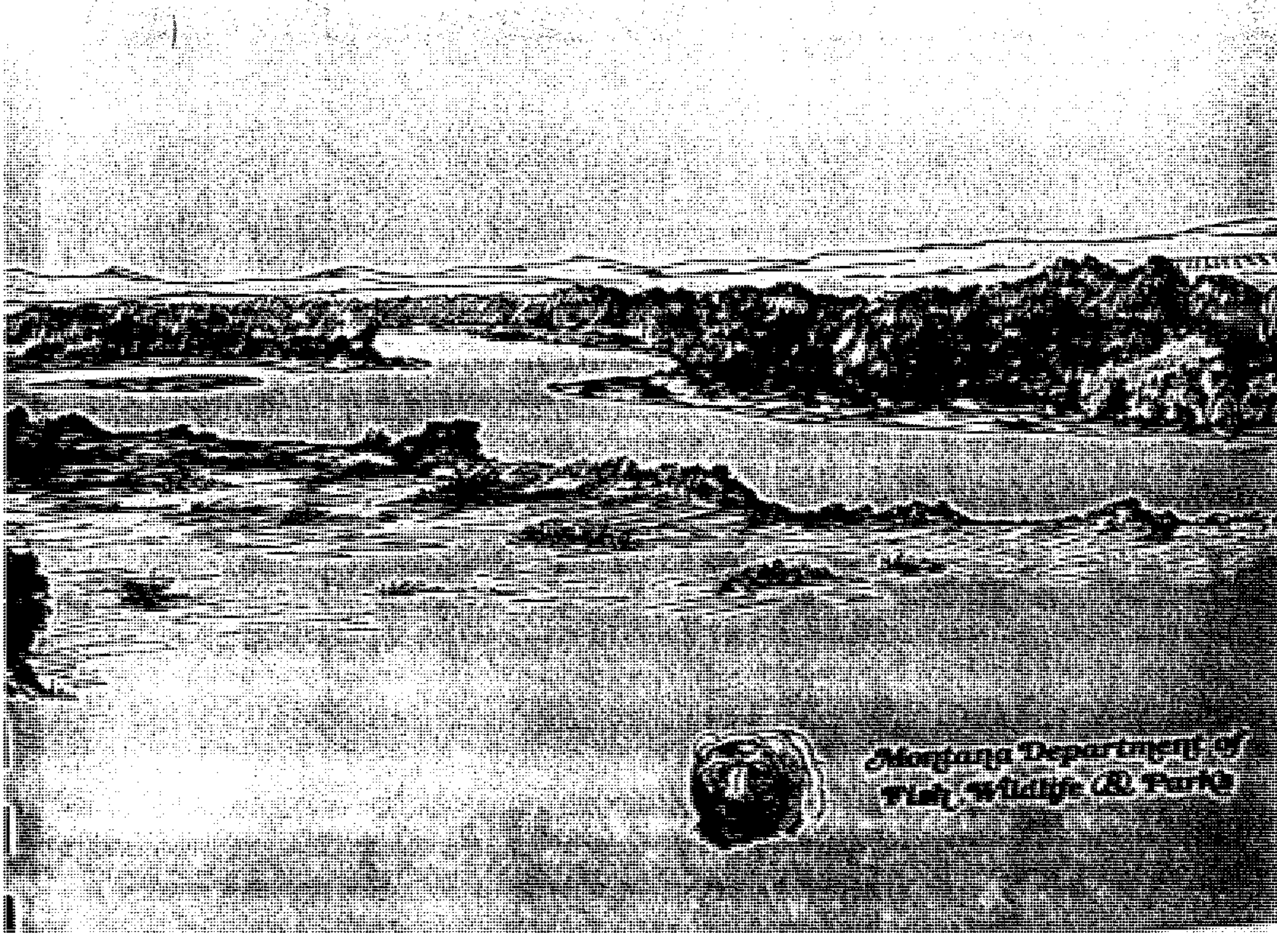
Application for Reservations of Water

in the Lower Missouri River and Little Missouri River Basins



Montana Department of Fish, Wildlife & Parks

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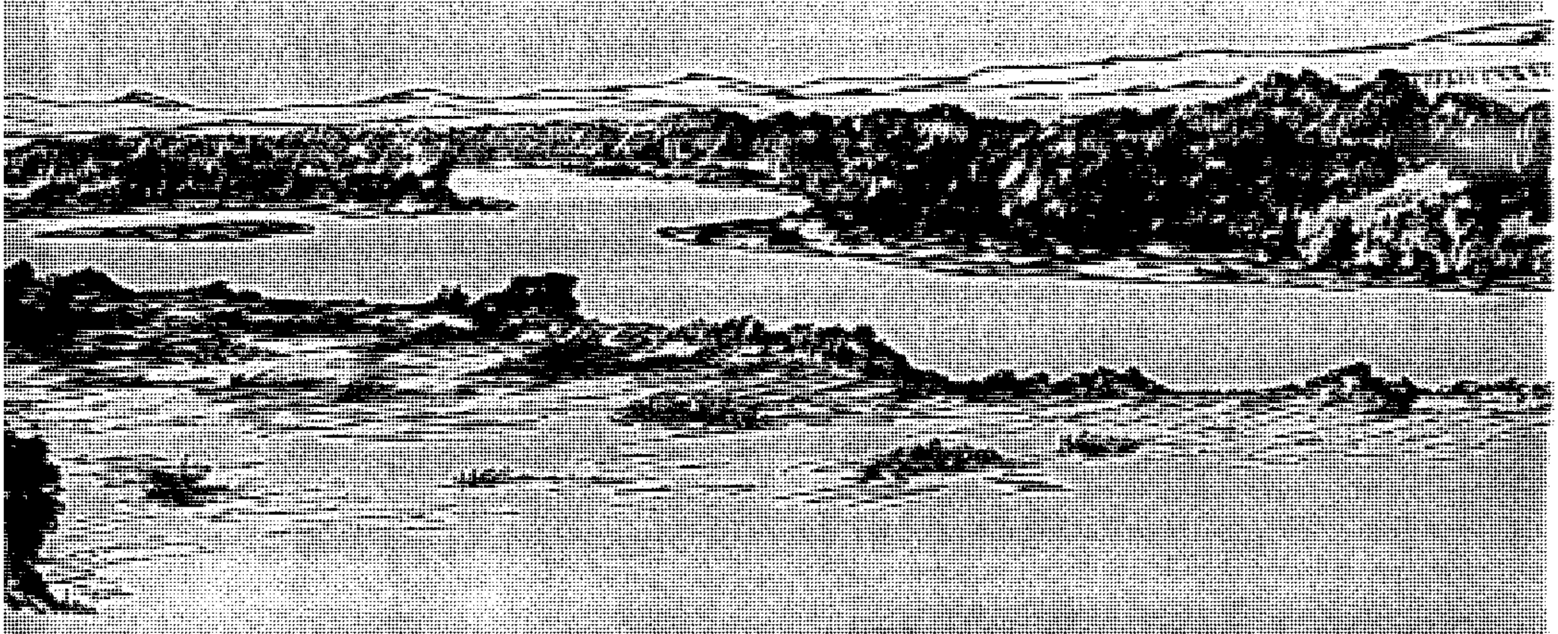

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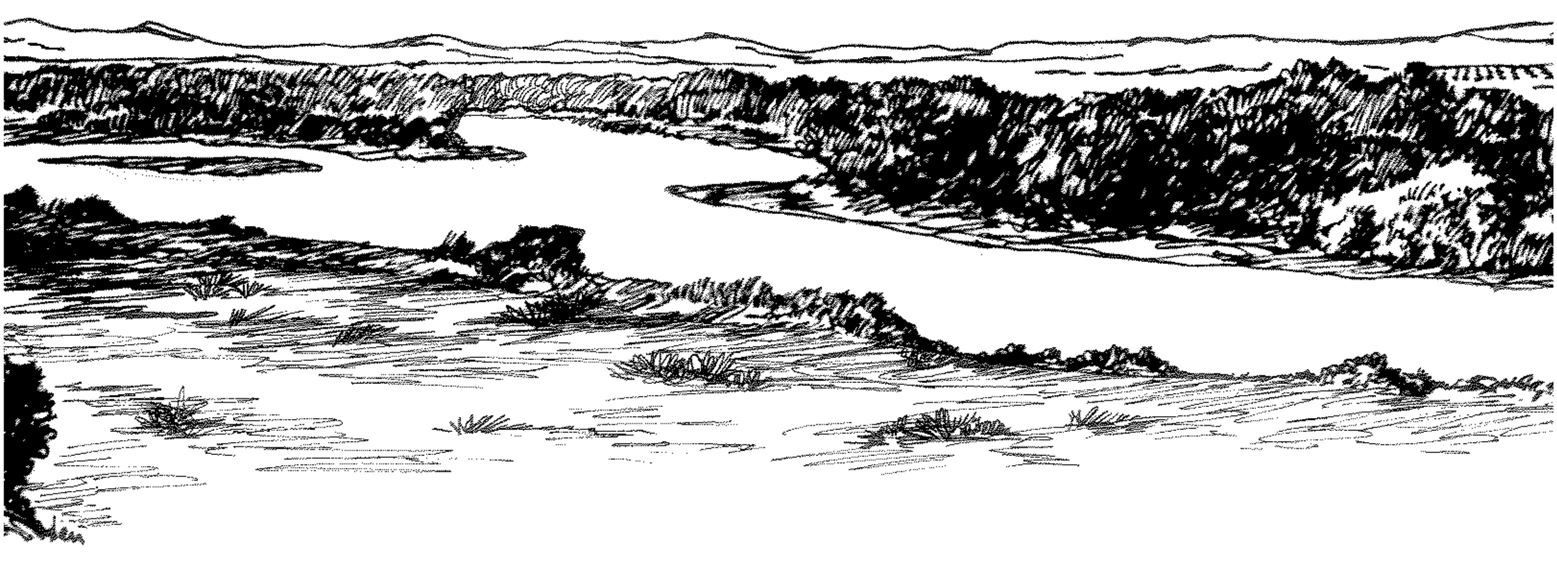

Montana Department of Fish, Wildlife & Parks

APPLICATION FOR RESERVATIONS OF WATER
IN THE MISSOURI RIVER BASIN BELOW FORT PECK
DAM AND THE LITTLE MISSOURI RIVER BASIN

Submitted by
Montana Department of Fish, Wildlife and Parks
1420 East Sixth Avenue
Helena, Montana 59620

June 1991

Cover Design Courtesy of Dan Stinson

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INTRODUCTION

This is the last of the applications submitted to the Board of Natural Resources and Conservation for reservations of water in the Missouri River basin. Section 85-2-331, MCA, authorizes this application from Fort Peck Dam to the Montana-North Dakota border and in the Little Missouri River basin. The application contains the Summary, Purpose, Need, Amount (including details of methods used), Public Interest considerations, and a Management Plan as required by ARM 36.16.104 through 36.16.106 for both the lower Missouri and Little Missouri River basins.

This application also contains specific information on streams in the Missouri River basin downstream from Fort Peck Dam and streams in the Little Missouri River basin for which reservations are requested. Information presented includes a brief physical description of the stream or stream reach, the fisheries and wildlife resources associated with the stream, and the flow levels that are requested. The methods and data used in deriving the requested flows are also discussed. Within each basin, streams are presented in a downstream order.

For purposes of this application, that portion of the Missouri River below Fort Peck Dam and its tributaries are referred to as the "lower Missouri River basin." The Little Missouri River and its tributaries will be referred to as the "Little Missouri River basin." Throughout the PUBLIC INTEREST section, the general discussion applies to both the lower and Little Missouri River basins. However, where appropriate, specific differences between the two basins are discussed separately.

No reservations are requested for streams or stream reaches which are within Indian Reservations, or in the case of the Fort Peck Reservation, streams which form the boundaries of the Reservation. Under terms of the Fort Peck Compact, the tribe has established its own instream flows on streams bordering and within the reservation.

SUMMARY

Pursuant to Section 85-2-316, MCA, and Article II of the Constitution of the State of Montana which establishes that a clean and healthful environment is an inalienable right of Montana citizens, the Montana Department of Fish, Wildlife and Parks respectfully files this application for reservations of water in the lower Missouri River basin below Fort Peck Dam and in the Little Missouri River basin. Section 85-2-331(1), MCA, requires that water reservation applications for both of the basins be submitted by July 1, 1991.

Figure 1 is an abridged map of the Missouri River basin below Fort Peck Dam and Figure 2 similarly illustrates the Little Missouri River basin. Both figures show, in general, where the requested reservations will be applied to use. Additional maps are included with the specific reservation requests.

The purpose of the reservations herein applied for is to reserve waters, and flows thereof, for existing and future beneficial uses and to maintain a minimum flow, level, and quality of water during such periods throughout each year in order to attain and serve existing and future beneficial uses.

Fish and wildlife populations and their habitats are inseparable. Therefore, preservation of fish and wildlife populations depends on the preservation of their habitats and all habitat components. The habitat components for streams and rivers are: (1) the physical streambed and banks, (2) the quantity of the water, and (3) the quality of the water.

Protection of the physical streambed and banks is provided by the Stream Protection Act (87-5-501, MCA) and the Natural Streambed and Land Preservation Act of 1975 (75-7-101, MCA). The prevention, abatement and control of pollution in state waters is the responsibility of the Montana Department of Health and Environmental Sciences through 75-5-211, MCA. The 1973 Water Use Act provides the opportunity for the state or any political subdivision or agency thereof or the United States to apply to the Board of Natural Resources and Conservation to reserve waters for existing or future beneficial uses or to maintain a minimum flow, level or quality of water (Section 85-2-316, MCA).

Fish, wildlife and outdoor recreational resources are important to human well-being and must be preserved for the use and enjoyment of current and future generations. These resources are owned by the people of the state and must be managed for the best public interest.

The Department of Fish, Wildlife and Parks (DFWP) has a two-fold responsibility: (1) to protect and enhance the abundant and diverse fish, wildlife and recreational resources, and (2) to

provide optimum opportunities for diverse outdoor recreation that are commensurate with resource preservation. Water reservations for instream flows would serve to protect a vital component of the stream fishery habitat and thereby assist in meeting those responsibilities.

The amount of the reservations requested varies from small flow quantities in headwater tributaries to larger quantities on the lower mainstem Missouri River. Flows are requested for warm and coldwater tributaries of the Milk River as well as for other tributaries of the Missouri. Flows are also requested for the mainstem Little Missouri River and three of its tributaries. The specific requests are set forth in the section "DETERMINATION OF THE AMOUNT OF THE RESERVATIONS."

There are attached hereto, and made a part hereof, statements on the purpose of, the need for, the amount of and public interest of these requested reservations of water. These statements and their attachments are presented in support of this application for reservations of water and to meet the requirements of the Montana Water Use Act and applicable rules thereunder for the establishment of reservations of water for fish, wildlife and recreational uses.

THIS APPLICATION CONTAINS NO PROPOSED PROJECTS FOR USE OF THE RESERVED WATER.

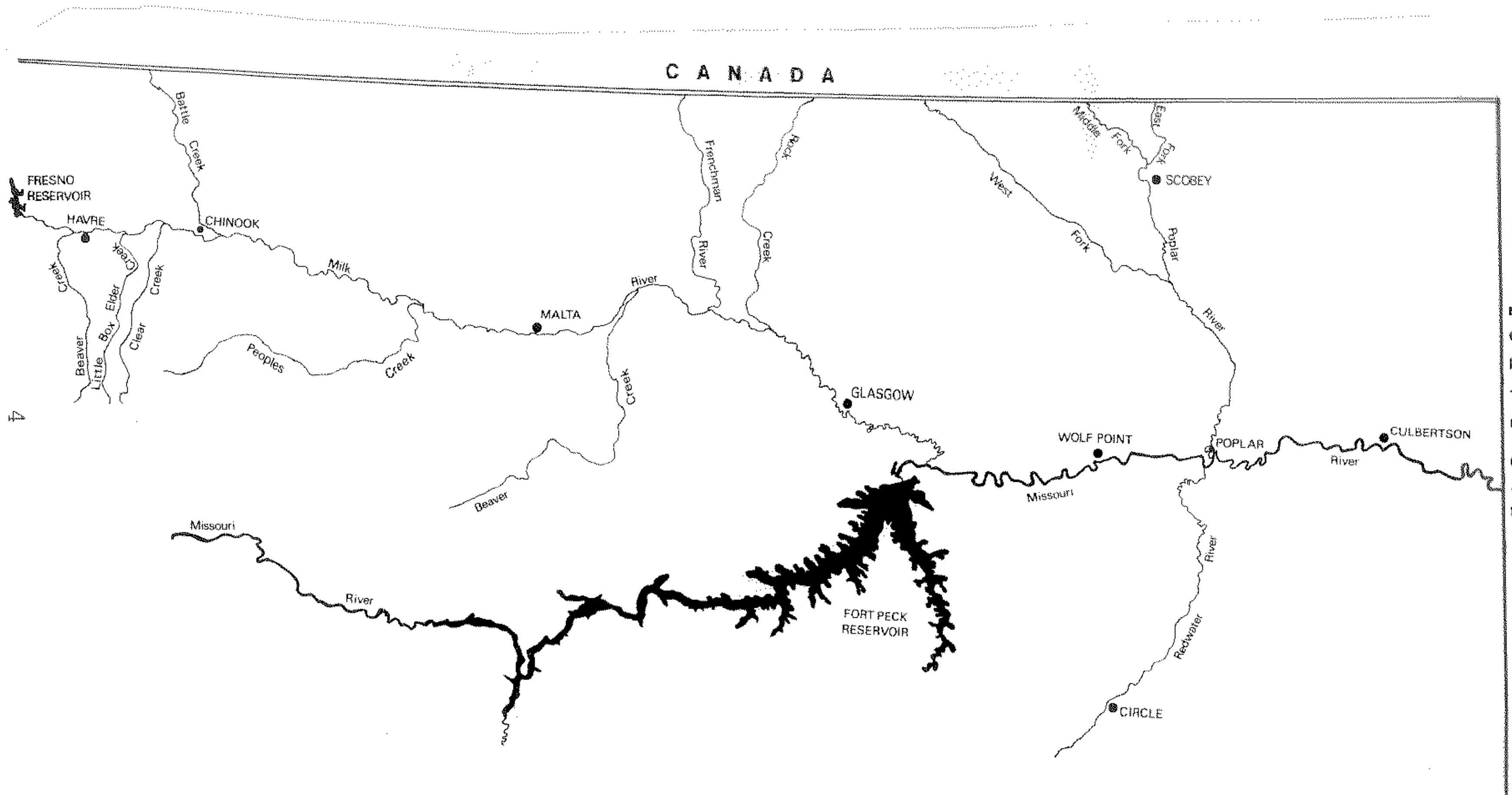

Figure 1. Map of the Missouri River basin below Fort Peck Dam.

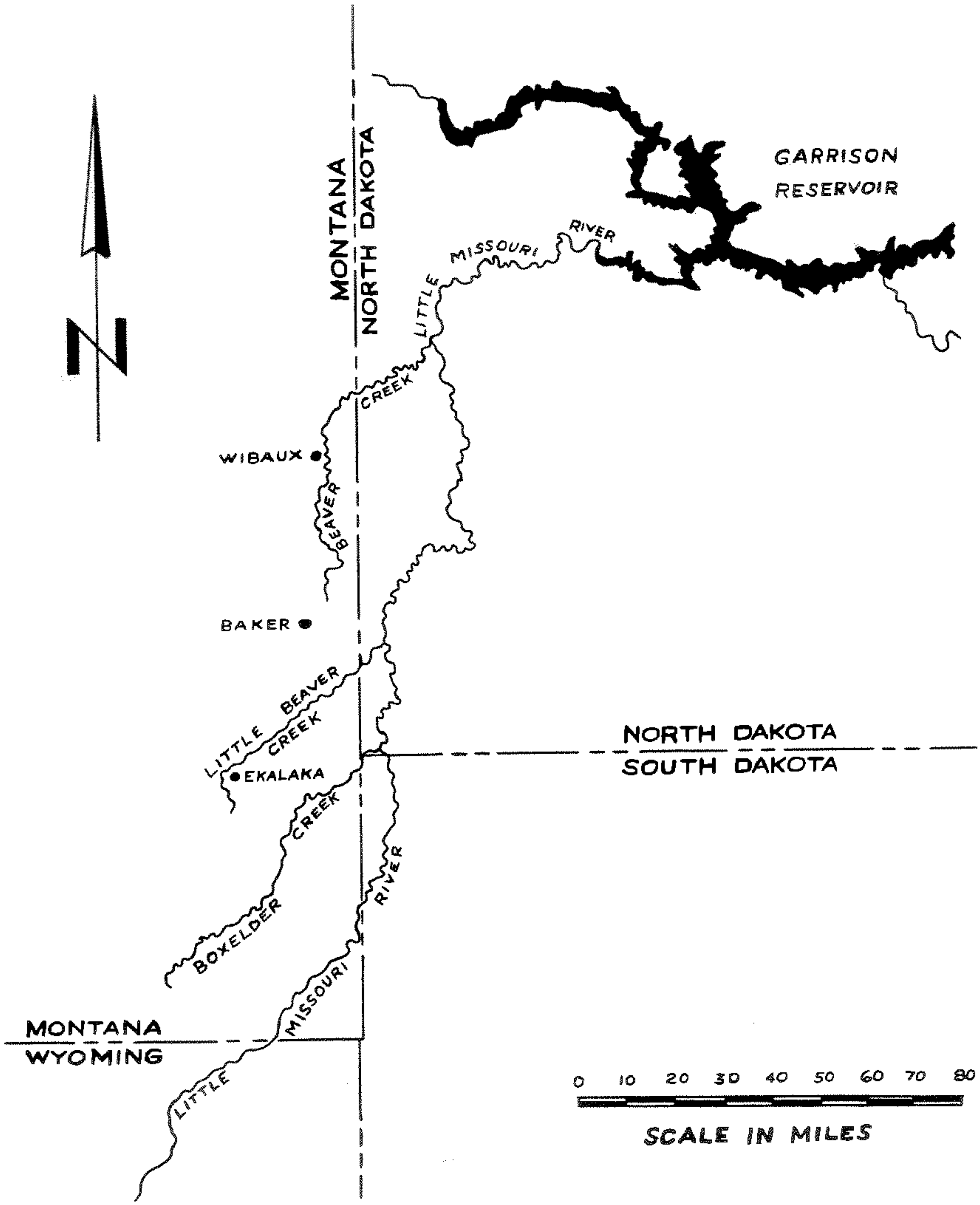

Figure 2. Map of the Little Missouri River basin.

PURPOSE OF THE RESERVATIONS

Section 85-2-102, MCA, and ARM 36.16.102 define beneficial use of water to include ". . . but not limited to agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses; . . ." (Emphasis added.)

The purpose of the reservations is to reserve flows for existing and future beneficial uses so as to maintain a minimum flow, level or quality of water by month and throughout each year to attain and serve those beneficial uses as follows:

(1) for the benefit of the public for fish and wildlife uses;

(2) for the benefit of the public for recreational uses.

The attainment and service of such uses are to:

(1) provide fish and wildlife habitat sufficient to accommodate a diversity of species comprising this natural resource at levels comparable to existing levels;

(2) contribute to, and maintain a clean, healthful and desirable environment;

(3) sustain adequate levels of water quality; and

(4) honor and support all existing water use rights.

The beneficiaries of the reservations will be the numerous and varied fish and other aquatic species currently inhabiting the streams and waters of the lower Missouri and Little Missouri basins as well as those wildlife species which depend, in one form or another, on the flows and adjacent riparian areas along those streams. Other beneficiaries are the people of Montana, resident and non-resident fishermen, other stream-based recreationists who visit from other states, and those Montana businesses which depend upon the fisheries resources and related tourism for their livelihood and economic well-being. Other benefits accrue to those non-fisherman who enjoy the streamside setting and the associated animal and bird life associated with flowing waters and their adjacent corridors.

Maintaining flows in stream channels also indirectly benefits those persons who divert water for consumptive uses. By maintaining water in channels, senior priority water right holders are safeguarded against upstream water diversions which may have a more recent water use priority date than the DFWP reservations. At the same time, the reservations honor and support all existing water rights.

ANALYSIS OF THE NEED FOR THE RESERVATIONS

A water right for instream beneficial use for fish, wildlife and recreational uses may be obtained, under existing Montana statutes, <u>only</u> by application for reservation and not by petition or application for a water use permit. The statutorily recognized beneficial use of water for fish, wildlife and recreation provided for by Montana law cannot be met or attained without these requested reservations.

Existing water rights in the river basins will at all times be honored. If the instream flow reservations requested in this application are granted, they will be junior in time to existing rights and thus will not affect existing uses. If the reservations requested are not granted, any waters available over and above existing rights will be available for future appropriation for off-stream use through the permit system. These future appropriations would permanently deprive the fish, wildlife and recreational resources of the waters necessary to perpetuate them. When considered realistically, it is readily apparent that, within the existing legal framework, waters once appropriated for off-stream use may never again be available to reserve for instream fish and wildlife purposes. This underscores the need to reserve adequate instream flows today.

This application for reservations of water for instream flows is unique in that most of the streams included in this application are sluggish, turbid, prairie streams that harbor a remarkably diverse and productive assemblage of fish species, including game fish such as sauger, walleye, northern pike and channel catfish. These streams provide fishing opportunities for Montana residents but, because they are not well known, presently attract relatively few non-resident anglers. These waters represent a future economic asset to Montana's tourist industry.

The fish community of these warmwater streams includes six fishes recognized as "Species of Special Concern" by DFWP and the Montana Chapter of the American Fisheries Society. One of these six, the pallid sturgeon, is listed as an endangered species under federal law.

Each of these prairie streams supports 20-30 different fish species. By comparison, most trout streams support less than 10 species. It is surprising that these warm, turbid, slow-moving waters sustain a much more diverse fish community than cold, clear, trout streams. It is especially impressive when one realizes that for long periods of the summer, fall and winter these fish survive in isolated pools as the flow over the connecting riffles approaches zero. At a time when people are concerned about maintaining biological diversity world-wide and particularly in the tropics, protecting instream flows in these prairie waters is an opportunity to maintain the biological diversity and wildlife heritage of our own state.

In addition to providing angling opportunities and harboring a great diversity of species, these streams provide the spawning and rearing habitats that are crucial for the recruitment of warmwater game and forage fish to the larger mainstem Milk and Missouri rivers and possibly Lake Sakakawea (the reservoir impounded by Garrison Dam on the mainstem Missouri River in North Dakota).

Instream reservations of water in the lower Missouri and Little Missouri basins are necessitated by the basic life history requirements of the fish, wildlife and other organisms that are dependent upon the flow of these streams and rivers. The instream reservations are needed to: (1) maintain sufficient living space for fishes, (2) protect fish spawning and juvenile rearing areas, (3) protect the aquatic food base, (4) protect water quality, (5) maintain streamside riparian areas, (6) provide for high quality fishing opportunities, (7) sustain or create fishing-related economic benefits, (8) help protect fish "Species of Special Concern", and (9) accommodate wildlife species which depend on aquatic systems.

(1) Living Space

Stream fishes occupy habitats with specific characteristics, including a preferred range of water velocities and depths. The quantity and quality of this physical habitat is influenced by the magnitude of the flows. It is through its impact on fish habitat that flow is believed to primarily regulate fish abundance. Simply stated, fish numbers tend to decrease following long-term flow reductions in response to the shrinking habitat. Conversely, long-term flow increases allow for the expansion of the population. Sufficient instream flows are essential for maintaining viable game fish populations at levels of abundance that are commensurate with the streams' biological capabilities and that satisfy the expectation of the angling majority, providing it with a high quality fishing experience. A reservation will help accomplish these goals.

(2) Spawning and Juvenile Rearing Areas

Game fish numbers in Montana's cold- and warmwater streams are maintained almost exclusively by natural reproduction in the wild, rather than by annual plants of hatchery fish. Spawning cold- and warmwater fishes use a variety of stream habitats. Fisheries of many warmwater lakes and reservoirs also depend on wild recruits spawned in feeder streams. Consequently, the production of the young recruits that are needed to sustain the vast majority of the fisheries is strongly tied to the magnitude of streamflows. The reservation will help preserve this reproductive capacity.

(3) Food Base

Game fish, whether they are trout, sauger, walleye or northern pike, are typically the top predators within the stream environment. These game species depend upon algae, aquatic insects and forage fish for their food supply at various stages in their life cycles. The many plant and animal species in the fishes' food web have specific water requirements that must be met for them to grow and reproduce. A reduction in availability of food items ultimately reduces the abundance of those organisms at higher trophic (top predators) levels. The health and well-being of the game fish populations and, in turn, the quality of the angling experience depend on the maintenance of sufficient food-producing habitat to protect the fishes' food base. A reservation will help accomplish this task.

(4) Water Quality

Reduced streamflows during the normal low flow period affect the quality of water that is necessary to sustain aquatic organisms. Possible consequences of lowered streamflows are higher water temperatures, increased amounts of dissolved solids, increased nutrient concentrations, and lower dissolved oxygen levels, all of which are potentially harmful to aquatic life. Low flow conditions will reduce the amount of water available for dilution of industrial and municipal discharges, and non-point pollution. Current and future industrial and municipal waste discharge permits could be affected by chronic low flows.

Instream flow reservations are needed to prevent further deterioration of water quality during low flow periods. Should existing pollution problems be corrected on those streams where poor water quality presently limits fish abundance, a reservation would help insure that sufficient flow is available in the future to allow populations to expand and reach the streams' biological potential.

(5) Riparian Areas

The riparian ecosystem is a transitional zone between aquatic and terrestrial habitats. This streamside zone of vegetation is characterized by the combination of high species diversity and densities, and high productivity. Many of the trees and shrubs that dominate this zone require groundwater within their rooting systems throughout the growing season.

The riparian zone is ecologically important because it provides seasonal and year-long habitat for greater numbers and species of wildlife than any other habitat in Montana. In addition to its rich assemblage of plants and animals, the riparian zone plays an essential role in determining the quality of the aquatic environment for supporting fish and aquatic invertebrates. The riparian zone, in filtering pollutants from the terrestrial system, helps prevent contamination of the aquatic system. It also provides a buffer zone for dissipating overland flood flows and has high aesthetic and recreational values.

The extent and quality of riparian zones are directly linked to shallow groundwater tables that are continuous with, and recharged by, surface streamflows. Fluctuations in streamflow cause concomitant fluctuations in associated shallow groundwater tables. Although the specific relationships among riparian vegetation and the amount and availability of groundwater have not been quantified in the lower and Little Missouri basins, requested instream flows are essential to the perpetuation of the existing plant communities and associated wildlife populations.

(6) Fishing Opportunities

With the exception of the tailwater trout fisheries of the Marias River below Tiber Dam and the Missouri River below Fort Peck Dam, the five coldwater streams included in this application provide much of the limited, high-quality angling for stream trout on the High-Line. Consequently, these streams are important recreational resources and should be protected by adequate instream flows.

The warmwater streams contain healthy, self-sustaining populations of game fish species such as northern pike, sauger, walleye and channel catfish. These streams provide ample opportunities for warmwater sportfishing. However, due to the distance of these streams from population centers and the general lack of knowledge of the fishing opportunities they afford, the streams are not presently utilized to their full potential. However, to develop warmwater sportfishing to its full potential, adequate instream flows are necessary.

The recreational use of the basins' waters is important to the human experience, providing both enjoyment and relief from day-to-day pressures. Montana statutes recognize this resource as worthy of protection. The fish species that would be protected by the instream flow reservations contribute to the well-being of the people of Montana and visitors who enjoy the outstanding fishing opportunities Montana has to offer.

(7) Economic Benefits

The entire Missouri River basin's nationally acclaimed sport fisheries provide a significant boost to Montana's economy. Although trout anglers account for the majority of economic input, warmwater angling will undoubtedly contribute more as its popularity spreads both among residents and non-residents.

In FY 1989, Montana ranked fifth in the nation in the number of non-resident fishing licenses sold [U.S. Fish and Wildlife Service (FWS) 1990]. In 1985, based on a fishing pressure of 2.5 million days per year, the annual net value of Montana's lake and stream fisheries totaled $215 million. In the same way that the price of farmland is related to the value of production, the net present recreational fishing value of Montana's streams and lakes is on the order of $5 billion (Duffield 1988). Warmwater angling in the lower and Little Missouri River basins comprises a modest amount of the total; nonetheless, it contributes $1.7 million annually (in 1989 dollars) to the state's economy.

The travel industry adds millions of dollars to the state's economy each year and provides jobs for thousands of Montanans (Stephens 1990). Without the quality fishing opportunities provided by the Missouri River basin, Montana's tourist industry, a major contributor to the state's economy, would suffer. Angling-related revenues depend on the maintenance of sufficient flows to protect the abundant fish resources that characterize Montana. Continued flow depletions will degrade some of the very resources that draw tourists to Montana. Instream reservations would help protect this economic base.

(8) Fishes of Special Concern

The lower Missouri River basin supports populations of fishes listed by DFWP and the Montana Chapter of the American Fisheries Society as "Species of Special Concern." These are native Montana fishes having limited habitats and/or limited numbers in the state (Holton 1986). Of the 17 Montana fishes of special concern that were listed in 1990, six (pallid sturgeon, paddlefish, sicklefin chub, shortnose gar, pearl dace, and northern redbelly dace x finescale dace) are inhabitants of Montana's lower Missouri River basin [Montana Natural Heritage Program (MNHP) 1990]. The dace hybrid reproductive strategy is a unique evolutionary development for temperate freshwater fish (Montana Rivers Information System 1991). One of these six, the pallid sturgeon, was, in 1990, listed as an endangered species under the federal Endangered Species Act. Another, the paddlefish, is being studied for possible inclusion as a threatened or endangered species. The sturgeon chub, another Montana "Species of Special Concern", was first collected in Montana in the 1850s in the Milk River. Although it hasn't been reported in the Milk River system since then, it still could be present. Instream flow reservations would help maintain a vital component of the habitat that is still available for this diverse group of fishes of special concern.

(9) Wildlife Species

Bald eagles, listed as threatened under the Federal Endangered Species Act, overwinter along the lower Missouri River below Fort Peck Dam. Eagles rely on the fishery resource to fulfill their dietary needs. Concentrations of cisco derived from Fort Peck Reservoir are present in the river downstream, attracting eagles in increasing numbers over the last few years. Having established a new wintering area with a new concentrated food source, bald eagles will likely attempt to nest locally in the next few years (Flath 1991). Instream flows, by protecting the fish forage base of bald eagles, will maintain this wintering area and may provide new nesting areas previously unexploited.

Piping plovers, listed as threatened under the Endangered Species Act, also depend on the aquatic system. Although few in number, plover nesting records exist throughout the length of the lower Missouri River from Fort Peck Dam to the North Dakota border. As shoreline birds, plovers nest on gravel bars but require instream flows to provide the aquatic interface of their habitat (Flath 1991).

The least tern is listed as endangered under the Endangered Species Act. It, too, depends on the aquatic system of the lower Missouri River. Least terns nest on river islands and frequently are seen with piping plovers (MNHP 1991).

Snapping and softshelled turtles also reside in the lower Missouri basin. Both are listed as "Species of Special Concern" by the Montana Natural Heritage Program because of their rarity (MNHP 1990). Although it is known that these turtles depend on slow-moving, turbid backwaters and side channels, other questions concerning life history requirements are largely unanswered. There is concern that without a reservation, backwaters and side channels could become dewatered by new diversionary uses.

American white pelicans are classified as endangered and imperiled in Montana because of their rarity (MNHP 1990). Whereas breeding pelicans utilize Medicine Lake during the spring and summer, non-breeders depend on the lower Missouri River during those seasons (Flath 1991). An instream flow reservation would help protect the small, schooling forage fish which pelicans require for food.

Although the precise flows necessary to meet the needs of these sensitive species are not known, they would directly benefit from an instream reservation.

Summary

The reservation requests are for the amount of water necessary to sustain aquatic organisms without significant long-term reduction in quantity and quality. Increased water withdrawals over existing levels would, in the long run, reduce availability of habitat and consequently reduce the number of organisms which can occupy that habitat. There is a limit to the amount of water which can be removed from any stream channel without severely changing the quantity and quality of the aquatic species present, or limiting the biological potential of the stream. In portions of the lower Missouri and Little Missouri River basins, that limit has already been exceeded.

Reservations also have values for terrestrial organisms. Although the precise flows necessary to meet the needs of sensitive terrestrial species are unknown, they would directly benefit from a reservation.

It is contended that if the requested reservations are not granted, the deterioration of the previously described aquatic and associated terrestrial habitat components, and, therefore, recreational opportunities is inevitable. Instream flow reservations in the lower Missouri and Little Missouri basins would serve to protect a vital component of stream fishery habitat and would assist in protecting the aquatic and related terrestrial resources so necessary to the social and economic well-being of the people of Montana and the nation.

DETERMINATION OF THE AMOUNT OF THE RESERVATIONS

This section describes in detail the methods used to derive the flow quantities requested for each stream reach in the application. Several alternative methods were utilized depending upon the type of fishery (coldwater or warmwater), stream channel shape, and the amount of streamflow and fisheries data available for the reach. In several cases, more than one method was utilized to address different periods of the year and life stages of the game fish present.

The water availability information required by ARM 36.16.105B(2) is also discussed in this section.

Overview of Instream Flow Determination Techniques

A variety of techniques have been developed for determining the instream flow requirements of fish and other aquatic life forms. These techniques range from office methods that base their recommendations on an analysis of the historic flow record to the development of flow requests based upon biological-flow relationships observed over a range of flows.

The DFWP believes that instream flow recommendations should, whenever possible, be derived from the observed relationships between streamflows and aquatic populations. The use of biological-flow relationships was not possible for each stream reach included in this application due to the extensive commitment of time, money and labor necessary to collect the long-term data that are needed to define these relationships. In those cases where available resources precluded the derivation of biological-flow relationships, other methods were utilized.

The instream flow methods used in this application are separated into three basic categories according to whether they applied to coldwater streams, warmwater streams or were the result of biological-flow relationships.

Coldwater Streams

1) Wetted Perimeter Inflection Point Method

The Wetted Perimeter Inflection Point Method is the principle method used by the DFWP for deriving low flow recommendations for Montana's streams. The method has primarily been used on the state's coldwater trout streams. In this application, the method was applied to four trout streams in the Bear Paw Mountains (Beaver, Clear, Little Box Elder and Peoples creeks) and the mainstem Missouri River below Fort Peck Dam.

This method focuses on the well-founded assumption that food supply can significantly influence a stream's carrying capacity (the total number and pounds of fish that can be maintained by the aquatic habitat). The principal food items of many of the juvenile and adult game fish inhabiting Montana streams are aquatic invertebrates which are produced primarily in stream riffles. A riffle is a section of stream where the water is less deep and flow is more rapid than in the sections above and below. Streams usually consist of a succession of pools and riffles.

Aquatic invertebrates inhabit the interstices of the bottom substrate. Flowing water supplies the oxygen needed to sustain these gill-breathing life forms. Without a cover of water, the substrate becomes uninhabitable. The amount of riffle habitat covered with water will increase with flow, causing the food-producing potential to also increase. Streamflow controls the amount of riffle area that is wetted and, thus, controls the amount of habitat that is available for producing food.

The method assumes that game fish carrying capacity is related to food production, which, in turn, is a function of the amount of wetted perimeter in riffles. Wetted perimeter is the distance along the bottom and sides of a channel cross-section in contact with water (Figure 3). As the flow in a stream channel increases, the wetted perimeter also increases, but the rate of gain of wetted perimeter is not constant throughout the entire range of flows.

A plot of wetted perimeter versus flow for stream riffle cross-sections generally shows two points, referred to as inflection points, where the rate of gain of wetted perimeter abruptly changes as flow increases. In the example (Figure 4), these inflection points occur at approximately 8 and 12 cfs. Below the lower inflection point, stream flow spreads out horizontally across the bottom, causing the wetted perimeter to increase rapidly for very small increases in flow. A point is eventually reached (at the lower inflection point) where the water starts to move up the sides of the active channel and the rate of increase of wetted perimeter begins to decline. At the upper inflection point, the stream approaches its maximum width and begins to move up the banks as flow increases. Large increases in flow beyond the upper inflection point cause only small increases in wetted perimeter.

The area available for food production is considered near optimal at the upper inflection point because almost all of the available riffle area is covered with water. At flows below the upper inflection point, the stream begins to pull away from the riffle bottom until, at the lower inflection

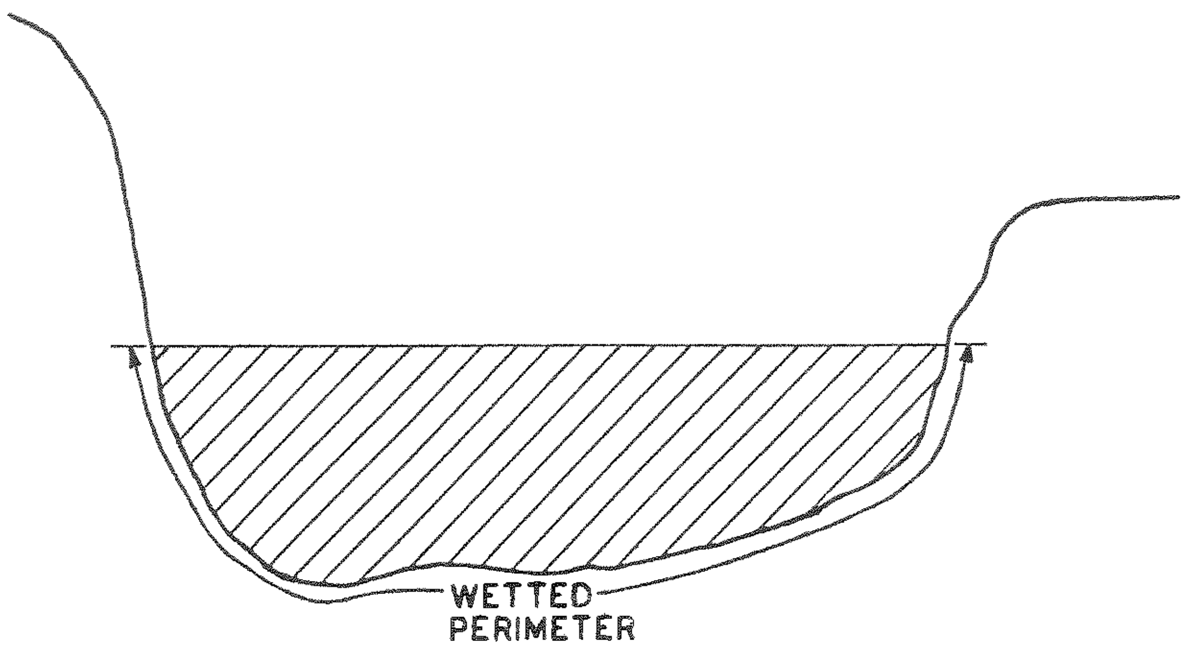

Figure 3. The wetted perimeter in a channel cross-section.

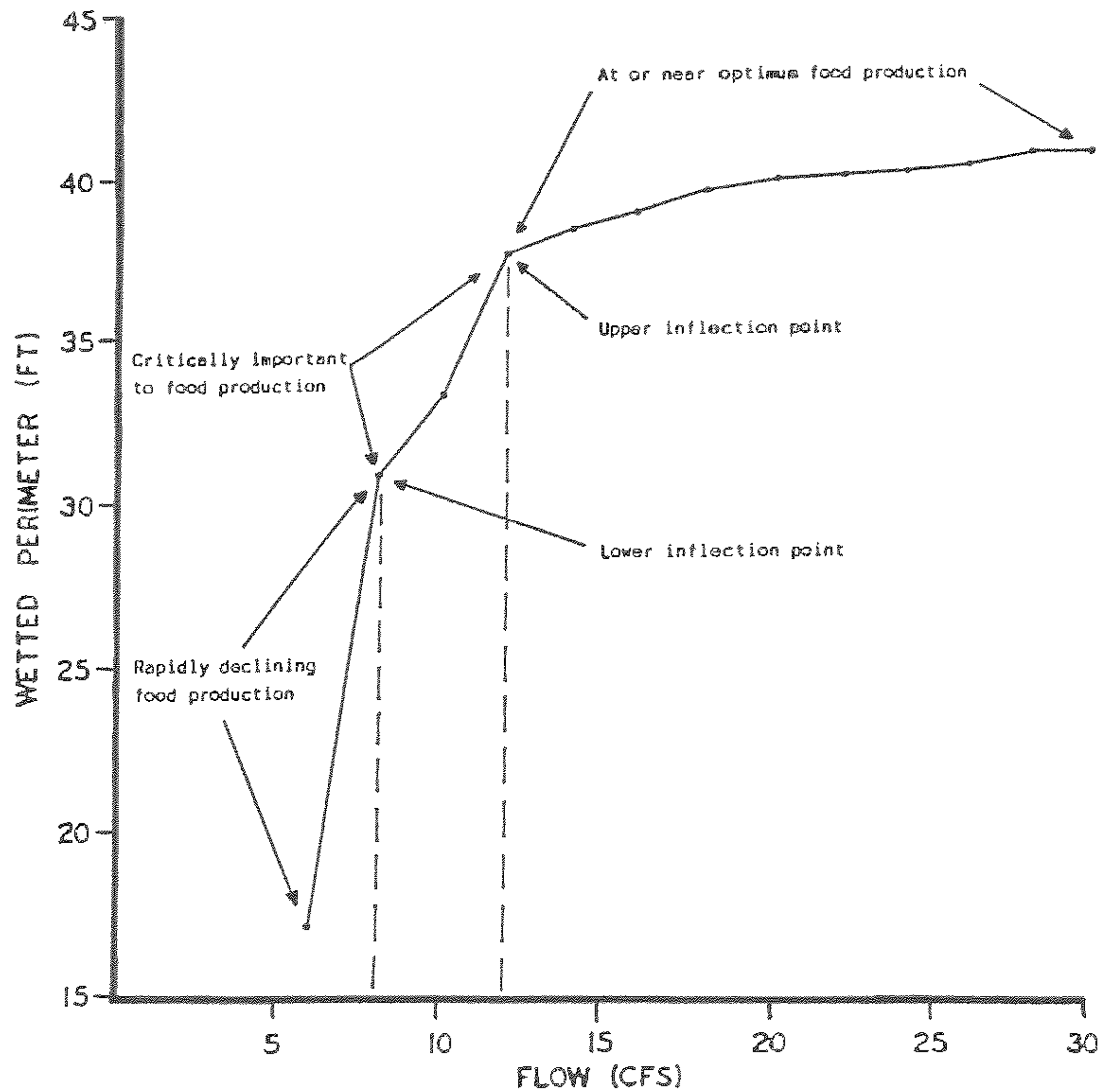

Figure 4. An example of a relationship between wetted perimeter and flow for a stream riffle cross-section showing upper and lower inflection points and their relationship to fish food production.

point, the riffle bottom is being exposed at an even greater rate and the area available for food production greatly diminishes. The method is intended to describe a threshold below which a stream's food producing capacity begins to decline (upper inflection point) and a threshold at which the loss is judged unacceptable (lower inflection point).

While the inflection point concept focuses on food production, there are indications that wetted perimeter relates to other factors that influence fish production. One such factor is cover (or shelter), a well-recognized component of fish habitat.

In the headwater streams of Montana, overhanging and submerged bank vegetation and undercut banks are important components of cover. The wetted perimeter-flow relationship for a stream channel is, in some cases, similar to the relationship between bank cover and flow. Flows exceeding the upper inflection point are considered to provide near optimal bank cover. Below the upper inflection point, the water pulls away from the banks, decreasing the amount of bank cover associated with water. At flows below the lower inflection point, the water is sufficiently removed from the bank cover to severely reduce its value as fish shelter. Support for this relationship is provided by Randolph (1984), who found a high correlation between riffle wetted perimeter at various flows and the total area of overhanging bank vegetation ($r = 0.88 - 1.00$) and undercut banks ($r = 0.84 - 0.97$) for three sections is a small Montana stream.

In addition to producing food, riffles are used by many game fish species for spawning and the rearing of their young (Sando 1981, Loar et al. 1985). Consequently, the protection of riffles helps ensure that the habitat required for these critical life functions is also protected.

Riffles are the area of a stream most affected by flow reductions (Bovee 1974, Nelson 1977, Loar et al. 1985). Other stream habitats (pools and runs) are less affected. By requesting a flow that covers a large portion of the available riffle area, we are, at the same time, protecting both runs and pools--areas where adult fish normally reside.

The Wetted Perimeter Inflection Point Method provides a range of flows (between and including the lower and upper inflection points) from which a single instream flow recommendation is selected. Flows below the lower inflection point are judged inadequate because of probable negative impacts on food production, bank cover, and spawning and rearing habitats. Flows at or above the upper inflection point are thought to provide near optimal conditions for fish. The upper and lower inflection points are believed to bracket those flows needed to maintain high and low levels of aquatic habitat potential. These habitat levels are defined as follows:

(1) <u>High Level of Aquatic Habitat Potential</u> -- That flow regime which will consistently produce abundant, healthy and thriving aquatic populations. In the case of game fish species, these flows would produce abundant game fish populations capable of sustaining a good to excellent sport fishery for the size of stream involved. For rare, threatened or endangered species, flows to accomplish the high level of aquatic habitat maintenance would: (a) provide the high population levels needed to ensure the continued existence of that species, or (b) maintain higher flows than those which would adversely affect the species.

(2) <u>Low level of Aquatic Habitat Potential</u> -- That flow regime which will provide for only low populations of the species present. In the case of game fish species, a limited sport fishery could still be provided. For rare, threatened or endangered species, their populations would exist at low or marginal levels. In some cases, this flow level would be insufficient to maintain certain species.

The final flow recommendation is generally selected from this range of flows by a consensus of the biologists who collected, summarized, and analyzed all relevant field data for the stream of interest. The biologists' evaluations of the stream resource form the basis of the flow selection process. Factors considered in the evaluation include: (1) level of recreational use, (2) existing level of environmental degradation, (3) water availability, and (4) size and composition of existing fish populations. Fish population information is a major consideration for all streams. A marginal or poor fishery may only justify a flow recommendation at or near the lower inflection point unless other considerations, such as the presence of "Species of Special Concern", warrant a higher flow. In general, streams with exceptional resident fish populations, those providing crucial spawning and/or rearing habitats for migratory populations, and those supporting populations of "Species of Special Concern" should be considered for flow recommendations that are at or near the upper inflection point.

The wetted perimeter-flow relationships in this application were derived using a wetted perimeter predictive (WETP) computer program developed in 1980 for the DFWP. WETP is a relatively simple computer model that eliminates the more complex data collection and calibration procedures associated with similar computer programs in current use, while at the same time provides more accurate and reliable wetted perimeter predictions. An in-depth description of the WETP computer program and data collection procedures is provided in a DFWP publication titled "Guidelines for Using the Wetted Perimeter (WETP) Computer Program of the Montana Department of Fish, Wildlife and Parks" (Nelson 1989).

When deriving instream flow recommendations for the coldwater rivers and streams of Montana, DFWP normally divides the annual flow cycle into two separate periods: (1) a relatively brief snow runoff or high flow period when up to 75% of the annual water yield is passed through stream channels and (2) a non-runoff or low flow period which is characterized by relatively stable base flows maintained primarily by groundwater outflow. For headwater rivers and streams, the high flow period generally includes the months of May, June and July, while the remaining months (approximately August through April) encompass the low flow period.

The Wetted Perimeter Inflection Point Method is normally applied only to the low flow period, whereas a separate method addressing the high flow functions of channel maintenance and flushing of bottom sediments is applied to the high flow period. However, because most water users, particularly irrigators, are unable to divert a significant portion of the high runoff flows in mountain streams and, therefore, are incapable of materially impacting the high flow functions of bedload movement and sediment transport, the need for high flow recommendations may be unnecessary in coldwater streams. Therefore, extending the wetted perimeter recommendations through the high flow period -- a practice applied to the mountain trout streams in this application -- should not jeopardize the maintenance of adequate high flows for most coldwater streams. Furthermore, Montana law [85-2-316(6), MCA] limits the granting of instream flows to no more than 50% of the average annual flow in gauged streams, thus eliminating (in some cases) flushing and channel maintenance flows from consideration in a reservation application.

A comprehensive survey of the instream flow methods literature compiled by Leathe and Nelson (1989) relates the significance of existing methods to Montana's Wetted Perimeter Inflection Point Method. This synopsis includes the history of instream flow development, the relationship between streamflows and fish populations, a survey and analysis of instream flow methods (including available techniques, advantages and limitations, evaluation studies and criteria for selecting an instream flow method), and finally, a discussion of why Montana uses the Wetted Perimeter Inflection Point Method in its instream flow program. This synopsis is an important component of DFWP's method and justification for the flows requested in this application and should be used in conjunction with the above discussion of the method.

2) Fixed Percentage Method

Various non-field or office methods which derive instream flow recommendations from existing hydrologic information are described in the literature. These methods are similar in that they are usually performed in the office with few, if any, on-site visits. Office methods are generally deemed most appropriate for deriving preliminary or reconnaissance-level recommendations. Final recommendations are typically derived using various field methods. In Alaska, however, levels of instream flow protection granted by the governing authorities were based solely on office methods (Estes 1988), indicating that such methods are being accepted as primary instream flow methods in certain situations.

One of the better known and widely used office methods is the Tennant Method, sometimes referred to as the Montana Method (Tennant 1975). Recommendations of the Tennant Method are based on a fixed percentage of the average annual flow. Tennant (1975) stated that 10% of the average annual flow only sustains short-term survival habitat, whereas 30% sustains good survival habitat for most aquatic species. Sixty percent provides excellent to outstanding habitat for most aquatic species during their primary periods of growth and accommodates the majority of recreational uses. The percentage actually recommended depends on the stream's numerical rating in a fisheries classification system. The higher the rating, the greater the percentage recommended.

The purpose of this section is to describe the Fixed Percentage Method used in this application to derive the instream flow recommendation for Reach #1 of Beaver Creek, a coldwater trout stream in the Little Rocky Mountains. Due to time constraints and the remoteness of the area, the Wetted Perimeter Inflection Point Method was not applied to this stream reach.

For this derivation, the high inflection point flows that were derived from the Wetted Perimeter Inflection Point Method for the four trout streams in the Bear Paw Mountains were expressed as a percentage of the average annual flow for each stream. Average annual flows used in the analysis were calculated by the USGS (Appendix B). These percentages were 37, 56, 19 and 19 for Beaver, Clear, Little Box Elder, and Peoples creeks, respectively. These percentages were then averaged to derive a basin mean percentage (33%), which was applied to Beaver Creek Reach #1.

Warmwater Streams

1) Base Flow Approach

The warmwater streams of the lower Missouri and Little Missouri River basins look nothing like the coldwater trout streams of the mountain headwaters where the Wetted Perimeter Inflection Point Method is the method of choice. The warmwater prairie streams in this application generally meander widely, are low-gradient, and consist of long, deep, low velocity pools separated by short, widely-spaced riffles. During the low flows of late summer, fall and winter, flow over the riffles can virtually cease for long periods. Despite critically low flows, the pools hold a sufficient reservoir of water to sustain more than 20 fish species that have adapted to and survive in this extreme prairie environment. These naturally occurring low flows ensure that sufficient water depth is maintained in the pools to provide a refuge for fish. The low flows also ensure an exchange of water, freshening the pools, and thus guaranteeing the water quality and dissolved oxygen levels necessary to support fish. Reducing these critically low flows would further stress the fish community by degrading the already borderline habitat. The continued survival of the fish community could be in jeopardy if additional flow reductions were to occur. To protect fish habitat in these prairie waters, maintenance of the existing stream flows is recommended during the low flow period.

Flow requests using this "base flow" approach were derived from the mean monthly flows, calculated by the USGS, for the prairie streams in this application (Appendix B). The mean monthly flows for each reach were grouped into two periods: (1) the winter period from December through March and (2) the non-winter period from April through November. The lowest mean monthly flow for each period was then identified and subsequently became the flow request throughout that period. For example, consider the following mean monthly flows (cfs) derived for a hypothetical prairie stream:

Example:

Month	Mean Monthly Flow
January	0.5
February	0.7
March	69.9
April	93.1
May	17.7
June	17.1
July	6.3
August	2.0
September	1.5
October	2.6
November	1.9
December	0.8

For the winter period (December-March), the lowest mean monthly flow occurred in January and was 0.5 cfs. A flow of 0.5 cfs is, therefore, requested for the entire winter period. Likewise, the request for the non-winter period is 1.5 cfs, the lowest mean monthly flow from April-November. These "base flow" requests are intended to preserve stream flows at the normally occurring low flow level yet allow for new, although limited, consumptive water uses. This level of protection is deemed sufficient to maintain adequate survival habitat for the gamefish community during the extended low flow period of late-summer through winter.

2) Dominant Discharge/Channel Morphology Concept

Several major components of aquatic habitat in river systems are related to the physical features and form of the river channel itself. Over time, aquatic populations have adapted and thrived within the physical constraints of channel configuration and flow. Basic to the maintenance of existing aquatic populations is the maintenance of the existing habitat that has historically sustained them. In the case of the warmwater prairie streams in this application, the existing channel shape (long, deep pools separated by widely-spaced riffles) is crucial to the survival of game fish from late summer through winter when flows in these prairie waters nearly cease for long periods. Pools provide the only refuge for fish. Maintaining the existing channel shape is essential to the continued survival of the diverse fish communities of these prairie waters.

It is generally accepted that the major force that establishes and maintains a particular channel morphology is the annual high flow regime of the stream (Reiser et al. 1985, Nelson et al. 1986). High spring flows determine the shape of the channel, not the average or low flows.

Increased discharge associated with spring runoff also results in a flushing action, which removes the annual accumulation of sediments from the stream bottom. Without this flushing, pools eventually fill with sediment and become too shallow to sustain game fish. Gravel riffles will also become clogged with sediment, diminishing their spawning value for walleye, smallmouth bass, and sauger.

Reducing the high spring flows would interrupt ongoing channel forming processes, thus changing the existing channel form and bottom substrates. A significantly altered channel configuration would affect both the abundance and species composition of the present aquatic populations by altering the existing habitat types.

Several workers (Leopold et al. 1964, Emmett 1972, U.S. Bureau of Reclamation 1973) adhere to the concept that the form and configuration of river channels are shaped by and designed to accommodate a dominant discharge. The discharge which is most commonly referred to as a dominant discharge is the bankfull discharge (Leopold et al. 1964, Emmett 1972). Bankfull discharge is the flow at which water just begins to overflow onto the active floodplain.

It is not presently known how long the bankfull flow must be maintained to accomplish the necessary channel forming processes. Until studies further clarify the necessary duration of the bankfull discharge, a duration period of 24 hours is chosen. A gradual rising and receding of flows should be associated with the dominant discharge, thus mimicking the duration and shape of the natural hydrograph.

High flow requests in this application include one day of flow at the dominant discharge. Requests are "stair-stepped" up to the dominant discharge, then "stair-stepped" down to the base flow. "Stair-steps" encompass a 13-21 day period, depending on the normal duration of the stream's annual high flow event. These daily "stair-steps" are intended to mimic the shape of a stream's natural hydrograph during high flows and to reflect normal water availability. High flow requests are also timed to correspond to the period that these flows typically occur in the natural system. The following high flow example demonstrates this concept:

Example:

Additional water is requested during a 14-day period to start no earlier than March 15 nor later than April 5 according to the following pattern:

Day	CFS	AF
1 & 2	50	198
3 & 4	200	793
5	710	1,408
6 & 7	300	1,190
8 & 9	200	793
10 & 11	100	397
12, 13 & 14	50	298
		5,077

All calculations used to derive the high flow requests were performed by the USGS (see Appendix A). These include the derivation of the dominant discharge, timing and duration of a stream's normal high flow period, shape of the high flow hydrograph, and the magnitude of the daily "stair-steps". All are intended to reflect the normal high flow pattern for each prairie stream in this application.

Biological-Flow Relationships

The observed response of selected fish populations to flow variations formed the basis for the instream flow requests for a few streams in this application. A few recommendations also reflect the observed relationships between changing flows and critical elements of the fishes' habitat. As noted earlier, the DFWP believes that instream flow requests based upon observed biological-flow relationships are more solidly based than those derived from modeling techniques, such as the Wetted Perimeter Inflection Point Method. Unfortunately, it is not possible to obtain the long-term empirical data to define these relationships on all streams. Consequently, this approach has had limited application for deriving flow recommendations.

Discussions of the biological-flow relationships and resultant flow recommendations for the stream reaches where this approach was used are presented in the "Reservation Requests" section of this application under the appropriate stream reach write-up.

The 50% of Average Annual Flow Limitation

Montana law [(85-2-316(6), MCA)] limits the amount of instream flow that the Board of Natural Resources and Conservation (Board) can grant on gauged streams to no more than 50% of the average annual flow (AAF). This limitation, in many cases, can result in the granting of an instream flow that is excessively low, thus potentially damaging the existing fishery and impacting recreational opportunities. The 50% limitation can be too restrictive when (1) gauged streams are badly depleted, (2) gauged streams are regulated, (3) the chosen gauge sites are located at or near the upstream boundary of the designated stream reach, and (4) high flows are needed to maintain channel morphology and flush bottom sediments.

1) Depleted Streams

Flows recorded on many gauged streams reflect consumptive withdrawals for agricultural, industrial and municipal uses. Reservoir evaporation also contributes to streamflow losses. Together, agricultural diversion and reservoir evaporation accounted for 98.4% (7.2 million acre-feet) of the water consumed in Montana in 1980 (DNRC 1986). Because stream flow is often diminished by diversion and evaporation, the AAF derived for most gauged streams reflects the depleted, or non-virgin, flow. This depleted AAF can be substantially less than the undepleted (virgin) AAF for the same stream site. The following example from the mid-Missouri River basin demonstrates the potential magnitude of the difference between a depleted and an undepleted AAF.

Example:

Flatwillow Creek is a 119-mile-long tributary to the Musselshell River. Increased diversions for irrigation above USGS gauge #06127900 in about 1930 drastically decreased the AAF from 46.2 cfs (1912-30 period of record) to 14.3 cfs (1930-32, 1935-56 period of record), a reduction of 69% (Shields and White 1981). The AAF of 29 cfs for the entire period of record reflects the post-1930 irrigation development, which is currently about 9,000 irrigated acres. Applying the 50% limitation to the depleted AAF, as derived for the entire period of record, will yield an instream flow (14.5 cfs) that short-changes the fishery resource. Applying the same 50% limitation to the pre-1930 AAF, which more accurately reflects the undepleted state, yields a much higher flow (23.1 cfs) that is more in line with the needs of the fishery.

Because most gauged streams have a long history of flow depletions, with some being more depleted than others, the AAF of record will be less than the undepleted AAF. Unlike the above example, an accurate quantification of the undepleted AAF is rarely achievable for the vast majority of Montana's streams due to a lack of long term gauge data. One must realize that the application of the 50% limitation to the depleted AAF of record will, in some cases, severely short-change the fishery.

2) Regulated Streams

Regulation by large reservoirs tends to stabilize downstream flows, causing the flow pattern to more closely resemble that of a large, spring-fed creek. An example is the Missouri River downstream from Fort Peck Dam (gauge #063132000). Here, the post-dam AAF for a 36-year period of record is 9,800 cfs and the base flow for the same period is 7,280 cfs, indicating a fair degree of flow stability (Shields and White 1981). In this case, the 50% limitation yields a flow (4,900 cfs) that is far less than the flow regime required to maintain the downstream fishery. When a stream is regulated and downstream flow extremes are moderated, the 50% limitation can result in an undesirable instream flow.

3) Gauge Location

The location of the gauge used to determine the 50% AAF within the designated stream reach is important. A reach, as defined by DFWP, does not represent a stream segment having the same flow regime and instream flow requirement throughout its length. Rather, the reach merely identifies a section of stream where junior water users will be subject to the instream flow reservation, which will be monitored at a site at, or near, the reach's downstream boundary. The instream flow (which DFWP typically derives for a site near the downstream boundary of the reach) will likely exceed 50% of the AAF determined from any gauges located near the upstream boundary. This is due to the fact that the available water supply at the downstream end of a reach commonly exceeds the supply at the upstream end, a consequence of accretion. Applying the 50% limitation derived for these upper gauges to the entire length of a reach will likely yield an undesirable instream flow for the downstream-most segment.

4) High Flows are Needed

Flow requests for five of the 14 prairie stream reaches in this application equal more than 50% of the AAF, as estimated by the USGS (Appendix B). One of the five (Little Beaver Creek in the Little Missouri River basin) has a long-term USGS gauge near the reach's downstream boundary where the instream reservation is intended to be monitored. Because DFWP is requesting the dominant discharge for prairie streams, some flow requests will exceed 50% of the AAF.

Prairie streams consist of long, deep pools separated by short, widely-spaced riffles. From late summer through winter, surface flows can virtually cease for long periods. Pools provide the only refuge for fish. Thus the maintenance of the existing channel form - a function of the dominant discharge that occurs during the high flow cycle - is essential to the fishes' continued survival during the critical low flow months. Without annual high flows to accomplish the needed channel-forming processes, the essential pool habitat would diminish, thereby jeopardizing the fishes' year-round survival.

Dominant discharge is a crucial component of instream flow protection in prairie streams. However, requesting the dominant discharge and its accompanying "stair-steps" could cause the instream flow recommendations to exceed the 50% limitation for gauged prairie streams.

Flows requested in this application are intended to maintain the fishery resources at a desirable level. In some cases, the requested flows exceed the 50% limitation imposed by Section 85-2-316(6), MCA. To assist the Board, the streams in which the requested flows exceed the 50% limitation are listed in Table 1. Because the length of record on a "gauged stream" is not defined by the statute, 10 years was selected as the minimum length of record required to determine the AAF. Table 1 shows only those streams with USGS gauges having year-long records of 10 years or more. (It should be noted that many reservation streams contain long-term USGS gauges that have seasonal records only. Average annual flows cannot be computed for these seasonal gauges. In addition, many reservation streams contain long-term gauges that are located outside the reach boundaries and, therefore, do not reflect water availability within the designated reach.)

The flow levels requested for each stream in this application are the flows required to maintain the fishery resources at the desired level. If the granted flows are less than the requested levels, the resource would be adversely affected.

We believe the AAF can be interpreted in acre-feet as well as in cfs, and downward adjustments may be more effectively made on an acre-feet basis. For example, a reduction could be made during a 1-month period simply by reducing the total acre-feet requested in that month by the amount which is over 50% AAF. The reduced volume granted can then be converted to flow in cfs.

It should also be understood that the average annual flows in Table 1 are based on the actual period of record, not on the adjusted period of record (1937-86) which is the basis for the average annual flows in Appendix B.

Water Availability

ARM 36.16.105B(2) requires the applicant to determine the physical availability of flows. Statistical information must include the monthly mean flows and the 20th, 50th, and 80th percentile exceedance frequency flows on a monthly basis throughout the year.

Through a cooperative agreement, DFWP contracted with the Helena office of the USGS to obtain this information. The completed work will be published as a USGS technical report.

At the time this reservation application was submitted, the USGS technical report had not been completed. However, Appendix B summarizes provisional water availability data. The narrative and statistical analyses pertaining to these data will be contained in the final report and forwarded to the Board upon receipt. Any corrections to these provisional data will also be brought to the Board's attention.

Table 1. USGS gauged streams (10 or more years of record) in the lower and Little Missouri basin reservation applications having instream flow requests that exceed 50% of the average annual flow (AAF).

Streams	Requested Flow (AF/yr)	USGS Gauge No.	AAF (AF/yr)	50% of AAF (AF/yr)	Period of Record (years)[a]
Mainstem Missouri River					
Missouri - Reach #7	5,620,361[c]	06132000	7,128,000[b]	3,564,000	1943-89 (46)
Missouri - Reach #8	5,522,972[d]	06177000	7,593,000[b]	3,796,500	1943-89 (46)
Missouri - Reach #8	5,522,972[e]	06185500	7,723,000[b]	3,861,500	1943-89 (40)
Little Missouri Basin					
Little Missouri River	32,562[f]	06334000	55,930	27,965	1912-69 (49)
Beaver Creek	7,984[g]	06336500	15,430	7,715	1938-83 (35)
Little Beaver Creek	17,895[h]	06335000	32,310	16,155	1938-79 (41)
Milk River Sub-Basin					
Rock Creek	27,600[i]	06169500	10,650	5,325	1979-89 (11)

[a] Period of record shown is not continuous in all cases.

[b] AAF after operational level in Fort Peck Reservoir was reached.

[c] Seasonal flow requests for Reach #7 total 5,620,361 acre-feet/year, which is 79% of the AAF (in acre-feet) at this gauge site. Flows at this gauge reflect complete regulation at Fort Peck Dam, as well as depletions to irrigate about 880,400 acres upstream from the gauge site.

[d] Seasonal flow requests for Reach #8 total 5,522,972 acre-feet/year, which is 73% of the AAF (in acre-feet) at this gauge site. Flows at this gauge reflect depletions to irrigate about 1,010,400 acres, as well as partial regulation at Fort Peck Dam and many other upstream reservoirs.

[e] Seasonal flow requests for Reach #8 total 5,522,972 acre-feet/year, which is 72% of the AAF (in acre-feet) at this gauge site. Flows at this gauge reflect depletions to irrigate about 1,030,400 acres, as well as partial regulation at Fort Peck Dam and many other upstream reservoirs.

[f] This inactive gauge site is located in the upper portion of the reach and, therefore, does not accurately reflect water availability in the lower reach where flows will be monitored. At the active USGS gauge site on the Little Missouri River near the Montana/South Dakota border (gauge #06334500 at Camp Crook, SD), the requested instream flow (32,562 AF/yr) equals 35% of the AAF (92,000 AF/yr) for the 36-years of record. This gauge more accurately reflects flows in the lower reach.

[g] This inactive gauge site is located in the upper portion of the reach and, therefore, does not accurately reflect water availability in the lower reach where flows will be monitored. At the active USGS gauge site on Beaver Creek near the Montana/North Dakota border (gauge #06336600 near Trotters, ND), the requested instream flow (7,984 AF/yr) equals 33% of the AAF (24,130 AF/yr) for the six complete years of record (1978-83). This gauge more accurately reflects flows in the lower reach.

[b] This inactive gauge site is located near the Montana/North Dakota border (near Marmarth, ND) and, therefore, reflects water availability in the lower reach. At this gauge site, the instream flow request (17,895 AF/yr) equals 55% of the AAF (32,310 AF/yr) for the 41-year period of record (1938-79).

[i] This active gauge site is located near the upper boundary of the reach at stream mile 82 near the U.S./Canada border. Flows at this gauge site, therefore, do not accurately reflect water availability at the creek's mouth where flows will be monitored. For Rock Creek at its mouth, the requested instream flow (27,600 AF/yr) equals 41% of the estimated AAF (67,579 AF/yr) at this site.

Reservation Requests

Alphabetical List of Streams

DESCRIPTION OF THE LOWER MISSOURI RIVER BASIN

This portion of the Missouri River basin extends from Fort Peck Dam, southeast of Glasgow, to the Montana-North Dakota border, north of Fairview, a distance of 183 miles (Figure 5).

Major perennial tributaries entering this reach include the Milk River, one of the longest tributaries to the Missouri; the Poplar River, which originates in Canada; and the Redwater River, which originates in McCone County, south of Circle. Although no reservations are sought for Big Muddy Creek, it also contributes to mainstem Missouri flows.

The lower Missouri is a low-gradient river (0.9 feet/mile), draining approximately 91,557 square-miles of prairie. The river's course has largely been determined by past continental glaciation. Generally, the topography on the north side varies from rolling hills to flat plains, contrasting with the rough badlands on the south side. The river floodplain upstream of Brockton is relatively wide, averaging four miles, and is a product of the easily-eroded Bearpaw shale underlying the valley. Downstream from Brockton, the floodplain narrows. Continental glaciation forced the river south into the more structured Fort Union formation (Swenson 1955). Below Culbertson, the valley narrows into a 15-mile-long canyon averaging one mile in width. Here, badlands flank both sides of the river, towering nearly 500 feet above it.

The segment of the Missouri River in this application is still in a semi-natural state, although flows are completely regulated by water releases from Fort Peck Dam. Completed in 1937, the dam impounds the Missouri River for 134 miles upstream. Flood control, navigation and hydropower are its chief purposes, although recreation has recently been recognized. The 185 megawatt hydropower unit is presently operated as a combined baseload and peaking plant, with the amount of peaking dependent on water availability and electrical power marketing. Fort Peck Dam operations restructure the normal seasonal flow pattern of the river by storing high spring run-off flows and augmenting summer and winter flows. Moreover, cold, deep water releases from Fort Peck Reservoir disrupt normal temperature regimes in the Missouri River below the dam. Normal, naturally occurring biological and hydrological features that depend upon the seasonal high flow period have been affected by these altered temperature and flow regimes.

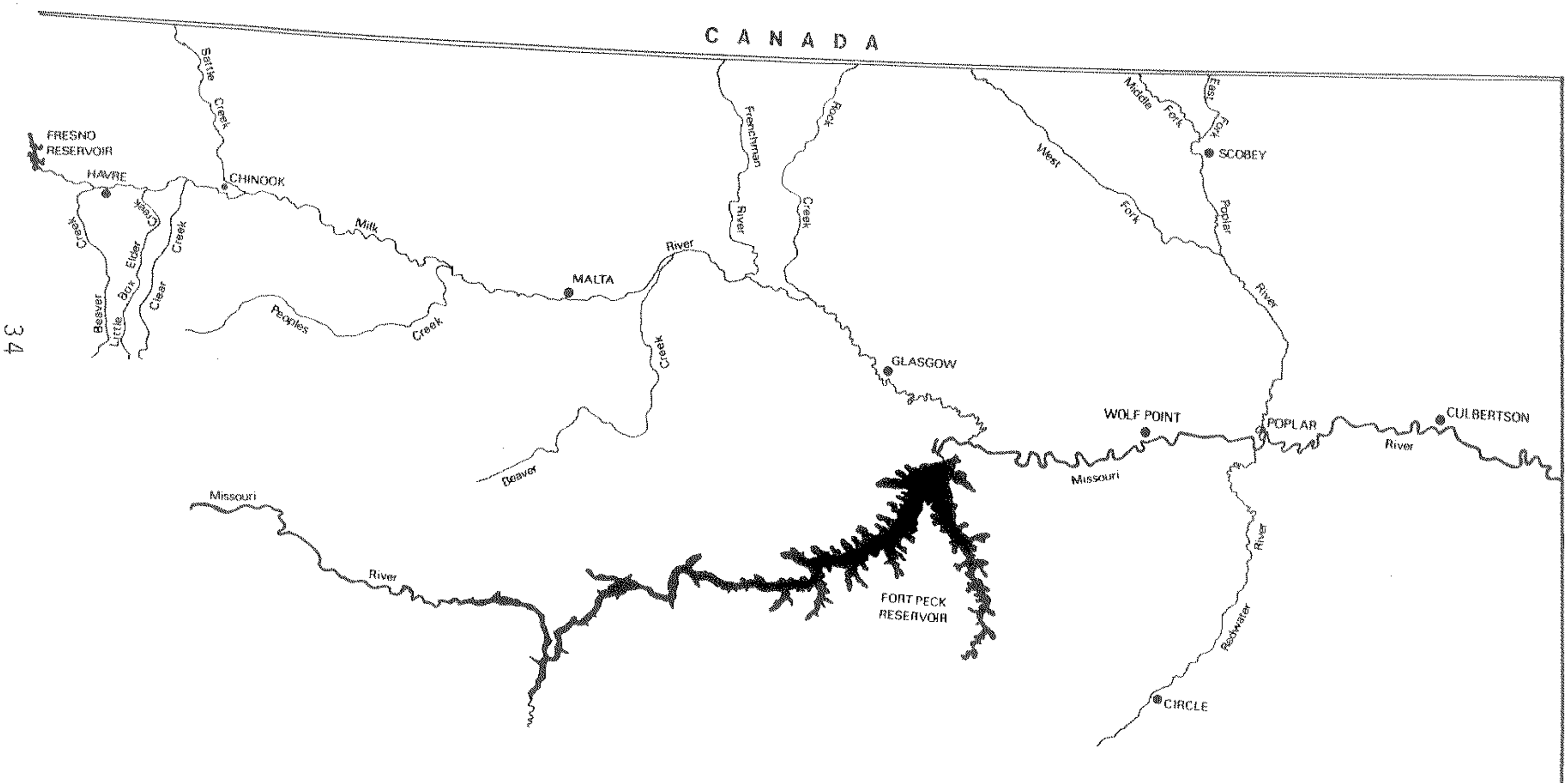

Figure 5. Map of the Missouri River basin below Fort Peck Dam.

The Missouri River immediately below the Dam is clear and cold, unlike the warm, turbid middle Missouri River upstream. The Milk and Poplar rivers, two of the larger tributaries entering the Missouri downstream from the dam, are particularly important in restoring prairie river characteristics by increasing water temperatures and turbidities to more natural levels.

Most lands adjacent to the Missouri River downstream from Fort Peck Dam are privately owned. Isolated parcels administered by the U.S. Bureau of Land Management border the river; however, these public lands are generally surrounded by private land. Between the Porcupine Creek/Milk River confluence and Big Muddy Creek, the Missouri River is bordered by the Fort Peck Indian Reservation to the north.

The lower Missouri River Basin is sparsely populated. According to the 1990 census, total population of the nine counties with streams for which reservations are sought is only about 84,141 persons. The Fort Peck Indian Reservation accounts for 13% of the total. The largest communities are Fort Peck, Poplar, Havre, Glasgow and Wolf Point. Numerous smaller communities are scattered throughout the basin.

Agriculture (livestock, dryland grain production, and irrigated farming) is the major land use in the basin. Although coal deposits are present, they are, as yet, undeveloped. Other energy-related land use is primarily oil and natural gas production.

Angling is but one of the many recreational opportunities along the lower Missouri River. Floating and scuba diving are also enjoyed. Wildlife viewing opportunities abound. Mule and white-tailed deer, upland game birds, birds of prey, waterfowl and furbearers can all be seen within the river corridor.

The lower Missouri River offers many diverse angling opportunities. The variety of habitats between Fort Peck Dam and the mouth of the Milk River supports a diverse fish community comprised of 35 species. Anglers can fish for sauger, walleye and trophy-sized rainbow trout in the cold tailwaters immediately below the dam. Paddlefish, another popular sport fish, reside year-round in the dredge cuts, which were created during construction of the dam.

With the inflow of the Milk River and other downstream tributaries, the Missouri River starts to regain its warm, turbid characteristics, causing it to revert back to a warmwater fishery. The warmwater fishery of the lower Missouri River is under-utilized, receiving only 9,525 angler-days of use in 1985 (McFarland 1989). However, the low level of use is not indicative of the quality of the fishery. On the contrary, the fishery, in many respects, is on a par with the well-known trout fishery in the upper Missouri River basin. Warmwater fishing has not had the same popularity among Montanans and non-resident visitors as the coldwater resource. This apparent lack of interest is changing as more resident and non-resident anglers discover Montana's excellent warmwater angling opportunities.

The lower Missouri River is rated by the Montana Department of Fish, Wildlife and Parks as a Class I fishery, the highest possible. The presence of prehistoric species (paddlefish, shortnose gar, and pallid sturgeon) adds to the rich fauna of the lower basin. These relics, along with the sicklefin chub, pearl dace and the northern redbelly dace x finscale dace hybrid, are all classified as "Species of Special Concern" by DFWP and the Montana Chapter of the American Fisheries Society. These fishes are native to Montana but have limited habitats and/or limited numbers in the state. Other sensitive species inhabiting the lower Missouri River basin are the bald eagle, piping plover, snapping and softshelled turtles, and white pelican.

Two reaches of the Missouri River are discussed in this section of the application. They are identified as reaches 7 and 8. The Missouri basin reservation process has been a two-part procedure. Reaches 1 through 6 of the Missouri River mainstem are contained in DFWP's Application for Reservations of Water in the Missouri River Basin Above Fort Peck Dam dated June 1989.

STREAM NAME: Missouri River

STREAM REACH: #7. From Fort Peck Dam to the confluence with the Milk River -- 10.7 miles

LOCATION: Sec. 15, T26N, R41E to Sec. 32, T27N, R42E

DESCRIPTION OF STREAM REACH:

The stream gradient is very low and averages 0.9 feet/mile. The upper six miles of the river channel were substantially altered during construction of Fort Peck Dam, over 50 years ago. These new channel features include three 40-foot-deep-pools, two large, off-channel dredge ponds, and an island complex with an associated side channel. These added features substantially diversify the aquatic habitat in this reach.

This reach of the river is a popular and heavily utilized recreation area. Access to the river is excellent due to the large amount of public land bordering the river and three public boat launch sites. Most of the river use is associated with fishing; however, in the dredge ponds, swimming and water skiing are the most popular activities. Other recreational uses include hunting, camping, boating, birdwatching, picnicking and scuba diving.

The flows in this reach are entirely regulated by Fort Peck Dam. The dam alters the normal seasonal flow pattern of the river by storing the high spring run-off flows and augmenting summer and winter flows. In addition, hydroelectric power peaking at the dam causes water releases to fluctuate daily by as much as 14,000 cfs.

Additional downstream impacts of Fort Peck Reservoir include abnormally cold water temperatures and extreme water clarity. These physical changes have significantly altered the river environment, changing it from a warmwater to more of a coldwater fishery.

Long-term flow records for Reach #7 are available from the USGS gauge site located 8 miles downstream from Fort Peck Dam. The average annual flow during a 46-year period of record (1943-89) was 9,839 cfs. Median monthly flows ranged from 7,790 cfs in April to 12,900 cfs in February.

GAME FISH PRESENT:

Shovelnose sturgeon, paddlefish, sauger, rainbow trout, northern pike, walleye, channel catfish, cisco, burbot, chinook salmon, lake trout, pallid sturgeon, brown trout, lake whitefish.

FISHERY:

The variety of habitats in Reach #7 supports an exceptionally diverse fish community. Of the 43 fish species inhabiting 183 miles of river downstream from Fort Peck Dam, 35 are found in this reach (Gardner and Stewart 1987). Of those 35, eight are not present in downstream Reach #8.

The reach is noted for its sauger/walleye fishery and for the opportunity to catch trophy-sized rainbow trout, which average nearly four pounds and occasionally exceed seven pounds. The paddlefish, a common inhabitant of the dredge cuts, is another popular quarry taken by both hook-and-line and bow-and-arrow. Needham (1979) estimated the paddlefish population in the 684-acre upper dredge pond at 3,406 fish in 1978. Attributes of the more common game fish in Reach #7 are given in Table 2.

Table 2. Statistics for game fish sampled in the Missouri River from Fort Peck Dam to the Milk River confluence, 1979-87.

Species	Number	Average Length (inches)	Range	Average Weight (pounds)	Range
Shovelnose sturgeon	599	25.9	(21.3 - 36.2)	2.19	(0.6 - 6.5)
Paddlefish	375	51.4	(31.0 - 66.0)	25.90	(5.0 - 72.0)
Rainbow trout	220	21.0	(9.2 - 26.5)	3.87	(0.32 - 6.6)
Northern pike	40	28.1	(20.3 - 40.0)	5.90	(1.80 - 17.5)
Channel catfish	51	18.9	(14.4 - 21.1)	2.08	(0.77 - 3.4)
Sauger	248	14.4	(9.3 - 19.9)	0.89	(0.24 - 2.3)
Walleye	105	15.3	(9.9 - 23.1)	1.50	(0.23 - 4.1)

With the exception of the rainbow trout, most of the game fish are about average size for river populations within the state. The tailwater environment and cold water releases from Fort Peck Dam apparently favor a trout population of large, older fish (Frazer 1985).

In addition to providing a diverse and high quality sport fishery, Reach #7 also supports three fish species of "special concern" in Montana -- pallid sturgeon, paddlefish and shortnose gar. One of these, the pallid sturgeon, is federally listed as endangered. Another, the paddlefish, is being studied for possible inclusion as a threatened or endangered species.

Twenty-one non-game species have been found in Reach #7. Table 3 lists these species.

Table 3. Non-game species and their relative abundance in the Missouri River, Reach #7, 1979-84.

Species	Abundance[1]
Shortnose gar	R
Goldeye	A
Rainbow smelt	L
Carp	A
Northern redbelly dace	R
Flathead chub	R
Lake chub	R
Emerald shiner	C
Northern spottail shiner	L
Western silvery minnow	L
Fathead minnow	C
Longnose dace	R
River carpsucker	C
Blue sucker	L
Smallmouth buffalo	A
Bigmouth buffalo	C
Shorthead redhorse	C
Longnose sucker	C
White sucker	C
White bass	R
Yellow perch	R

[1] A = abundant; C = common; R = rare; L = limited distribution but occurs in fair numbers

Source: Gardner and Stewart (1987).

WILDLIFE:

The riparian zone of the Missouri River provides diverse habitats which support many wildlife species. Excellent populations of both white-tailed and mule deer occupy the productive river bottomlands. The Merriam's turkey was recently introduced in this area. Other game birds found along the river include ring-necked pheasants, sharp-tailed grouse and mourning doves. Canada geese and several species of ducks use this reach of the Missouri River throughout the year. A substantial winter concentration of bald eagles occurs immediately downstream from Fort Peck Dam. Open water, an abundance of waterfowl, and the discharge of fish through the dam's turbines attract eagles. Furbearers commonly found in the river corridor include beaver, raccoon, muskrat, and mink.

INSTREAM FLOW METHODS:

Studies to determine the instream flow needs for the lower Missouri River were conducted by the DFWP in the mid-1980s (Frazer 1985 and 1987, Gardner and Stewart 1987). The following narrative summarizes the results of these studies.

Wetted Perimeter Inflection Point Method

The wetted perimeter inflection point method was applied to three representative riffles in the Missouri River between Fort Peck Dam and the Milk River confluence. Seven cross-sections were established in these riffles. The WETP computer program was calibrated to field data collected at flows of 4,400, 7,200, and 9,800 cfs.

The upper inflection points on the wetted perimeter-flow curves for the three riffles occur at flows of 4,000, 4,200, and 4,700 cfs, respectively (Figure 6). To maintain wetted perimeter in all riffles in Reach #7, a flow of 4,700 cfs is recommended. However, this wetted perimeter recommendation was overridden by the flow requests for other purposes (see below).

Maintenance of Main Channel Riffles in Reach #8

A flow of 7,000 cfs is required to maintain riffle wetted perimeter in Reach #8 of the Missouri River, located downstream from Reach #7 (see the instream flow write-up that follows for Reach #8). USGS data from the Fort Peck and Wolf Point gauges indicate that flow releases at Fort Peck Dam contribute nearly all of the median flow of the Missouri River at Wolf Point (in Reach #8) from October through February. A flow of 7,000 cfs is, therefore, needed in Reach #7 during this period to maintain downstream riffles in Reach #8.

During the month of March, the Milk River contributes 14% of the median flow for the Missouri River at Wolf Point, with flow releases at Fort Peck Dam accounting for the remaining 86%. To provide the required flow for downstream riffle maintenance, the flow of the Missouri River at the Fort Peck gauge must be maintained at 86% of 7,000 cfs, or 6,000 cfs, during March.

Maintenance of Rainbow Trout Spawning Areas

The trophy-sized rainbow trout inhabiting Reach #7 are an important fishery resource (Frazer 1985). The 2.5-mile-long east side channel below the dam is crucial to the perpetuation of this fishery. This side channel is the major spawning, incubation and rearing area for rainbow trout. Sufficient flows must be maintained in the side channel to sustain these critical life functions.

The wetted perimeter inflection point method was used to determine the flow needed to maintain the side channel riffles where adult trout spawn, young trout rear, and the food for rearing young is produced. Two large riffles, located in the lower quarter mile of the east side channel, were identified as major spawning and rearing sites. Two riffle cross-sections were established at these sites. The WETP computer program was calibrated to field data collected at side channel flows of 55, 297, and 706 cfs.

At a side channel flow of about 250 cfs, the side channel riffles are almost completely covered by water (Figure 7). The main channel flow that would provide a side channel flow of 250 cfs is about 7,800 cfs (Figure 8). Therefore, 7,800 cfs is needed to maintain essential side channel habitats for rainbow trout. This flow should be maintained from the onset of spawning (April 1) to the end of the rearing period (September 30) when the majority of young have exited the channel for the main river.

Maintenance of Sauger Spawning Areas in Reach #8

At least 11,500 cfs is required to maintain an adequate water depth over important sauger spawning and incubation areas in downstream Reach #8 of the Missouri River (see the instream flow write-up that follows for Reach #8). USGS data for the Fort Peck and Wolf Point gauges indicate that flow releases at Fort Peck Dam contribute about 96% of the median flow of the Missouri River at Wolf Point (in Reach #8) during the sauger spawning and incubation period of May 11 - June 30. Therefore, to protect sauger spawning and incubation habitats in Reach #8, the Missouri River at the Fort Peck gauge must be maintained at about 96% of 11,500 cfs, or 11,000 cfs, from May 11 - June 30.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain existing resident game fish populations; to protect the habitat of three fish species of "special concern", which include the federally listed "endangered" pallid sturgeon; to meet the spawning and incubation flow requirements of sauger; to protect spawning, incubation and rearing habitats for the trophy-sized rainbow trout population; to preserve the recreational values of the lower Missouri River; and to help protect the habitat of the wildlife species that depend upon the river and its riparian zone for food, water, and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Flow (cfs)	Acre-Feet	Primary Purpose
April 1 - May 10	7,800	618,843	Maintain essential side channel habitats for rainbow trout
May 11 - June 30	11,000	1,112,727	Maintain spawning and incubation habitats for sauger in downstream Reach #8 of the Missouri River
July 1 - Sept. 30	7,800	1,423,338	Maintain essential side channel habitats for rainbow trout
Oct. 1 - Feb. 28	7,000	2,096,528	Maintain downstream riffle habitat in Reach #8 of the Missouri River
March 1 - March 31	6,000	368,925	Maintain downstream riffle habitat in Reach #8 of the Missouri River
		5,620,361 AF/yr	

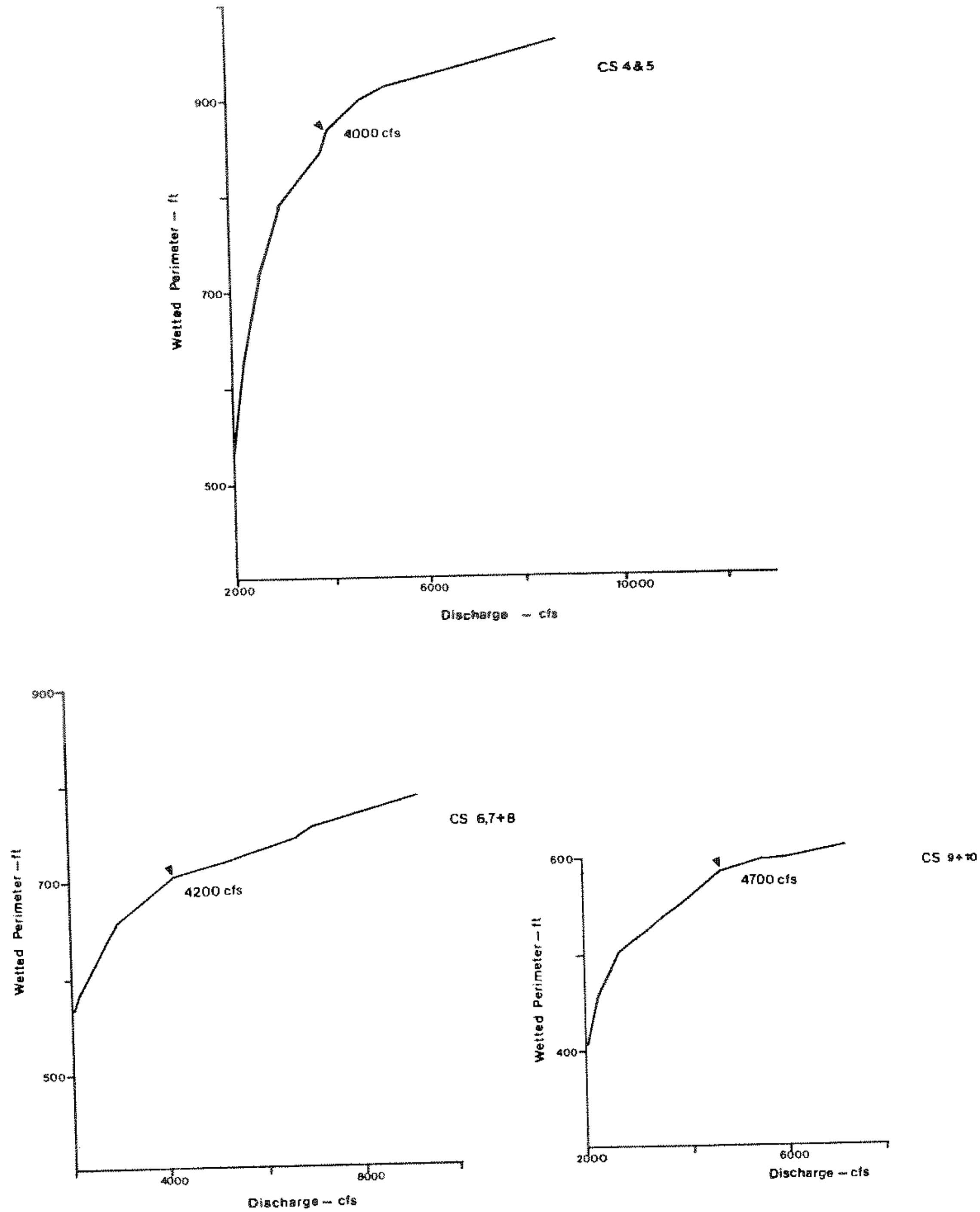

Figure 6. Relationship between wetted perimeter and flow for three different riffles located on the Missouri River in Reach #7. Each curve is a composite of two or three cross-sections. Inflection points are marked. (From Gardner and Stewart 1987).

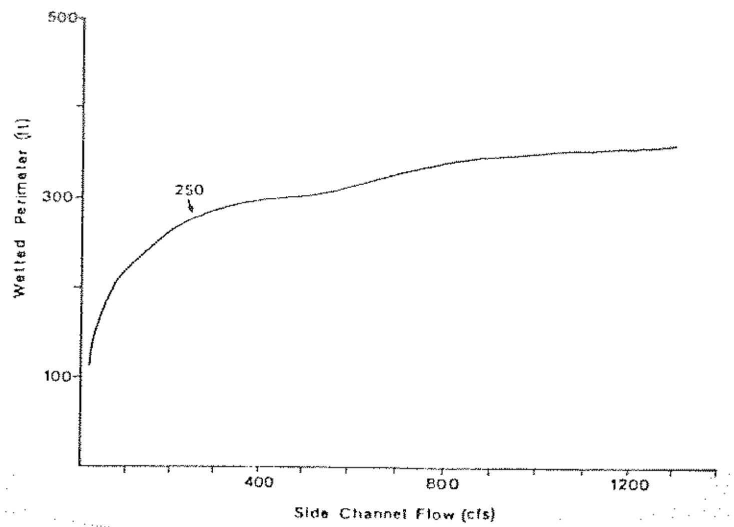

Figure 7. Relationship between wetted perimeter and flow for a composite of two riffle cross-sections in the east side channel, Reach #7, Missouri River. (From Frazer 1985).

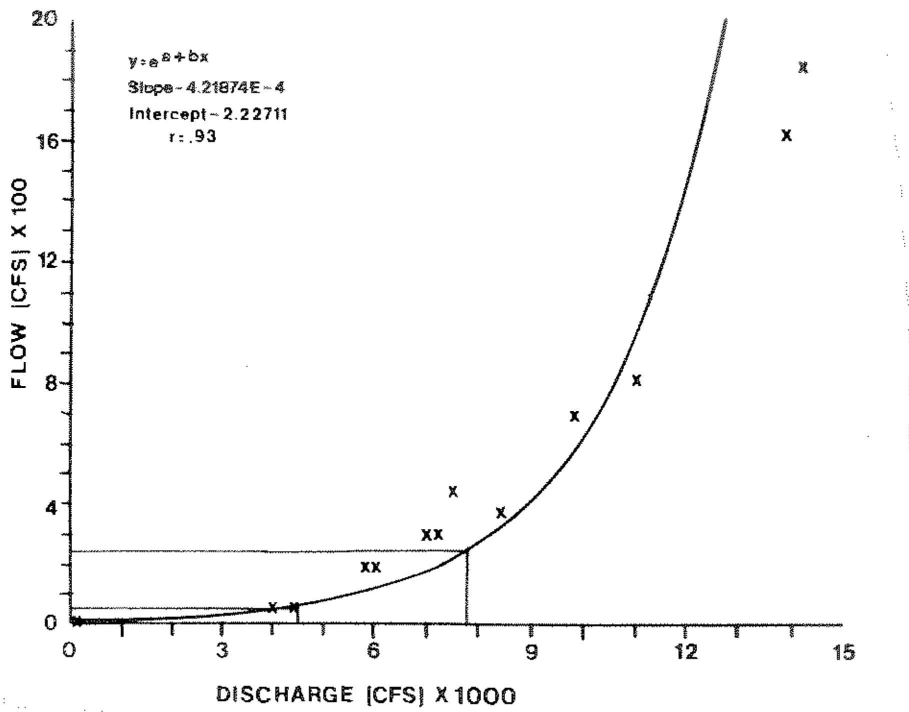

Figure 8. Relationship between Fort Peck Dam discharge and flow in the east side channel, Reach #7, Missouri River. (From Frazer 1987).

STREAM NAME: Missouri River

STREAM REACH: #8. From the confluence of the Milk River to the Montana-North Dakota border -- 171.9 miles

LOCATION: Sec. 32, T27N, R42E to Sec. 13, T26N, R59E

DESCRIPTION OF STREAM REACH:

The Milk, Poplar and Redwater rivers and Big Muddy Creek are perennial tributaries to Reach #8. The stream gradient is very low, averaging 0.9 feet/mile. The upper 55 miles of this reach are in an erosional state in spite of the low stream gradient and, therefore, much of the riffle substrate is comprised of gravel. The remaining 117 miles gradually shift to a depositional state. Here, the water increases in turbidity and sand comprises the channel substrate.

Reach #8 receives a relatively low amount of recreational use because of the sparse population in the vicinity and limited access to the river. There are three public boat launching sites in the 172-mile reach. Much of the land within the river corridor is privately owned and access to the river is usually granted with permission. Most of the river use is associated with fishing. Between the Milk River confluence and Wolf Point there are about five popular paddlefish snagging sites. Other recreational uses in this reach include hunting, camping, boating and picnicking.

Flows in this reach are regulated by Fort Peck Dam. The dam restructures the normal seasonal flow pattern of the river by storing the high spring run-off flows and augmenting summer and winter flows. The Milk River and other tributaries to this reach normally contribute about 1,000 cfs during the spring run-off period, thereby helping to restore a "June rise" in river flow and return Reach #8 to a turbid, warm water environment.

Long-term flow records are available from two USGS gauge sites within the reach. For the site at the upper end, near Wolf Point, average annual flow over a 46-year period of record (1943-89) was 10,480 cfs. Median monthly flows ranged from 8,650 cfs during October to 13,000 cfs in February. The average annual flow for a 40-year period of record (1943-51, 1959-89) for the Culbertson site (9 miles downstream from the confluence of Big Muddy Creek) was 10,660 cfs. Median monthly flows ranged from 8,850 cfs during October to 13,300 cfs in February.

GAME FISH PRESENT:

Sauger, burbot, shovelnose sturgeon, paddlefish, northern pike, walleye, channel catfish, rainbow trout, smallmouth bass, pallid sturgeon, brown trout.

FISHERY:

Reach #8 of the Missouri River supports 35 fish species, eight of which are not found in upstream Reach #7 (Gardner and Stewart 1987). Sauger, burbot, shovelnose sturgeon and northern pike are the most common game fish. In the summer and fall of 1982, electrofishing estimates near the confluence of the Milk showed 2,028 sauger per mile of river. Downstream, near Wolf Point, the population declined to 54 sauger per mile. At the lower end of the reach in the Culbertson section, the sauger population increased to 364 fish per mile. Another important game fish, the paddlefish, migrates out of Lake Sakakawea and up the Missouri River to spawn in the Milk River and the upper portion of the reach during late spring. During five years of electrofishing, 1,700 paddlefish were counted in the reach. Attributes of the more common game fish in Reach #8 are given in Table 4.

Table 4. Statistics of game fish sampled in the Missouri River from the Milk River confluence to North Dakota border, 1979-83.

Species	Number	Average Length (inches)	Range	Average Weight (pounds)	Range
Sauger	3687	14.4	(4.8 - 29.6)	1.00	(0.02 - 6.4)
Burbot	578	15.3	(4.3 - 40.5)	1.39	(0.02 - 12.6)
Shovelnose sturgeon	364	25.1	(14.5 - 35.8)	1.99	(0.14 - 6.5)
Paddlefish	151	57.2	(43.0 - 69.0)	36.80	(16.00 - 76.0)
Northern pike	449	24.1	(6.2 - 42.5)	3.80	(0.04 - 21.5)
Walleye	301	15.5	(4.3 - 29.2)	1.82	(0.02 - 10.2)
Channel catfish	121	13.9	(5.1 - 24.1)	1.04	(0.04 - 4.6)

Sizes of most of the game fish found in Reach #8 are above average for river populations within the state, especially for sauger, northern pike and walleye. This is probably due to the Missouri's productivity and proximity to Lake Sakakawea, where some river fish reside during portions of the year.

Four fish species of "special concern" in Montana--the paddlefish, pallid sturgeon, shortnose gar, and sicklefin chub--inhabit Reach #8. The pallid sturgeon is also federally listed as an endangered species.

Twenty-four non-game species have been found in this reach. A list of these species and their relative abundance is given in Table 5.

Table 5. Non-game species and their relative abundance in the Missouri River, Reach #8, 1979-84.

Species	Abundance[1]
Shortnose gar	R
Goldeye	A
Rainbow smelt	L
Carp	A
Flathead chub	R
Sicklefin chub	R
Lake chub	R
Emerald shiner	C
Fathead minnow	C
River carpsucker	C
Blue sucker	L
Smallmouth buffalo	A
Bigmouth buffalo	C
Shorthead redhorse	C
Longnose sucker	C
White sucker	C
Black bullhead	R
Stonecat	R
Brook stickleback	R
White bass	R
Yellow perch	R
Iowa darter	R
Freshwater drum	R
White Crappie	R

[1] A = abundant; C = common; R = rare; L = limited distribution but occurs in fair numbers

Source: Gardner and Stewart (1987)

WILDLIFE:

The extensive riparian zone found along Reach #8 provides diverse habitats which support many wildlife species. Excellent populations of both mule and white-tailed deer occupy the productive river bottomlands. Game birds found along the river include ring-necked pheasants, sharp-tailed grouse and mourning doves. Canada geese and several species of ducks use this reach either during their spring and fall migrations or throughout the ice-free months. Furbearers within the river corridor include beaver, raccoon, muskrat and mink.

INSTREAM FLOW METHODS:

The following narrative summarizes the results of a study conducted by the DFWP to derive instream flow recommendations for Reach #8 of the lower Missouri River. More in-depth information can be obtained in Gardner and Stewart (1987).

Wetted Perimeter Inflection Point Method

The wetted perimeter inflection point method was applied to three representative riffles in Reach #8 between the Milk River confluence and Wolf Point. A total of five cross-sections were established in these riffles. The WETP computer program was calibrated to field data collected at flows of 4,400, 7,200, and 9,800 cfs.

The upper inflection points on the wetted perimeter-flow curves for the three riffles occur at flows of 4,200, 5,000, and 7,000 cfs (Figure 9) To maintain wetted perimeter in all riffles in Reach #8, a flow of 7,000 cfs is recommended.

Maintenance of Sauger Spawning/Incubation Areas

Major spawning/incubation sites used by Missouri River sauger and to a lesser extent, walleye, are located on rocky reef areas associated with eroding cliffs of a hard, sandstone formation bordering the river. Known spawning/incubation reefs are confined to eight sites in the 184-mile-long study area. This scarcity of spawning/incubation reefs was considered limiting to the sauger population and underscores the importance of maintaining adequate flows through these crucial areas.

Gardner and Stewart (1987) determined that Missouri River sauger require a two-foot minimum water depth over their spawning areas to successfully reproduce. To determine at what flow this minimum depth requirement is met, river stage heights were monitored at two representative sauger spawning reefs on the Missouri River between Poplar and the North Dakota border. These stage height data were used in conjunction with program options in the WETP computer program to derive the needed spawning/incubation flows.

Flows of 10,986 and 11,497 cfs, respectively, would satisfy the two-foot minimum criterion at the two spawning reefs modeled by cross-sections 29-31 and cross-sections 39-41 (Table 6). Therefore, to maintain sauger/incubation habitat in Reach #8, flows should remain at or above 11,500 cfs during the spawning/incubation period of May 11 - June 30.

Table 6. River stage height and corresponding flows required to maintain adequate water depth at two representative sauger spawning/incubation sites.

Cross Section Number	River Stage Providing 2-Foot Minimum Depth		Flow Corresponding to River Stage
29	19.88 feet[1]		10,673 cfs
30	29.67 feet		11,367 cfs
31	24.41 feet		10,917 cfs
		Average:	10,986 cfs
39	22.64 feet		13,483 cfs
40	17.80 feet		10,286 cfs
41	16.74 feet		10,722 cfs
		Average:	11,497 cfs

[1] River stages are not keyed to a common reference point.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain the existing resident game fish populations; to help protect the habitat of four fish species of "special concern", which include the pallid sturgeon, a federally designated endangered species; to meet the spawning and incubation flow requirements of sauger; to preserve the recreational values of the lower Missouri River; and to help protect the habitat of those wildlife species that depend upon the river and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Flow (cfs)	Acre-Feet	Primary Purpose
May 11 - June 30	11,500	1,163,305	Maintain habitat for sauger spawning/ incubation
July 1 - May 10	7,000	4,359,667	Maintain main channel riffle habitat
		5,522,972 AF/yr	

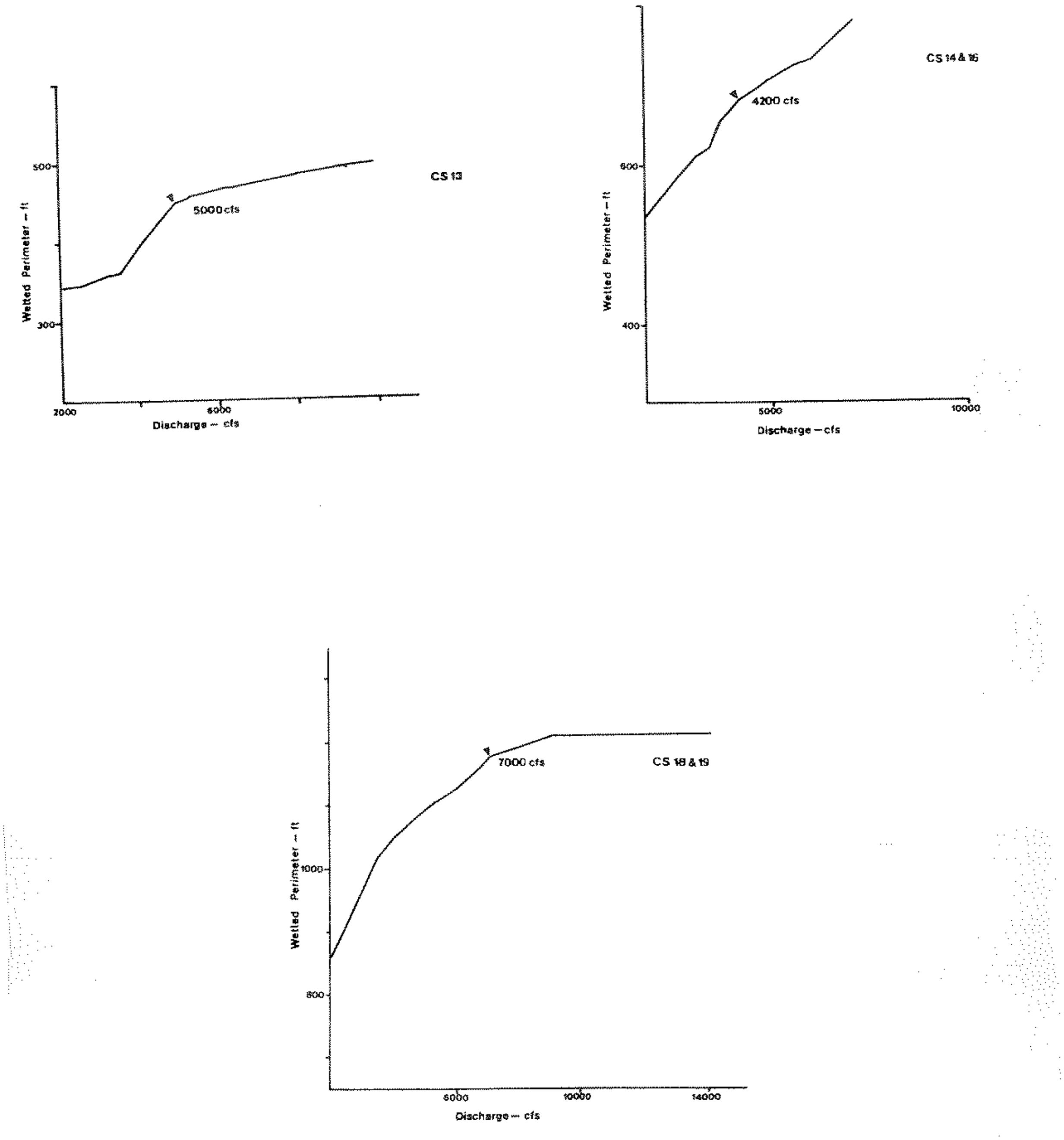

Figure 9. Relationships of wetted perimeter to flow for three different riffles located on the Missouri River in Reach #8. Each curve represents one or a composite of two cross-sections. Inflection points are marked. (From Gardner and Stewart 1987).

Milk River Sub-Basin

Figure 10 shows illustrates the location of the following streams discussed in this section:

Beaver Creek (Hill County)
Little Box Elder Creek
Clear Creek
Battle Creek
Peoples Creek
Beaver Creek Reach #1 (Phillips County)
Beaver Creek Reach #2 (Phillips County)
Frenchman River
Rock Creek

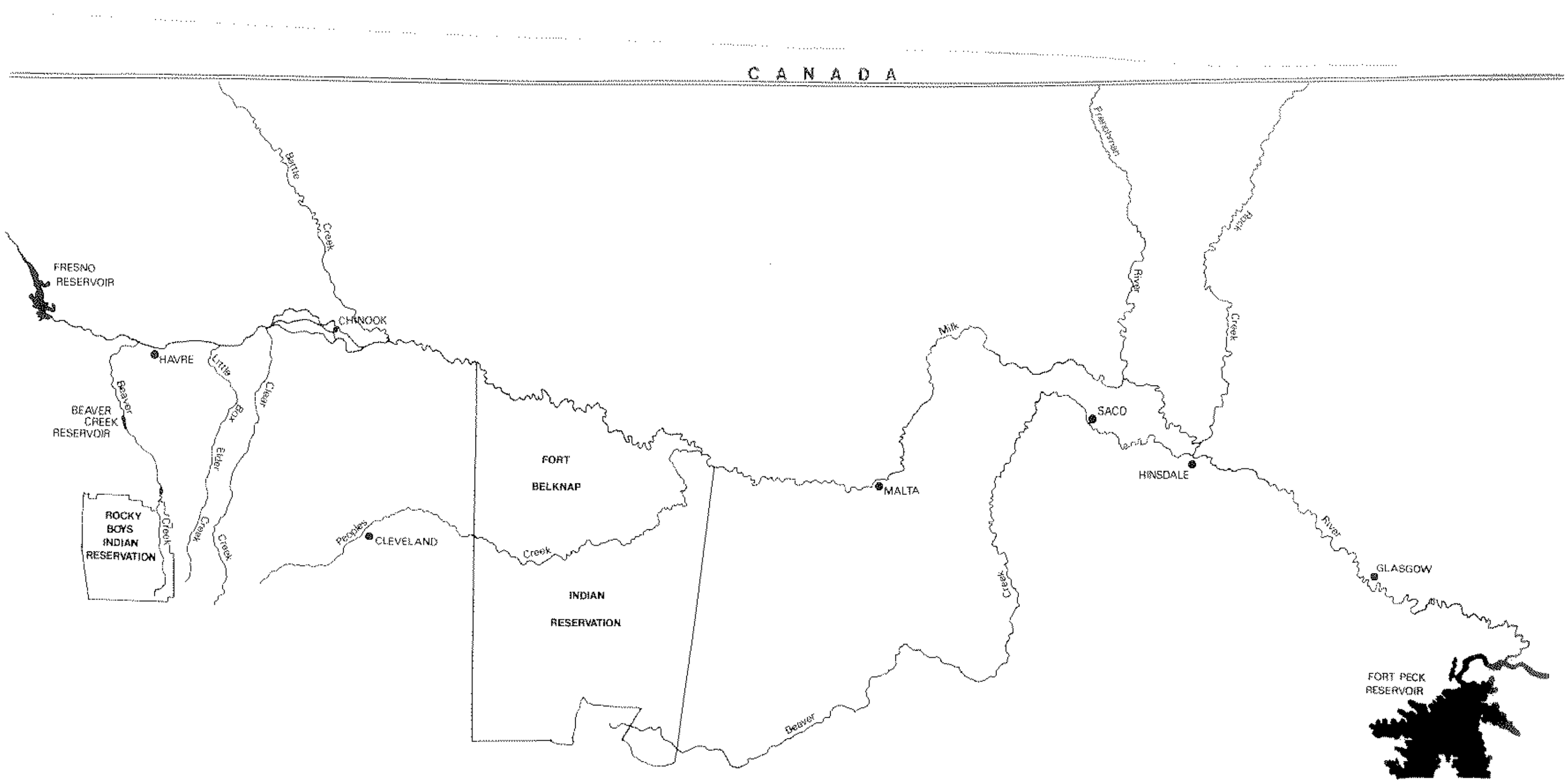

Figure 10. Map locating the Milk River sub-basin.

STREAM NAME: Milk River

DESCRIPTION OF THE SUB-BASIN:

The Milk River, one of the longest tributaries to the Missouri River at 705 river-miles, originates at the juncture of its south and middle forks on the Blackfeet Indian Reservation in Glacier County. The Milk then flows northeasterly into Alberta, Canada. After meandering for 167 miles, it re-enters the United States in Hill County, flowing another 490 miles to its confluence with the Missouri River below Fort Peck Dam. Because a portion of the Milk River flows through Canada, water allocation is governed, in part, by the Boundary Waters Treaty of 1909 between the United States and Great Britain. In addition, water use is also governed by the "Winters Doctrine", which recognizes that the Fort Belknap, Rocky Boys and Blackfeet Indian reservations have water rights dating back to 1888.

The Milk River drains 23,300 square-miles, 67% of which is in the United States. Thirteen principle tributaries arise in the United States while five originate in Canada. Seven major dams and diversions and a number of minor diversions are present on the mainstem Milk River. Water quality upstream from Havre is considered good. However, it progressively worsens downstream due to agricultural returns and municipal discharges (Department of Natural Resources and Conservation 1977).

Some Milk River tributaries originate in the Bear Paw and Little Rocky mountains. These headwaters are the only coldwater trout streams on the High Line. Here, the brook trout is the most common gamefish species, although rainbow, cutthroat and brown trout are also present in some streams. Upon leaving the mountains, these coldwater tributaries enter the prairie where they gradually change to warmwater streams having low water velocities and silty pools. Other tributaries arising in Canada are warmwater systems throughout their length. These northern warmwater tributaries are typically low-gradient prairie waters consisting of slow, deep pools, long, shallow runs, and intermittent riffles. Most support populations of sauger, walleye, northern pike, channel catfish and smallmouth bass.

The climate of the Milk River sub-basin is semi-arid. Droughts occur periodically. Hot summers and cold winters combine to make both the aquatic and terrestrial environments challenging. Precipitation averages 12.5 to 14 inches per year, with half falling between April and September. Over 138,000 acres are irrigated in the Milk River basin (U.S. Bureau of Reclamation 1990). Milk River flows are augmented by a trans-basin diversion from the St. Mary's River in Glacier County. Still, Milk River irrigators encounter significant water shortages in six years out of every ten (U.S. Bureau of Reclamation 1990).

Upon re-entry into the United States, the Milk River cuts through glacial debris, which largely determines the soils and topography of the basin. Downstream from Havre, the Milk River flows through a valley carved by the Missouri River before continental glaciation forced the Missouri south to its present channel. As soils vary, some places are amenable to farming, whereas others are totally unsuitable. Riparian zones vary from grass/forb communities to occasional shrub communities. Outside the river corridors, rangeland or dryland farming are the primary land uses.

The Milk River and its tributaries are important contributors of flow to the mainstem Missouri River during spring runoff. These contributions are particularly important in initiating the restoration of warm water temperatures and turbidity to the lower Missouri River. Peak spring runoff in the Missouri River is stored in Fort Peck Reservoir. As a result, Milk River discharge is often a significant portion of the Missouri River's flow during spring (Gardner and Stewart 1987). In fact, median Milk River flows from April through June average 10.3% of the Missouri River flow (USGS 1984). Rising water temperatures and increased spring flows are important stimuli for triggering spawning activity for many warmwater species in riverine environments (Hynes 1970). The peak spring runoff from the Milk River is important in triggering spawning runs of many mainstem Missouri River fishes, including the paddlefish.

Overall angling pressure on the Milk River is low compared to other rivers in Montana. However, the Milk River and its tributaries received over half of the total annual angler days throughout the entire lower and Little Missouri river basins. The angling opportunities are quite good, particularly at the confluence of the Milk and Missouri rivers and where Milk River tributaries empty into the mainstem Milk. All of the tributaries provide deep, quiet water in the vicinity of their confluence. These areas are generally less turbid than the river and allow aquatic vegetation to establish, providing excellent spawning, feeding, and rearing habitats for a variety of forage and predatory fish species. Walleye, sauger and northern pike are the most important gamefish species in the mainstem Milk River and are present throughout much of its length. Furthermore, the natural production occurring in tributaries contributes to the recruitment of sport fish to the Milk. In addition, the forage fish produced in the Milk River and its tributaries are particularly valuable as a food base for the gamefish populations of both the Milk and Missouri rivers.

Three fishes of "special concern" are known to inhabit the Milk River or its tributaries. These are the shortnose gar, pearl dace and the northern redbelly dace x finescale dace hybrid. Their distribution in the Milk River system is probably wider than present data suggest. Another fish of "special concern", the paddlefish, migrates into the Milk River to spawn in high runoff years.

In 1982, the Department of Natural Resources and Conservation closed the mainstem of the Milk River to new water permit applications. Because of the severe water shortages that plague the area during most irrigation seasons, DFWP is not seeking a water reservation for the mainstem Milk River. However, requests are made for eight tributaries.

STREAM NAME: Beaver Creek (Hill County)

STREAM REACH: From the Rocky Boys Indian Reservation boundary to Beaver Creek Reservoir -- 17 miles

LOCATION: Sec. 33, T29N, R16E to Sec. 31, T31N, R16E

DESCRIPTION OF STREAM REACH:

Beaver Creek is one of the largest tributaries draining the Bear Paw Mountains. The watershed encompasses approximately 117 square-miles. The headwaters are located on the Rocky Boys Indian Reservation. The creek flows north from the Reservation boundary 9.0 miles to Bear Paw Lake and another 8.0 miles before it enters Beaver Creek Reservoir. This 17.0-mile section of stream is located on public land within Beaver Creek County Park, which is administered by the Hill County Park Board. From Beaver Creek Reservoir, the creek flows 22.0 miles through predominately private land until it reaches the Milk River near Havre.

The streambed above Bear Paw Lake is rocky and exhibits a higher gradient than the creek below. Typical streambed substrates below Bear Paw Lake are clay, shale, gravel and sediment. Beaver Creek is appropriately named as considerable beaver activity is apparent throughout its length.

A heavily vegetated riparian zone comprised mainly of willows, chokecherry, wild rose and juneberry is present below the Reservation boundary. Conifers and aspens predominate along the headwaters. Land uses include livestock grazing and irrigated hay production.

GAME FISH PRESENT: Brook trout, rainbow trout, cutthroat trout, brown trout

FISHERY:

The brook trout, which is the predominant game fish above Bear Paw Lake, is replaced by rainbow trout downstream. Cutthroat trout and brown trout are also present in small numbers. Non-game species include white, longnose and mountain sucker, longnose dace, fathead minnow, Iowa darter, lake chub, northern redbelly dace and mottled sculpin. Trout populations above and below Bear Paw Lake have been periodically estimated using the two-pass method. Some recent estimates are summarized in Tables 7 and 8.

Table 7. Fall population estimates of age I and older trout from two sections of Beaver Creek. Estimates are presented as numbers of trout per 1,000 feet of stream.

Species	1980	1981	1982	1983	1988	1990
	Three Miles Below Bear Paw Lake					
Rainbow trout	51	68	36	11	90	28
	1,000 Feet Above Bear Paw Lake					
Rainbow trout	47	40	12	58	80	10
Brook trout	172	186	149	186	169	36
Total:	219	226	161	244	249	46

Table 8. Age group structure of the 1981 estimates of trout in the two sections of Beaver Creek shown in Table 7. Ninety-five percent confidence limits are in parentheses.

Species	Age	Mean Length (inches)	Mean Weight (inches)	Number per 1,000 feet	Pounds per 1,000 feet
		Three Miles Below Bear Paw Lake			
Rainbow trout	0	2.7	0.01	33 (±13)	0.3
	I	7.3	0.13	47 (±5)	6.1
	II+	9.9	0.27	21 (±6)	5.8
Total:				101 (±23)	12.2
		1,000 feet above Bear Paw Lake			
Rainbow trout	0	2.8	0.01	13 (±0)	0.1
	I+	7.3	0.16	40 (±6)	6.5
Total:				53 (±6)	6.6
Brook trout	0	3.0	0.01	85 (±34)	0.9
	I	5.4	0.06	115 (±28)	6.9
	II	7.4	0.15	62 (±9)	9.3
	III+	11.5	0.65	9 (±0)	5.5
Total:				271 (±70)	22.6

Beaver Creek receives considerable fishing pressure due to good access and its close proximity to Havre. Severe drought in 1988 significantly reduced trout stocks but natural reproduction is adequate to rebuild the populations over the next few years.

WILDLIFE:

Big game species inhabiting the watershed are elk, mule deer and white-tailed deer. Resident upland game bird species include pheasant, sharp-tailed grouse and Hungarian partridge. Waterfowl of various kinds utilize the many beaver ponds. Beaver, mink, muskrat, raccoon, bobcat and coyote are common furbearers in the drainage. An abundance of non-game wildlife, birds of prey and songbirds are found in close proximity to the creek.

WETTED PERIMETER:

Cross-sectional data were collected in a 77-foot section of Beaver Creek near the head of Beaver Creek Reservoir (Sec. 31, T31N, R16E). Four cross-sections describing the riffle habitat were established. The WETP program was calibrated to field data collected at flows of 4.3, 19.7, and 25.2 cfs.

The relationship between wetted perimeter and flow for the composite of four riffle cross-sections is shown in Figure 11. A prominent upper inflection point occurs at about 7.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain resident trout populations and to help protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water, and shelter.

FLOW REQUEST: January 1 - December 31 -- 7.0 cfs (5,068 AF/yr)

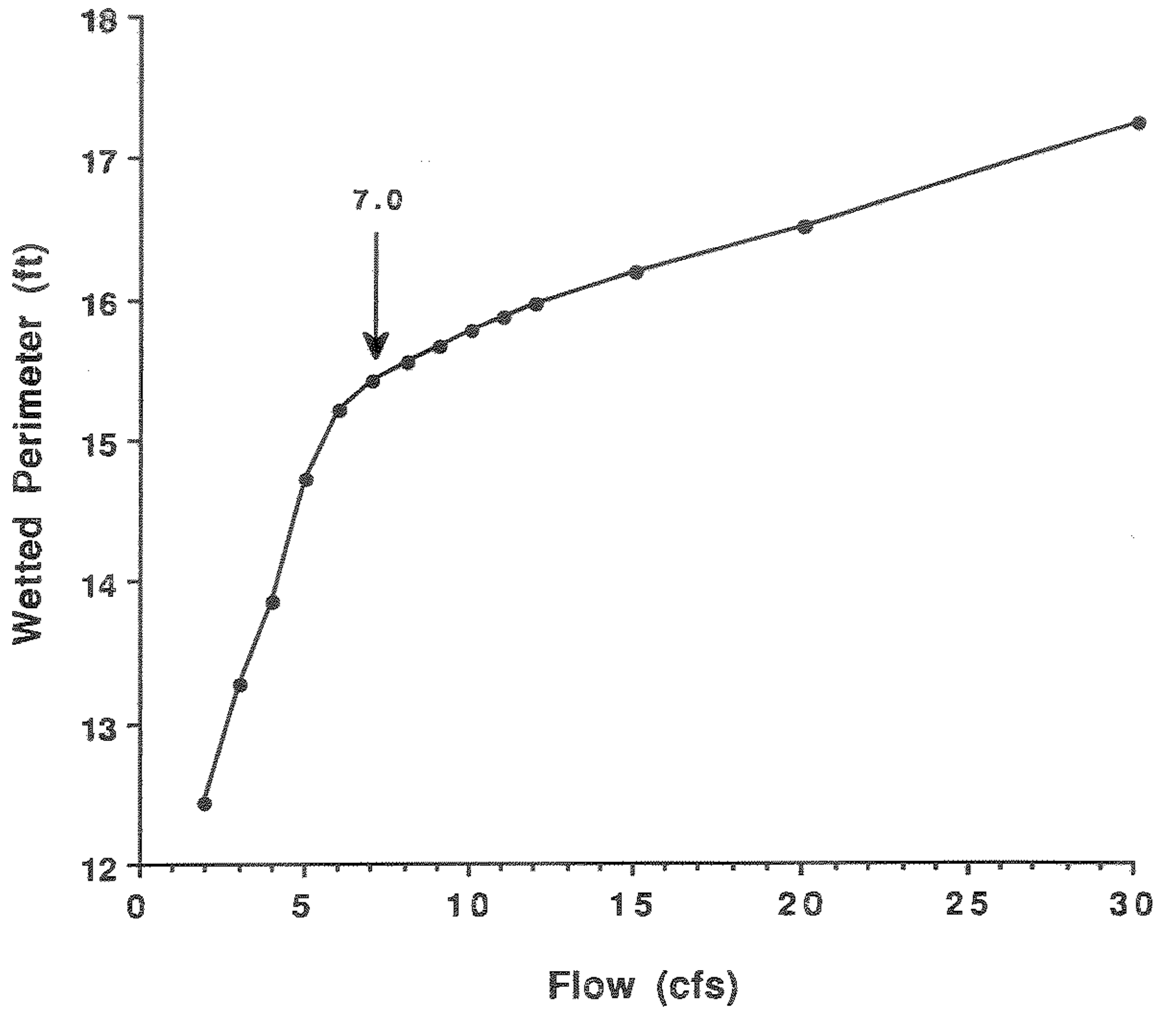

Figure 11. The relationship between wetted perimeter and flow for a composite of four riffle cross-sections in Beaver Creek.

STREAM NAME: Little Box Elder Creek

STREAM REACH: From the headwaters to Clear Creek Road crossing--26 miles

LOCATION: Sec. 19, T28N, R17E to Sec. 15, T31N, R17E

DESCRIPTION OF STREAM REACH:

Little Box Elder Creek originates on the northern slopes of the Bear Paw Mountains and flows 40 miles to its confluence with the Milk River east of Havre. The creek drains an area of 95 square miles.

Gravel and silt comprise the streambed. The riparian zone is predominately vegetated with willows throughout its length. Major land uses include grazing and hay production. Adjacent lands are entirely in private ownership, but access for recreation is usually granted. Bank stability along portions of the stream has been impaired by livestock.

GAME FISH PRESENT: Brook trout

FISHERY:

A 400-foot section of Little Box Elder Creek near Faber School was electrofished in the fall, 1990. Estimates of young-of-the-year and age I and older brook trout were made using the two-pass method. The longnose dace was the only other species collected in the section. Results are presented in Table 9.

Table 9. Population estimates of brook trout in Little Box Elder Creek near Faber School, 1990. Ninety-five percent confidence limits are in parentheses.

	Number per 400 feet of stream	Size Range (inches)
Young-of-the-year	39 (±0)	3.7 - 4.8
Age I and older	18 (±1)	6.9 - 8.5

This fishery suffered severely from dewatering during the drought of 1988. Current young-of-the-year numbers are significant and are expected to rebuild the population in the near future, provided stream flows remain adequate. The fishery receives light to moderate use due to the dense cover of streamside vegetation which hinders access.

WILDLIFE:

Big game species inhabiting the drainage are mule deer, white-tailed deer and elk. Resident game bird species include sharp-tailed grouse, Hungarian partridge and pheasant. Mink, beaver, muskrat, raccoon, bobcat, coyote and red fox are common furbearers in the stream corridor.

WETTED PERIMETER:

Cross-sectional data were collected in a 21-foot section of Little Box Elder Creek (Sec. 18, T29N, R17E). Three cross-sections describing the riffle habitat were established. The WETP program was calibrated to field data collected at flows of 1.0 and 7.6 cfs. A beaver dam constructed at the head of the study section during the field season prevented the collection of calibration data at a third flow.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 12. An upper inflection point occurs at an approximate flow of 1.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain resident trout populations and to help protect the habitat of those wildlife species, which depend upon the stream and its associated riparian zone for food, water, and shelter.

FLOW REQUEST: January 1 - December 31 -- 1.0 cfs (724 AF/yr)

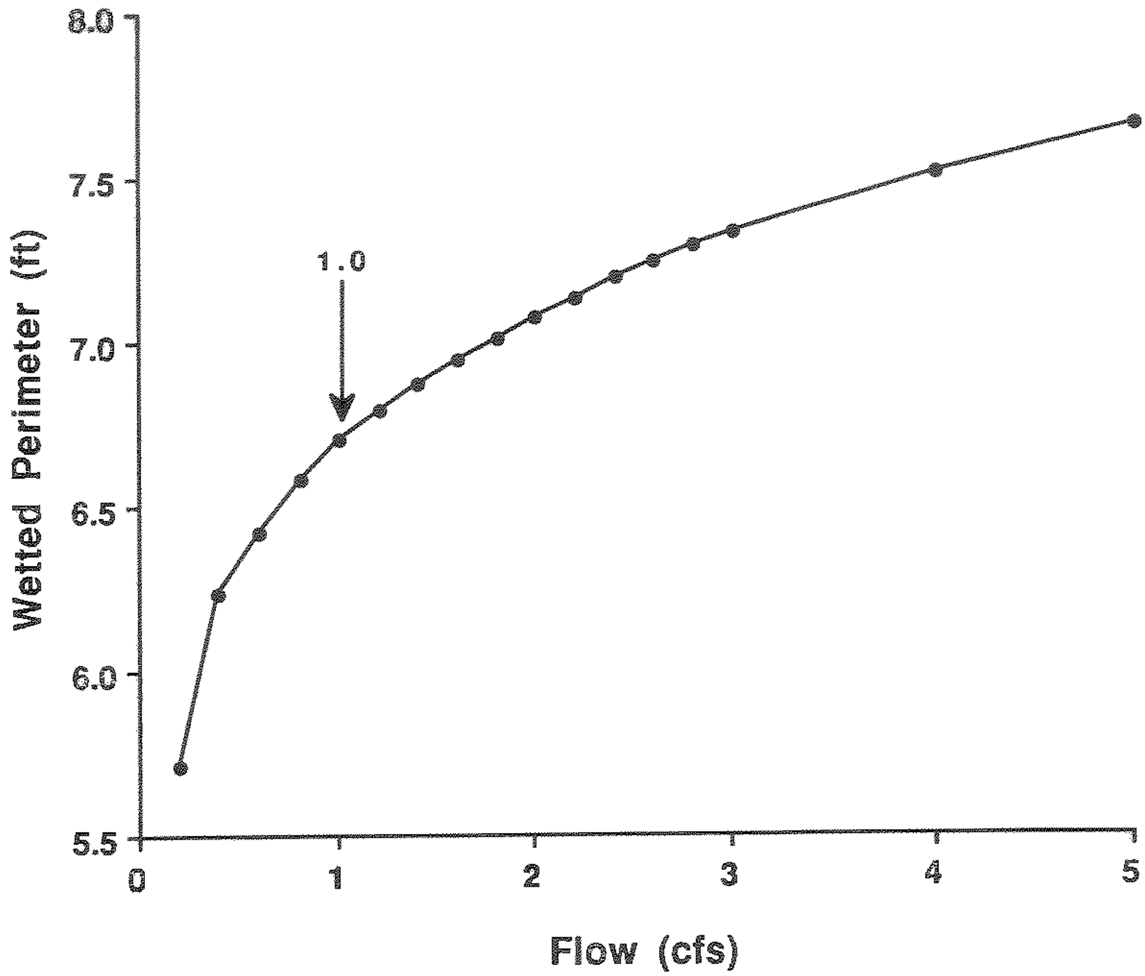

Figure 12. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Little Box Elder Creek.

STREAM NAME: Clear Creek

STREAM REACH: From the headwaters to Clear Creek Road crossing--24 miles

LOCATION: Sec. 26, T28N, R17E to Sec. 1, T30N, R17E

DESCRIPTION OF STREAM REACH:

Clear Creek originates in the coniferous northern slopes of the Bear Paw Mountains and flows 50 miles to its confluence with the Milk River near Chinook. It drains an area of 135 square miles. Lands along the reach are characterized by steeply rolling foothills, meadows of native grasses, and irrigated alfalfa fields. The riparian zone is comprised of a narrow band of willows flanked by grassy meadows. Beaver dams are common throughout the reach. The bottom substrate is primarily gravel and silt.

Common land uses adjacent to the reach are livestock grazing and hay production. Hunting, fishing and trapping are popular recreational uses in this area. Although the entire reach is under private ownership, recreational access is usually granted. Fishing pressure is moderate.

Livestock trampling and farming practices such as field encroachment on banks have destabilized streambanks, thereby increasing in-channel sedimentation in Clear Creek. Timber harvesting, which is expected to commence in the next few years near the headwaters, could increase silt loads and impact trout reproduction.

GAME FISH PRESENT: Rainbow trout, brook trout, brown trout

FISHERY:

Brook, rainbow, and brown trout offer excellent fishing opportunities. Brook trout are the most abundant, followed by rainbow and brown trout. Riparian vegetation is not dense, allowing access to most of the stream. Rainbows up to 2.0 pounds and browns exceeding 4.0 pounds have been reported by anglers. Non-game fish include white and mountain suckers, longnose dace, lake chubs and mottled sculpins.

In 1983, a population estimate using the two-pass method was made in a 400-foot section of Clear Creek near Young's Ranch. Results, which are impressive, are shown in Table 10.

Table 10. Population estimates of trout in a 400-foot section of Clear Creek at Young's Ranch, July 17, 1983.

Species	Age	Mean Length (inches)	Mean Weight (pounds)	Number per 1,000 feet	Pounds per 1,000 feet
Rainbow trout	0	--	--	--	--
	I	5.2	0.06	83	5.0
	II+	8.6	0.19	193	36.6
Totals:				276	41.6
Brook trout	0	2.9	0.01	20	0.2
	I	6.6	0.12	43	5.1
	II	7.9	0.19	145	27.6
	III+	9.7	0.32	30	9.6
Totals:				238	42.5

WILDLIFE:

Big game inhabiting the area include mule deer, white-tailed deer and elk. Pheasants, sharp-tailed grouse and Hungarian partridge are numerous. Mink, beaver, muskrat, raccoon, bobcat and coyotes are the common furbearers found along this reach.

WETTED PERIMETER:

Cross-sectional data were collected in a 51-foot section of Clear Creek near the Clear Creek Road Crossing (Sec. 1, T30N, R17E), the downstream boundary of the designated reach. Three cross-sections describing the riffle habitat were established. The WETP program was calibrated to field data collected at flows of 1.2, 11.3, and 29.2 cfs.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 13. A prominent upper inflection point occurs at about 5.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain resident trout populations and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1 - December 31 -- 5.0 cfs (3,620 AF/yr)

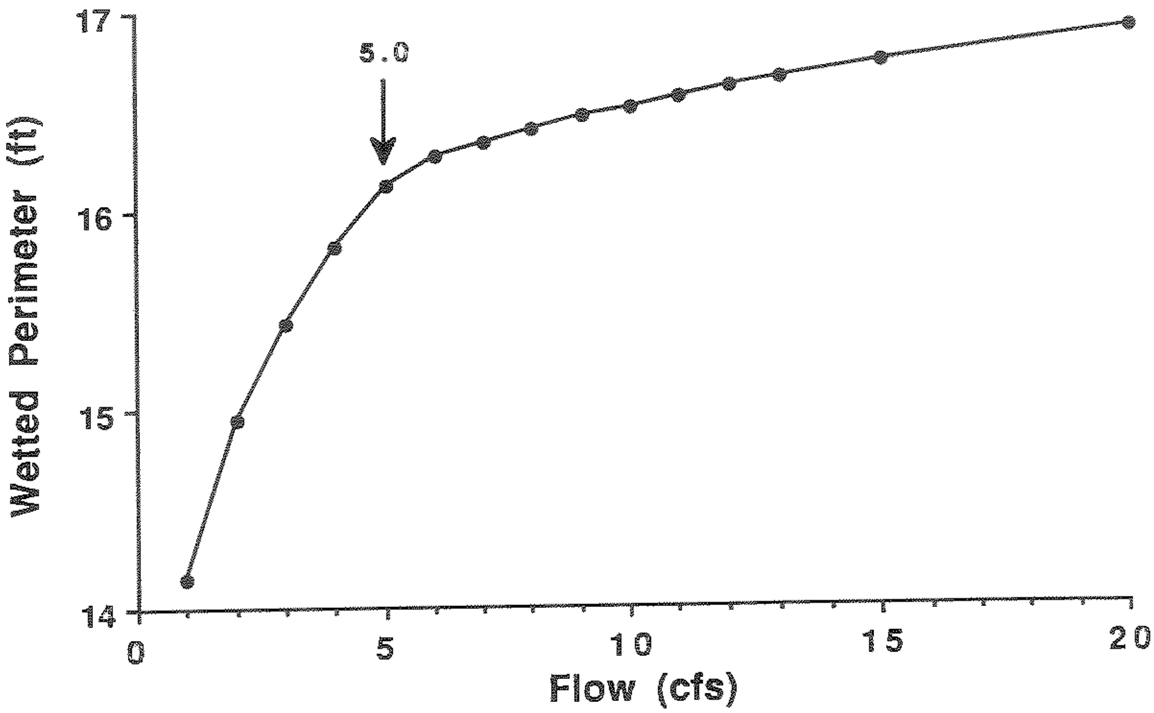

Figure 13. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Clear Creek.

STREAM NAME: Battle Creek

STREAM REACH: From the international boundary to the mouth-- 69.5 miles

LOCATION: Sec. 6, T37N, R18E to Sec. 34, T33N, R20E

DESCRIPTION OF STREAM REACH:

Battle Creek originates in Canada and flows southerly before discharging into the Milk River near Havre. The drainage area is large, encompassing 1,500 square-miles. The creek flows through prairie rangeland for most of its length. Water is diverted to irrigate hay meadows throughout the narrow stream corridor. Land ownership is almost entirely private. The stream occasionally crosses tracts of public land administered by the U.S. Bureau of Land Management. Access for hunting, fishing and trapping is generally good.

The riparian zone supports an overstory of scattered, mature cottonwoods. Sagebrush, wild rose, snowberry, buffaloberry and native grasses vegetate the high banks along the creek. Willows and cottonwoods predominate along the lower 10 miles.

The channel substrate is indicative of a low-gradient stream winding through glacial deposits. Gravel riffles and silty, long pools are the norm. Water clarity is excellent with the exception of the extreme lower end, which is most affected by irrigation return flows.

Peak flows typically occur during snowmelt in April. Occasionally, late-summer flows are immeasurable. Fall showers and subterranean springs recharge the creek, usually providing good fall and winter flows. Although there are no dams on the mainstem of Battle Creek, a proposal to build a storage regulation dam in Canada near the border is being considered. It's conceivable that such a regulatory dam could provide year-round flows to the mouth.

GAME FISH PRESENT: Walleye, northern pike, sauger, burbot

FISHERY:

Northern pike are widespread throughout the drainage, occasionally occurring in isolated pools far up small tributaries. Walleye and sauger are confined to the lower 10 miles of creek. The 1.0 mile of creek immediately upstream from the mouth is heavily fished. Anglers catch northern pike, walleye and sauger year-round. Occasionally, burbot are taken on setlines. Yellow perch and black bullheads are often sought in this area.

Two overnight gill net sets were made in 1990 approximately 6.0 miles above the mouth. These data are summarized in Table 11.

Table 11. Results of gill net sampling in Battle Creek using two overnight sets, 1990.

Species	Number	Mean Length (inches)	Length Range (inches)	Mean Weight (pounds)
Northern pike	9	25.3	19.6 - 35.2	4.56
Walleye	7	11.7	9.6 - 12.7	0.52
Sauger	3	10.6	10.2 - 11.2	0.34

The clear, gravel riffles and deep, long pools provide spawning and rearing habitats for a variety of sport and forage fishes. Larval fish netting has documented successful walleye reproduction in the lower-most stream. Battle Creek is a significant contributor of walleyes to the Milk River fishery.

Non-game species usually present throughout much of the creek include carp, white and longnose sucker, lake chub, fathead minnow, flathead chub, brook stickleback, silvery/plains minnow, emerald shiner, yellow perch, black bullhead, northern redbelly dace, longnose dace, stonecat, Iowa darter and brassy minnow. Battle Creek provides excellent habitat for a variety of forage fish and is undoubtedly a major producer of the forage species that help sustain the gamefish of the Milk River.

WILDLIFE:

Mule deer, white-tailed deer and antelope are present in large numbers along the reach. Common furbearers include, badger, raccoon, bobcat, coyote, fox, beaver, mink and muskrat. Upland game birds such as pheasant, sage grouse, sharp-tailed grouse and Hungarian partridge are plentiful. Waterfowl and migrating birds of prey, including bald eagles, frequent the creek.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and Base Flow Approach were used to derive the flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to help protect spawning and incubation habitat for walleye, sauger, and northern pike, to maintain the channel form, provide for the annual flushing of bottom sediments, and to maintain survival habitat for the entire fish community during low flow periods. The flows are also necessary to help protect the wildlife species which depend upon the stream and its riparian zone for food, water, and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	2.0	123[a]
February	2.0	111[a]
March	2.0	123[a]
		12,178[b]
April	5.0	298[a]
May	5.0	307[a]
June	5.0	298[a]
July	5.0	307[a]
August	5.0	307[a]
September	5.0	298[a]
October	5.0	307[a]
November	5.0	298[a]
December	2.0	123[a]
Total:		15,078

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 14-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	45	89
2	95	188
3	470	932
4	930	1,845
5	1,970	3,907
6	1,330	2,638
7	650	1,289
8	180	357
9	130	258
10	90	179
11	75	149
12	65	129
13	60	119
14	50	99
		12,178

STREAM NAME: Peoples Creek

STREAM REACH: From the headwaters to the Barney Olson Road crossing -- 17 miles

LOCATION: Sec. 15, T28N, R18E to Sec. 1, T29N, R20E

DESCRIPTION OF STREAM REACH:

Minor branches of Peoples Creek originate in both the Bear Paw and Little Rocky mountains. Peoples Creek generally flows in a northeasterly direction to its confluence with the Milk River near Dodson. Most of Peoples Creek is on the Fort Belknap Indian Reservation. An instream flow reservation is being requested for the coldwater reach within the Bear Paw Mountains upstream from the Reservation.

The headwaters are in a relatively steep mountainous area. The creek flows in a lush, narrow corridor surrounded by irrigated hay meadows. Water is diverted for irrigation beginning near the headwaters. Late summer dewatering can be severe. Beaver dams throughout the middle of the reach provide sanctuary for fishes until fall rains recharge the stream.

The riparian zone is sparsely to heavily vegetated with willows and native grasses. Rose and chokecherry are common along the reach. Channel substrate is comprised primarily of gravel, sand, and silt.

Land along the entire reach is privately owned and public access is often limited.

GAME FISH PRESENT: Brook trout, rainbow trout

FISHERY:

The brook trout is the predominant trout species in Peoples Creek. Rainbow trout are occasionally reported by anglers but have not been collected during electrofishing surveys conducted to date. In 1990, a 500-foot section midway in the reach was electrofished and the trout population estimated by the two-pass method. Results are presented in Table 12.

Table 12. Estimates of brook trout in a 500-foot section of Peoples Creek, August, 1990.

Species	Mean Length (inches)	Length Range (inches)	Mean Weight (pounds)	Number per 500 feet
Brook trout	10.2	6.7 - 12.6	0.47	10 (±3)

The low trout numbers reflect the severe dewatering that occurred in 1988. Although the fish population is depressed, it is believed that these survivors will be able to reproduce sufficiently to rebuild the fishery.

Non-game species inhabiting the reach include white and mountain sucker, lake chub, fathead minnow, northern redbelly dace, brook stickleback and silvery minnow. Fishing pressure is light due to access problems and the fact that the best fishing occurs where streambank cover is densest and usually flooded by beaver dams. Pools created by beaver dams provide secure habitat for resident fishes during both high and low flow events.

WILDLIFE:

Big game species using the stream corridor are mule and white-tailed deer. Pheasants, Hungarian partridge, sharp-tailed grouse and sage grouse are common in adjacent habitats. Common furbearers include bobcat, beaver, muskrat, mink, red fox, raccoon and coyote. Birds of prey and songbirds are also present.

WETTED PERIMETER:

Cross-sectional data were collected in a 21-foot section of Peoples Creek (Sec. 17, T29N, R20E) located about five miles upstream from the downstream boundary of the designated reach. Three cross-sections describing the riffle habitat were established. The WETP program was calibrated to field data collected at flows of 2.0 and 6.7 cfs. During the third site visit on August 14, 1990, the stream channel was dry, thus preventing the collection of calibration data at a third flow.

The relationship between wetted perimeter and flow for the composite of three riffle cross-sections is shown in Figure 14. A prominent upper inflection point occurs at about 1.0 cfs.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain resident trout populations and to help protect the habitat of those wildlife species which depend upon the stream and its associated riparian zone for food, water and shelter.

FLOW REQUEST: January 1 - December 31 -- 1.0 cfs (724 AF/yr)

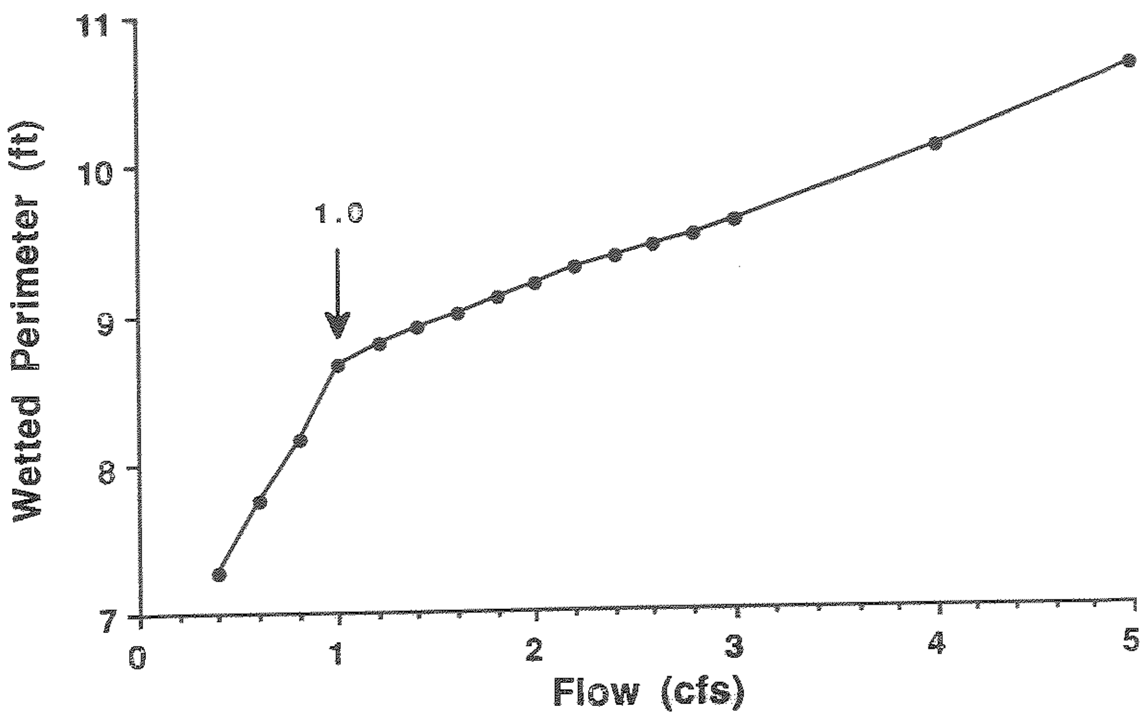

Figure 14. The relationship between wetted perimeter and flow for a composite of three riffle cross-sections in Peoples Creek.

STREAM NAME: Beaver Creek (Phillips County)

STREAM REACH: #1. From the headwaters to the Fort Belknap Indian Reservation boundary -- 5 miles

LOCATION: Sec. 4, T25N, R25E to Sec. 35, T26N, R25E

DESCRIPTION OF STREAM REACH:

Beaver Creek originates on the east slopes of the Little Rocky Mountains and flows northeasterly to the Milk River. Total stream length is over 200 miles. The drainage area is large and is influenced by both mountain and prairie climates.

Reach #1 is the upper-most portion of Beaver Creek upstream from the Fort Belknap Indian Reservation. The surrounding mountainous terrain creates a high stream gradient. The channel substrate is indicative of the high gradient, being composed primarily of angular boulders, cobble and gravel. The creek is comprised of a network of beaver ponds which provide most of the available habitat for resident fish. The reach is bounded by stands of lodgepole pine. There is little riparian undergrowth due to the dense lodgepole overstory and shallow, rocky soils. Short sections of the reach meander through meadows of native grasses. There are old mining patented claims within the headwaters region. Past mining activity has not significantly impacted Beaver Creek like it has other drainages in the Little Rockies. A gold mining company currently mining in a nearby drainage is exploring some of the old patented claims to determine the feasibility of expansion.

Reach #1 is located on public land administered by the U.S. Bureau of Land Management. Access by way of rough trails over the mountains is fair.

GAME FISH PRESENT: Brook trout

FISHERY:

The brook trout is the only fish species sampled in the reach. In 1979, an electrofishing survey found 35 young-of-the-year brook trout per foot of stream at Bear Gulch Trailhead. At the same time, a beaver pond was sampled near the Reservation boundary and 13 adult brook trout between 11.3 and 12.7 inches were taken. Fishing pressure is light due to the remoteness of this reach.

Beaver dams are critical in that, by creating ponds, they provide the majority of fish habitat in this reach. Beaver trapping has been banned in this area to help promote aquatic habitat development. Spawning conditions are excellent at present. Timber harvesting and/or mining could impact the fishery in the future by altering streambed substrate and water quantity and quality.

WILDLIFE:

Big game found along the reach include mule deer, white-tailed deer and bighorn sheep. Furbearers include beaver, bobcat, coyote, raccoon, mink and muskrat. Blue grouse are present in low numbers.

INSTREAM FLOW METHODS:

A flow recommendation derived from the wetted perimeter inflection point method is unavailable for Reach #1 of Beaver Creek. The instream flow request is, therefore, based on the Fixed Percentage Method described earlier. Under this method, 33% of the average annual flow is being requested for the trout streams of the Milk River drainage having high fishery values. An average annual flow of 0.6 cfs was estimated by the USGS for Reach #1 of Beaver Creek. A flow of 0.2 cfs is, therefore, requested.

WHY FLOW IS NECESSARY:

The requested flow is necessary to maintain resident trout populations and to help protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter.

FLOW REQUEST: January 1 - December 31 -- 0.2 cfs (145 AF/yr)

STREAM NAME: Beaver Creek (Phillips County)

STREAM REACH: #2. From U.S. Highway 191 to the mouth -- 189.6 miles

LOCATION: Sec. 15, T25N, R26E to Sec. 30, T31N, R36E

DESCRIPTION OF STREAM REACH:

Beaver Creek originates on the eastern slopes of the Little Rocky Mountains and flows northeast to its confluence with the Milk River. The creek courses over 200 miles. The drainage area is large and is influenced by both mountain and prairie climates.

Reach #2 encompasses that portion of Beaver Creek from the foothills of the Little Rocky Mountains (at the Fort Belknap Indian Reservation boundary) to its mouth near Hinsdale. The entire reach winds through native grasslands, supporting an abundance of sagebrush, wild rose and snowberry. Willows are occasionally encountered. The creek has a low gradient and meanders through a gently-sloping, wide valley for most of its length. The creek is characterized by long, often deep, pools and short riffles. Streambed material is sand, silt and clay. The silty-clay soils of the region are highly alkaline and erosive.

The riparian zone is narrow and the slopes of the high cutbanks found throughout the reach are often unvegetated. The tops of the banks are often vegetated with rose, snowberry, chokecherry and buffaloberry, especially near the lower end of the reach.

Land uses include livestock grazing, haying of irrigated grass and alfalfa, and small grain production. Over 80% of the floodplain is privately owned. However, some large tracts are administered by the U.S. Bureau of Land Management and provide public access for hunting, trapping and other recreational pursuits. Sportfishing, though generally light, is concentrated in the lower end of the reach. The creek harbors numerous non-game species which are collected privately and commercially for use as bait.

GAME FISH PRESENT: Walleye, northern pike, smallmouth bass, channel catfish

FISHERY:

Game fish numbers are generally low with the exception of the lower 25 miles of the reach. Resident populations of walleye and northern pike inhabit the creek. Walleye and pike numbers are believed to be augmented in the spring by migrants from the Milk River that enter to spawn. Walleye have been sampled near Content Bridge, over 100 miles upstream from the mouth. Successful utilization of Beaver Creek by spawning walleye has been documented by the capture of larval walleye near Beaverton.

In October of 1981, 13 walleye were collected by electrofishing about 12 miles upstream from the mouth. The walleye ranged in weight from 0.15 to 10.5 pounds, averaging 19.0 inches and 2.89 pounds. Smallmouth bass have occasionally been reported from the lower portion of the reach and channel catfish have been trapped near the mouth. Their ranges are presumed to be limited to the lower 20 miles of creek.

Numerous non-game species are present throughout the entire length of Reach #2. These include: white sucker, lake chub, pumpkinseed, black bullhead, carp, fathead minnow, river carpsucker, brassy minnow, redhorse sucker, bigmouth and smallmouth buffalo, yellow perch, goldeye, emerald shiner, Iowa darter and silvery/plains minnow. These non-game species undoubtedly provide a forage supply for game fishes in downstream portions of the Milk River.

Beaver Creek appears to be an important spawning tributary for a variety of sport and forage fish inhabiting the Milk River. Though water quality may be poor, the deep pools provide adequate habitat for fishes even in drought years.

WILDLIFE:

Principal big game species inhabiting the floodplain include mule and white-tailed deer and antelope. Furbearers include coyote, fox, raccoon, mink, muskrat and bobcat. The area supports a variety of non-game wildlife, including birds of prey. Prairie dog towns are found throughout the drainage. Waterfowl use is high. Resident upland game birds include sage grouse, sharp-tailed grouse, Hungarian partridge and pheasant.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide access to fish ascending Beaver Creek to spawn, to help protect spawning and incubation habitat for walleye and northern pike, to maintain the channel form, provide for the annual flushing of bottom sediments, to maintain survival habitat for the entire resident fish community during low flow periods, and to help protect the habitat of those wildlife species which depend upon the stream and its riparian area for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	7.0	430[a]
February	7.0	389[a]
March	7.0	430[a]
		8,947[b]
April	11.0	655[a]
May	11.0	676[a]
June	11.0	655[a]
July	11.0	676[a]
August	11.0	676[a]
September	11.0	655[a]
October	11.0	676[a]
November	11.0	655[a]
December	7.0	430[a]
Total:		15,950

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 19-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	40	79
2	160	317
3	400	793
4	1,160	2,301
5	920	1,825
6	440	873
7	320	635
8	240	476
9	200	397
10	160	317
11	120	238
12	85	169
13	75	149
14	55	109
15	45	89
16	30	60
17	25	50
18	20	40
19	15	30
		8,947

STREAM NAME: Frenchman River

STREAM REACH: From the international boundary to the mouth--76.3 miles

LOCATION: Sec. 6, T37N, R34E to Sec. 24, T32N, R34E

DESCRIPTION OF STREAM REACH:

Frenchman River originates in the Cypress Hills of southwest Saskatchewan and flows southeasterly before entering Montana, where it flows south to its confluence with the Milk River near Saco. The Frenchman River has a low gradient and meanders through a gently-sloping valley. Due to its low gradient and meandering characteristics, the river contains long, deep pools, particularly downstream from Frenchman Dam. Streambed materials consist of sand, gravel, and mud. The advance and recession of continental glaciers have influenced the soils in this drainage.

Flows are controlled by several irrigation storage reservoirs in Canada. Frenchman Reservoir, midway between the Canadian border and the river's mouth, also regulates flow. This shallow reservoir is approximately 800 surface acres in size. Silt deposition has obscured data on storage capacity. Streamflow in the lower stream is affected and often enhanced by irrigation return flows. Water quality is relatively good and most chemical constituents are present in small amounts. Water clarity is generally moderate, with turbidity increasing during spring run-off.

Upstream from Frenchman Reservoir, the riparian zone is heavily vegetated with native grasses and willows. Downstream, vegetation is more abundant and diverse, consisting also of ash, buffaloberry, chokecherry, snowberry and wild rose under a cottonwood canopy. Riparian zone land uses are livestock grazing, haying of grasses and alfalfa, and small grain production. Higher benches above the riparian zone are utilized for grazing and small grain production.

A high percentage of the floodplain is privately owned. The river bisects several sections of state-owned land and crosses a few small parcels of public land administered by the U.S. Bureau of Land Management. Hunting and trapping are popular recreational uses within the drainage. Sportfishing is minimal. The river is a source of non-game bait fishes for both individual and commercial use.

GAME FISH PRESENT: Walleye, northern pike, smallmouth bass

FISHERY:

Game fish are generally sparse and little sportfishing occurs due to poor access and the close proximity of better fishing waters. The most significant numbers of gamefish are found in the 30.5 mile stretch from Frenchman Dam to the confluence with the Milk River. Walleye and northern pike are the most common game fish. Northern pike abundance is greatest during years of high run-off when pike from the Milk enter Frenchman River to spawn. A large segment of the naturally-reproducing walleye population is believed to be resident. The natural reproduction that occurs in Frenchman River contributes to the maintenance of the sport fishery of the Milk River.

Smallmouth bass are present in the extreme lower stretch where both resident and migratory fish (from the Milk River) are found. Smallmouth bass were established from stocking 13,000 fingerlings during 1976 and 1977. Approximately 5,000 brook trout (4-inch fingerlings) were stocked immediately below the dam in both 1959 and 1962 to establish a self-sustaining population but this effort was unsuccessful.

Limited data exist on game fish abundance. In September, 1979, a 1.0-mile section immediately below the dam was sampled using seining and electrofishing techniques. This effort yielded a catch of 40 walleye and 11 northern pike. Walleye ranged in size from 5.6 to 24.2 inches, with the largest weighing 4.92 pounds. Numerous young-of-the-year and yearling walleye were taken, indicating a self-sustaining, resident population. Northern pike ranged in size from 19.9 to 35.2 inches and averaged 4.11 pounds. The largest northern pike was 6.90 pounds.

The river also supports an abundant, diverse community of non-game fish, consisting of goldeye, carp, lake chub, fathead minnow, longnose dace, silvery/plains minnow, white sucker, shorthead redhorse, river carpsucker, smallmouth buffalo, bigmouth buffalo, stonecat, yellow perch and Iowa darter. Sampling efforts have been minimal and, if expanded, would undoubtedly reveal several additional species. The non-game species provide a significant forage supply to the sport fishes in downstream segments of the Milk and Missouri rivers.

WILDLIFE:

The Frenchman River drainage supports outstanding populations of mule deer and white-tailed deer. Antelope are also common in the basin. Upland game bird species include ring-necked pheasant, sharp-tailed grouse, Hungarian partridge and sage grouse. This drainage provides excellent winter habitat for big game and upland game birds. Resident furbearers include mink, beaver, muskrat, badger, fox, coyote, raccoon and bobcat. Various waterfowl species utilize the river and Frenchman Reservoir. The area also supports a wide variety of non-game wildlife, including birds of prey and songbirds.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide access to fish ascending Frenchman River to spawn, to help protect spawning and incubation habitats for walleye, northern pike, and smallmouth bass, to maintain the channel form, provide for the annual flushing of bottom sediments, and to maintain survival habitat for the entire resident fish community during the low flow periods. The flows are also necessary to help protect the wildlife species which depend upon the stream and its riparian zone for food, water, and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	AF
January	2.0	123[a]
February	2.0	111[a]
March	2.0	123[a]
		22,414[b]
April	5.0	298[a]
May	5.0	307[a]
June	5.0	298[a]
July	5.0	307[a]
August	5.0	307[a]
September	5.0	298[a]
October	5.0	307[a]
November	5.0	298[a]
December	2.0	123[a]
Total:		25,314

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 21-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	30	60
2	45	89
3	70	139
4	110	218
5	240	476
6	450	893
7	690	1,369
8	1,150	2,281
9	2,050	4,066
10	1,570	3,114
11	1,180	2,340
12	900	1,785
13	730	1,448
14	560	1,111
15	430	853
16	310	615
17	240	476
18	190	377
19	150	298
20	110	218
21	95	188
		22,414

STREAM NAME: Rock Creek

STREAM REACH: From the international boundary to the mouth -- 88.2 miles

LOCATION; Sec. 1, T37N, R36E to Sec. 26, T31N, R36E

DESCRIPTION OF STREAM REACH:

Rock Creek originates in southern Saskatchewan and flows southerly until it enters the Milk River near Hinsdale. Due to its low gradient and many meanders, pools are well developed. Numerous beaver dams and associated ponds enhance pool size and depth. Streambed materials consist of gravel, sand, and mud. Gravel areas are common.

Flows are greatest during spring run-off, with peak flows normally occurring in March. Several small diversion dams in Saskatchewan alter natural flows. This, however, does not appear to have a significant impact because a large portion of the watershed is within Montana. A concrete/rock diversion dam, located about 5.0 miles upstream from the mouth, has little effect on flows except during low flow periods. Water quality is relatively good and most chemical constituents present are in low concentrations. Turbidity increases during periods of high run-off. Agricultural activities have the greatest potential for affecting water quality.

The riparian zone, with its cottonwood overstory, is thickly vegetated with native grasses, willows, ash, chokecherry, buffaloberry, snowberry and wild rose. Woody vegetation is more abundant and diverse along the lower stream. Land uses in the riparian zone are livestock grazing, haying of grasses and alfalfa, and small grain production. A high percentage of the floodplain is privately owned. The creek bisects some state-owned land and public land administered by the U.S. Bureau of Land Management. Hunting and trapping are popular recreational uses. Sportfishing is nil except at the confluence with the Milk River. The creek is utilized extensively to collect non-game bait fish for both individual and commercial use.

GAME FISH PRESENT: Walleye, northern pike, smallmouth bass

FISHERY:

Game fish abundance is greatest in the extreme lower portion of Rock Creek, apparently due to migration and spawning use by Milk River fishes. Adult walleye, northern pike and smallmouth bass appear to be permanent residents in the larger, deeper pools downstream from the Rock Creek diversion dam.

Smallmouth bass were first introduced into Rock Creek in 1976 and 1977. Limited spot sampling to determine survival and distribution indicates that bass are present only in the lower creek below Rock Creek diversion dam. While the population of adults is low, young-of-the-year smallmouth are abundant. Occasionally, smallmouth bass are taken by anglers in the Milk River between the confluence of Rock Creek and Vandalia Dam. This fishery is undoubtedly maintained, in part, by the reproductive contribution of Rock Creek.

In September, 1979, several Rock Creek sites were sampled using seining and electrofishing techniques. This effort revealed an abundant, diverse community of non-game fish, including goldeye, carp, fathead minnow, lake chub, longnose dace, flathead chub, emerald shiner, silvery/plains minnow, white sucker, shorthead redhorse, river carpsucker, bigmouth buffalo, perch and Iowa darter. Emigration of these non-game species provides a significant forage supply for sport fishes such as walleye, sauger and northern pike that inhabit downstream segments of the Milk and Missouri rivers.

WILDLIFE:

Riparian/floodplain lands bordering Rock Creek support outstanding populations of white-tailed deer, mule deer, and antelope. Pheasant, sharp-tailed grouse, Hungarian partridge and sage grouse are also abundant. Resident furbearers include mink, beaver, muskrat, raccoon, fox, coyote and bobcat. Various waterfowl species utilize the creek. The area also supports a wide variety of non-game wildlife, including birds of prey and songbirds.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flow is necessary to provide access to fish ascending Rock Creek to spawn, to help protect spawning and incubation habitats for walleye, northern pike, and smallmouth bass, maintain the channel form, provide for the annual flushing of bottom sediments, and to maintain survival habitat for the entire resident fish community during the low flow periods. Flows are also necessary to help protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	AF
January	2.0	123[a]
February	2.0	111[a]
March	2.0	123[a]
		23,248[b]
April	8.0	476[a]
May	8.0	492[a]
June	8.0	476[a]
July	8.0	492[a]
August	8.0	492[a]
September	8.0	476[a]
October	8.0	492[a]
November	8.0	476[a]
December	2.0	123[a]
Total:		27,600

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 21-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	15	30
2	25	50
3	80	159
4	780	1,547
5	2,180	4,324
6	2,960	5,871
7	1,970	3,907
8	1,320	2,618
9	760	1,507
10	480	952
11	310	615
12	200	397
13	140	278
14	100	198
15	80	159
16	55	109
17	45	89
18	35	69
19	25	50
20	20	40
21	20	40
		23,248

Redwater River Sub-Basin

Figure 15 illustrates the location of the Redwater River and its tributaries.

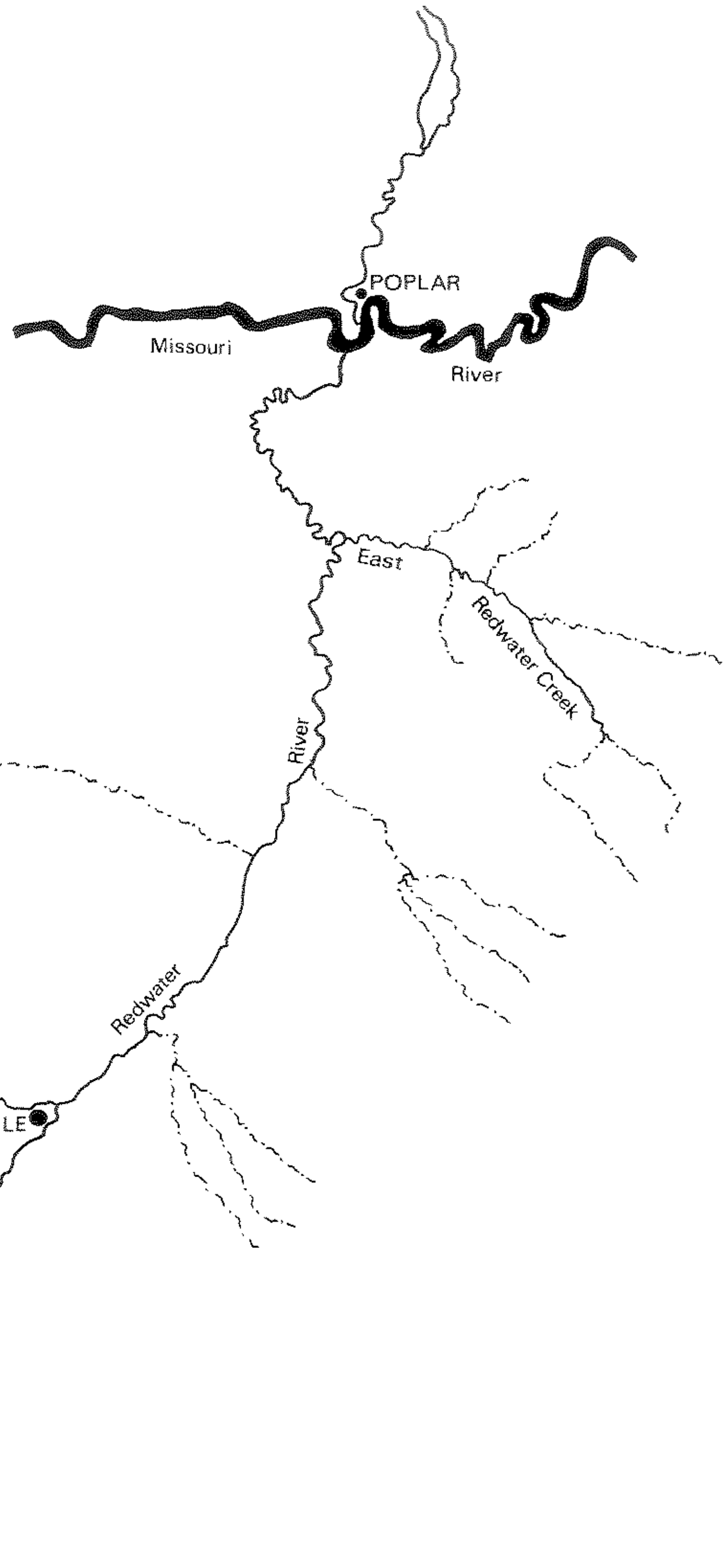

Figure 15. Map locating the Redwater River sub-basin.

STREAM NAME: Redwater River

DESCRIPTION OF THE SUB-BASIN:

The Redwater River drains portions of Prairie, McCone, Dawson and Richland counties. It is one of the larger tributaries to the Missouri River in eastern Montana. Streamflow is highly variable, ranging from zero to several thousand cubic feet per second (cfs). The annual peak discharge often occurs in March from snowmelt. Extended periods with flow less than one cfs are common.

The river drains rolling prairie. Much of the watershed is rangeland, but dryland farming is also an important land use. True river bottom riparian vegetation of cottonwoods and willows is lacking. Typical streamside vegetation consists of low shrubs and grasses. Often the sagebrush prairie extends to the river channel.

The Redwater River aquatic habitat is similar to that found in other eastern Montana prairie streams of comparable size. Much of the river consists of long pools up to several feet deep connected by short, infrequent riffles. Some gravel is often present in riffles but sand and silt bottoms predominate. The lower river is 50-100 feet wide. During late summer and fall, the flow over riffles often approaches zero. Fish survive in the long, deep pools despite low dissolved oxygen levels, elevated water temperatures, and high salinity.

Coal and related developments could impact the Redwater River in the future. Considerable strippable coal is present in the drainage.

STREAM NAME: Redwater River

STREAM REACH: #1. From the Town of Circle to the confluence with East Redwater Creek -- 78.3 miles

LOCATION: Sec. 8, T19N, R48E to Sec. 26, T25N, R50E

DESCRIPTION OF REACH:

The general basin description adequately describes this reach.

GAME FISH PRESENT: Northern pike

FISHERY:

Twenty-two fish species live in Reach #1 despite the challenging physical conditions. Most are small cyprinids (minnows). Other species include Iowa darter, green sunfish, brook stickleback, stonecat, black bullhead, shorthead redhorse, white sucker, river carpsucker and goldeye.

The only gamefish species found in this reach is the northern pike. Numbers of northern pike are very low near Circle and increase in a downstream direction from the Highway 254 bridge. The presence of young-of-the-year indicates that northern pike reproduce in this reach of the river. Northern pike numbers in Reach #1 have not been estimated.

Estimates of fishing pressure and harvest for this reach are unavailable. Fishing pressure is probably low due to the low human population near the river and the limited recognition of the fishery by residents in more populated areas. The fishery is well recognized by local anglers.

WILDLIFE:

Wildlife values in Reach #1 and #2 of the Redwater River are similar. Mule and white-tailed deer are common along the river. Mule deer predominate wherever rougher terrain borders the river and whitetails are more abundant where extensive cropland is present along the larger, flatter bottoms. The Redwater drainage is good spring, summer and fall antelope habitat. Antelope are common along the Redwater, although they do not generally winter there when snow cover is deep because of a lack of sagebrush habitat.

Upland bird species along the Redwater include sage and sharptail grouse, pheasant and Hungarian partridge. Habitat is quite limited for all but sharptails. Pheasant winter habitat is limited because of a lack of brushy cover. Partridge are also probably restricted by a deficiency of good winter habitat. Sage grouse are limited by a shortage of sagebrush. The area is best for sharptails, although the uplands bordering the river are better than the actual river bottom. Some coulees associated with creeks flowing into the Redwater have extensive stands of buffaloberry and chokecherry, which are excellent habitat for sharptails.

Waterfowl use of the Redwater is probably considerable, although data are lacking. Numerous species of ducks and probably Canada geese nest along the river. Certain stretches of the river are slow, wide, and support emergent vegetation, which provides some high quality duck nesting habitat. Mallards are probably the most common ducks along with gadwalls, pintails, American widgeon and blue-winged teal. A variety of migrating waterfowl use the river in spring and fall.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain survival habitat for game fish during the low flow months, maintain the existing channel form (long, deep pools interspersed with short riffles), which provides refuge for fish populations during extended periods of low flow, and provide for the annual flushing of bottom sediments. Flows are also necessary to protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	2.0	123[a]
February	2.0	111[a]
March	2.0	95[a]
		10,860[b]
April	3.0	179[a]
May	3.0	184[a]
June	3.0	179[a]
July	3.0	184[a]
August	3.0	184[a]
September	3.0	179[a]
October	3.0	184[a]
November	3.0	179[a]
December	2.0	123[a]
Total:		12,764

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 14-day period to start no earlier than February 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	5	10
2	90	179
3	890	1,765
4	1,440	2,856
5	1,730	3,431
6	870	1,726
7	170	337
8	60	119
9	50	99
10	40	79
11	40	79
12	30	60
13	30	60
14	30	60
		10,860

STREAM NAME: Redwater River

STREAM REACH: #2. From the confluence of East Redwater Creek to the mouth -- 30.7 miles

LOCATION: Sec. 26, T25N, R50E to Sec. 26, T27N, R50E

DESCRIPTION OF REACH:

Reach #2 flows entirely within McCone County, entering the Missouri River near the Town of Poplar. The general description of the basin adequately describes this reach.

GAME FISH PRESENT: Walleye, northern pike, sauger, channel catfish, burbot

FISHERY:

Twenty-five fish species inhabit Reach #2. Most are small cyprinids (minnows). Other species include Iowa darter, green sunfish, brook stickleback, stonecat, black bullhead, shorthead redhorse, white sucker, river carpsucker and goldeye. Channel catfish, burbot and sauger are found only in the one-mile section upstream from the mouth. These species are probably migrants from the Missouri River that may be using the lower river for spawning and rearing. Northern pike and walleye are more widely distributed, inhabiting the reach year-round.

Estimates of game fish numbers are unavailable. The relative abundance of game species is thought to be low. Populations of walleye and northern pike are self-sustaining, as evidenced by collections of both adults and young-of-the-year.

Estimates of fishing pressure and harvest are unavailable for Reach #2. Fishing pressure is probably low due to the low human population near the river and the lack of recognition of the fishery by residents in more populated areas. Local anglers are well acquainted with the fishery.

WILDLIFE:

See the wildlife description for Reach #1 of the Redwater River.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain survival habitat for gamefish during the low flow months, maintain the existing channel form (long, deep pools interspersed with short riffles), which provides refuge for fish populations during extended periods of low flow, and provide for the annual flushing of bottom sediments. In addition, the high spring flows will allow for the upstream passage of fish species that enter the Redwater River to reproduce. Flows are also necessary to help protect the habitat of those wildlife species which depend upon the stream and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	2.0	123[a]
February	2.0	111[a]
March	2.0	95[a]
		12,644[b]
April	4.0	238[a]
May	4.0	246[a]
June	4.0	238[a]
July	4.0	246[a]
August	4.0	246[a]
September	4.0	238[a]
October	4.0	246[a]
November	4.0	238[a]
December	2.0	123[a]
Total:		15,032

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 14-day period to start no earlier than February 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	5	10
2	100	198
3	1,040	2,063
4	1,680	3,332
5	2,010	3,987
6	1,010	2,003
7	200	397
8	70	139
9	60	119
10	50	99
11	40	79
12	40	79
13	40	79
14	30	60
		12,644

Poplar River Sub-Basin

Figure 16 illustrates the location of the following streams discussed in this section.

East Fork Poplar River
Middle Fort Poplar River
Poplar River
West Fork Poplar River

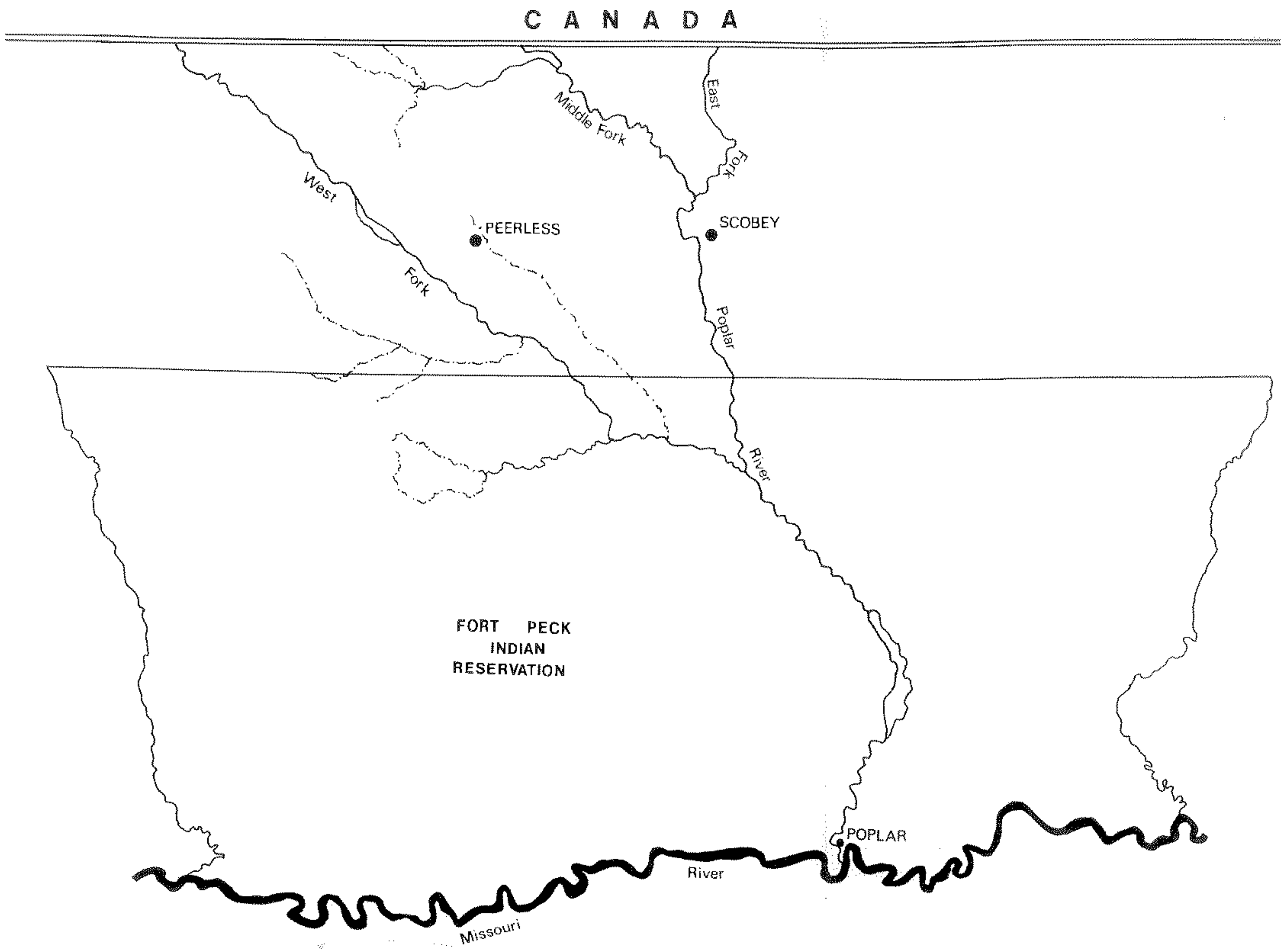

Figure 16. Map locating the Poplar River sub-basin.

STREAM NAME: Poplar River

DESCRIPTION OF THE SUB-BASIN:

The Poplar River is a major south-flowing tributary to the Missouri River. The drainage consists of three forks of approximately equal size. All three forks originate in Saskatchewan where approximately 37% of the 3,329 square-mile-drainage area is located. The East and Middle Forks join a few miles north of Scobey, Montana, forming the mainstem Poplar River. The West Fork confluence is located a few miles south of the point where the mainstem crosses the northern boundary of the Fort Peck Indian Reservation. From the confluence of the West Fork, the Poplar River flows generally south to its confluence with the Missouri River at the Town of Poplar.

The DFWP has collected a great deal of fisheries data for the three forks of the Poplar River upstream from the Fort Peck Indian Reservation (see BIBLIOGRAPHY under Stewart). Instream flow reservations are being sought for these three forks, as well as for the uppermost section of the Poplar River from its origin downstream to the Reservation boundary.

The gradient of these prairie streams is only a few feet per mile. As a result, the streams are comprised of long pools (often 0.5 mile in length) and short riffles. Except during spring runoff, there is little or no measurable velocity in the pools. The streams can be described as a series of long, narrow ponds connected by short riffles.

Stream bottom types consist mostly of gravel in riffles and varying proportions of gravel, sand and silt in pools. The upper few miles of the East Fork Poplar River in the U.S. differs in that gravel is less common and fine sediments are more abundant.

Streambank vegetation is relatively sparse, consisting mostly of grasses and small shrubs, of which rose and snowberry are the most common. The more typical riparian vegetation of cottonwoods and large shrubs is absent. The floodplain vegetation consists largely of grasses, small shrubs, silver sage, wild rose and snowberry.

Emergent and submerged aquatic vegetation are not abundant in these streams except for a few miles of the East Fork near the Canadian border. In this reach of the East Fork, submerged vegetation is often heavy during the summer and emergent shoreline vegetation is also abundant.

Stream flow in the drainage is highly variable. The lowest flows of the year occur in winter and peak flows are reached during snow melt between early March and late April. Winter flows less than one cfs are common in the upstream portions of the drainage.

The Poplar River and its forks are similar to other northeastern Montana tributaries to the Missouri River, but few of the other tributaries have significant gamefish populations. Gamefish populations of the Poplar system are well known and utilized by the local populace.

Although the Poplar River is certainly one of the better warmwater stream fisheries in Montana, the fishery exists under marginal physical conditions. For example, in 1977-78 and 1978-79, much of the Poplar River froze to the bottom. Ice was over four feet thick in many pools. Dissolved oxygen in partially frozen pools was also at stress levels during this time. A partial walleye and northern pike kill occurred in the East Fork due to these conditions of low streamflow and low dissolved oxygen. Any significant decreases in winter dissolved oxygen or pool depth would probably greatly reduce numbers of walleye in large portions of the drainage.

STREAM NAME: East Fork Poplar River

STREAM REACH: From the international boundary to the Middle Fork Poplar River confluence -- 21.9 miles

LOCATION: Sec. 5, T37N, R48E to Sec. 33, T36N, R48E

DESCRIPTION OF REACH:

The East Fork Poplar River originates in southern Saskatchewan, flows to the south, and joins with the Middle Fork Poplar River to form the Poplar River near Scobey, Montana. Cookson Reservoir is located on the East Fork Poplar River approximately two miles north of the international border.

The surrounding land uses are small grain production and rangeland. Because prairie vegetation generally extends to the river banks, there is little riparian vegetation.

The upstream portion of this reach contains scant bottom gravel; bottom materials are mostly silts and clays. Aquatic macrophytes are abundant. Gravel is more common in downstream riffle areas. Much of the river is composed of pools up to several feet deep at low flow. Riffles are infrequent, often being separated by several hundred yards.

Like the rest of the Poplar River drainage, streamflows are highly variable but generally highest in March and April due to snowmelt. Flows are lowest from late summer through winter. There is limited irrigation use of water in this reach.

GAME FISH PRESENT: Walleye, northern pike

FISHERY:

Walleye and northern pike are the gamefish species found in the East Fork Poplar River. East Fork walleyes average one to two pounds in weight, with the largest reaching five pounds. Northern pike tend to be larger, averaging two to three pounds, and occasionally reach 12 pounds.

Severe winters can dramatically reduce the survival of East Fork gamefish, causing populations to periodically plummet. Likewise, a series of mild winters allows the population to expand, greatly enhancing the quality of the fishery. The number of gamefish available to anglers can be highly variable between years, depending on the severity of the previous winters.

In addition to walleye and northern pike, the fish community of the East Fork also includes carp, creek chub, northern redbelly dace, lake chub, emerald shiner, silvery/plains minnow, fathead minnow, longnose dace, shorthead redhorse, white sucker, brook stickleback, goldeye and Iowa darter.

WILDLIFE:

The Poplar River and its tributaries provide important habitat for migrating and breeding waterfowl. Extensive long, slow stretches of water and abundant emergent vegetation in the upper reaches of the East Fork provide better duck breeding habitat than the other portions of the Poplar system. While surveying 205 miles along the East Fork, Middle Fork, and main Poplar River in the spring of 1978, DeSimone (1979) observed an average of 3.6 breeding pairs of ducks per mile of water. Duck species, in order of breeding pair abundance, were: mallard (over 50% of total), American widgeon, gadwall, pintail, blue-winged teal, northern shoveler, lesser scaup, and common merganser. He also found 8.7 and 17.5 ducklings per river mile in 1977 and 1978, respectively, in over 52.7 miles inventoried on the East Fork and main Poplar River. He also found over 45 ducks per river mile in the fall along the Middle Fork. DeSimone (1979) also documented the upper West Fork as nesting habitat for Canada geese and as habitat used by migrating geese as well.

Upland bird species found in relative abundance throughout the system include pheasant, Hungarian partridge and sharp-tailed grouse. Portions of the system provide excellent year-round habitat for these species. Extensive brushy areas in various places along the river system are good winter habitat for pheasants. In those places where this is associated with small grain farming, pheasants are abundant. Partridge are found throughout the system but are generally most abundant in areas where small grain croplands border the rivers. Sharptails are found mainly in uplands bordering the river bottoms. Some high quality sharptail habitat can be found in these areas, particularly along the upper West Fork. Sage grouse have been found along the main Poplar River but are probably not long-term residents because of a lack of high quality sagebrush habitat.

White-tailed deer is the principal big game species in the area. Some portions of the river system are excellent year-round habitat for whitetails. Mule deer also occur, but at low densities. In general, mule deer habitat is minimal along these rivers except the West Fork, the upper reaches of which border some rough hills. Antelope are found sporadically throughout the area, but, in general, this is poor antelope habitat. Beaver, muskrat, mink, raccoon and coyotes are common furbearers throughout the system.

INSTREAM FLOW METHODS:

In general, instream flow requests were based on detailed knowledge of the biology of the stream and, especially, by determining the effect of flows on the reproductive success of walleye and northern pike. When achievable, this direct observational approach is preferred over those instream flow methods that rely on hydraulic simulation models for deriving flow recommendations. Specifically, instream flows for the East Fork were determined by the following procedures.

1. Spawning and egg incubation needs

Population estimates of walleye and northern pike in the lower East Fork (Cromwell Section) were made from 1977 through 1981 (Table 13). The number of young-of-the-year (YOY) walleye per mile increased dramatically in 1979 only to decline drastically in 1980 and 1981. Northern pike show a similar trend, although 1981 YOY numbers are excellent.

Cookson Reservoir on the East Fork in Saskatchewan was finally filled with water early in 1979. Water releases from the reservoir began in March and continued for much of the spring. The resultant flows, supplemented by considerable snowmelt runoff in the lower portions of the East Fork, allowed for the production of large year classes of walleye and northern pike.

Flows to sustain walleye spawning and egg incubation (months of April and May) were determined by comparing mean April and May flows with the annual population size of YOY walleyes (Table 14). Only in 1979, when April and May flows were exceedingly high, was a substantial crop of YOY produced. In the other four years, flows were considerably lower and YOY production was poor.

Stewart (1981), using linear regression analysis, showed a strong relationship between streamflows in April and May and the production of YOY walleyes in the streams of the Poplar River drainage. Based on his analysis, he recommended minimum flows of 15 cfs in April and 10 cfs in May for the East Fork. These are the minimum flows to meet spawning and incubation needs of walleyes.

Table 13. Number of walleye and northern pike per mile in East Fork Poplar River (7,560 feet Cromwell Section) in Fall 1977 –1981.

Age Class	Walleye 1977	Walleye 1978	Walleye 1979	Walleye 1980	Walleye 1981	Northern Pike 1977	Northern Pike 1978	Northern Pike 1979	Northern Pike 1980	Northern Pike 1981
0+	3[b]	69	490	0[b]	5[b]	0	0	211	0[b]	374
I+	6	24	39	0[b]	0	74	5	74	0[b]	171
II+	100	87	9	0[b]	0	122[a]	44[a]	39	1[b]	58
III+ and older	55	59	12	1[b]	8[b]					

[a] Age II+ and older.
[b] Statistical criteria not met; number is approximate.

Table 14. Mean streamflows (cfs) for April and May and number of young-of-the-year walleye per mile in the East Fork Poplar River, 1977-1981.

Year	April Flow	May Flow	Young-of-the-year Walleye
1977	2.4	17.1	3[a]
1978	2.9	3.0	69
1979	143.0	43.9	490
1980	7.1	11.4	0[a]
1981	3.5	5.5	5[a]

[a] Statistical criteria not met; number is approximate.

Numbers of young northern pike showed a weak relationship with April-May flows (Stewart 1981). Despite low streamflows in 1981, a strong year class of northern pike was produced (Table 13). Stewart's data suggested that while April and May streamflows were important in determining walleye recruitment, the relationship was not as strong for northern pike.

2. Maintenance of Channel Form

See the discussion of the Dominant Discharge/Channel Morphology Concept beginning on page 23.

3. Low Flow Period

The description of the Poplar River basin mentioned the severe conditions created by thick ice, low flows, and extreme cold during the winters of 1977-1978 and 1978-1979. The impact is particularly evident in the 1979-1981 data for age I+ and older walleye, whose numbers declined from 170 per mile in 1978, to 60 in 1979, and to one in 1980 (Table 13). Significant decreases in winter dissolved oxygen probably resulted in reduced walleye numbers in the East Fork.

These data indicate that severe winter weather, in association with naturally occurring low flows, often leads to substantial reductions in gamefish numbers. Streamflow depletions during the critical winter period would only further aggravate an already stressful situation for fish and lead to more frequent and greater losses. Due to the stressful nature of the naturally occurring low flows that commonly characterize prairie streams from late summer through winter, maintenance of existing flow levels is recommended during this period.

Flow requests for the low flow months were derived using the Base Flow Approach discussed on page 22.

WHY FLOW IS NECESSARY:

The requested flows are necessary to help protect spawning and incubation habitats for gamefish, to maintain the channel form, provide for the annual flushing of bottom sediments, and maintain survival habitat for gamefish during the low flow months. Flows are also necessary to help protect the habitat of the wildlife species that depend upon the river and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on the information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	3.0	184[a]
February	3.0	167[a]
March	3.0	184[a]
		3,191[b]
April	15.0	893[c]
May	10.0	615[c]
June	4.0	238[a]
July	4.0	246[a]
August	4.0	246[a]
September	4.0	238[a]
October	4.0	246[a]
November	4.0	238[a]
December	3.0	184[a]
Total:		6,870

[a] Flows derived using the Base Flow Approach.

[b] Additional water required during a 13-day period to start no earlier than February 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	6	12
2	10	20
3	60	119
4	280	555
5	540	1,071
6	330	655
7	200	397
8	80	159
9	60	119
10	20	40
11	9	18
12	7	14
13	6	12
		3,191

[c] Flows derived to meet spawning and incubation needs.

STREAM NAME: Middle Fork Poplar River

STREAM REACH: From the international boundary to the confluence with the East Fork Poplar River -- 43.2 miles

LOCATION: Sec. 2, T37N, R45E to Sec. 33, T36N, R48E

DESCRIPTION OF THE REACH:

The physical characteristics of this stream reach and its drainage area are described in the general description of the Poplar River drainage. This reach is very similar to the East Fork Poplar River. It differs in that gravel is somewhat more abundant in riffles.

GAME FISH PRESENT: Walleye, northern pike

FISHERY:

Walleye and northern pike comprise the game fish in the Middle Fork Poplar River. Middle Fork walleyes reach weights of up to five pounds but average one to two pounds. Northern pike commonly reach two to three pounds, with pike up to 12 pounds occasionally taken by anglers.

Gamefish in the Middle Fork are also subject to dramatic reductions following severe winters. Like the East Fork, the number of gamefish available to anglers can fluctuate widely between years.

In addition to walleye and northern pike, the fish community of the Middle Fork includes creek chub, lake chub, silvery/plains minnow, fathead minnow, longnose dace, shorthead redhorse, white sucker, brook stickleback, Iowa darter and goldeye.

Annual angling pressure for the Middle Fork Poplar River is unquantified. The stream and its fishery are well known to local anglers who are the principle users.

WILDLIFE:

See the wildlife description for the East Fork Poplar River.

INSTREAM FLOW METHODS:

Instream flow requests were derived using the same approaches described for the East Fork Poplar River, which are as follows:

1. Spawning and Egg Incubation Needs

   Walleye and northern pike populations in the Middle Fork were estimated from 1977 through 1981 (Table 15). The number of young-of-the-year (YOY) walleyes per mile increased dramatically in 1979 but declined precipitously in 1980 and 1981. Northern pike showed a similar trend through 1979, but did not show decreased numbers of YOY in 1980 and 1981.

   Streamflow may explain the annual variation in numbers of YOY walleye. Table 16 compares mean stream flow during April and May (the walleye spawning and incubation period) and numbers of YOY walleye for the years 1977-1981. High flows in 1979 corresponded to high production of YOY walleyes. Flows were much less in 1980 and 1981 and YOY production was also low.

   Stewart (1981), using linear regression analysis, showed a strong relationship between streamflows in April and May and the production of YOY walleyes in the streams of the Poplar River drainage. Based on his analysis, he recommended minimum flows of 30 cfs in April and 20 cfs in May for the Middle Fork Poplar River. These are the minimum flows to meet the spawning and incubation needs of walleyes.

   Numbers of young northern pike showed little correlation with April and May flows (Tables 15 and 16). Contrary to other studies which indicate that pike prefer to spawn over flooded terrestrial vegetation, flooding beyond the primary channel apparently is not necessary for successful pike spawning in the Poplar River drainage (U.S. Environmental Protection Agency 1980).

2. Maintenance of Channel Form

   See the discussion of the Dominant Discharge/Channel Morphology Concept beginning on page 23.

Table 15. Number of walleye and northern pike per mile in Middle Fork Poplar River (8,240 feet Hagfeldt Section) in Fall 1977 - 1981.

Age	Walleye					Northern Pike				
Class	1977	1978	1979	1980	1981	1977	1978	1979	1980	1981
0+	186	215	397	69	[c]	6[a]	101	115	184	103
I+	22	26	8	26	1	18[a,b]	18[a,b]	66[a,b]	199[b]	103[b]
II+	53	26	3	4	4					
III+ and older	15	28	12	14	8					

[a] Statistical criteria not met; number is approximate.
[b] Age I+ and older.
[c] Numbers sampled insufficient for estimate.

Table 16. Mean streamflows (cfs) for April and May and number of young-of-the-year walleye per mile in the Middle Fork Poplar River, 1977-1981.

Year	April Flow	May Flow	Young-of-the-year Walleye
1977	11.1	12.4	186
1978	74.4	25.6	215
1979	325.3	59.7	397
1980	47.8	5.3	69
1981	6.7	4.3	*[a]

[a] Numbers sampled insufficient to obtain estimate.

3. Low Flow Period

The description of the Poplar River basin mentioned the severe conditions created by thick ice, low flows, and extreme cold during the winters of 1977-1978 and 1978-1979. The effects of these conditions were evident in the 1978 and 1979 data for age I+ and older walleye (Table 15). The numbers of age I+ and older walleye declined from 90 per mile in 1977 to 23 in 1979. By 1981, only 13 age I+ and older walleye were estimated per mile. Significant decreases in winter dissolved oxygen probably resulted in reduced walleye numbers in the Middle Fork. The 1981 decline may also be related to the poor production and the subsequent low numbers of age 0+ walleye in 1980.

The exceedingly low flows that occur naturally in prairie streams from late summer through winter can, in general, be highly stressful to gamefish populations. Like the East Fork, severe winter weather, in association with the naturally occurring low flows, often leads to substantial gamefish losses in the Middle Fork. Water depletions during this period will only aggravate the problem. Consequently, the maintenance of existing flow levels is recommended during the low flow period.

Flow requests for the low flow months were derived using the Base Flow Approach discussed on page 22.

WHY FLOW IS NECESSARY:

The requested flows are necessary to help protect spawning and incubation habitats for gamefish, maintain the channel form, provide for the annual flushing of bottom sediments, and maintain survival habitat for gamefish during the low flow months. The flows are also necessary to help protect the habitat of the wildlife species that depend on the river and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	1.0	61[a]
February	1.0	56[a]
March	1.0	61[a]
April	30.0	1,785[b]
		6,705[c]
May	20.0	1,230[b]
June	2.0	119[a]
July	2.0	123[a]
August	2.0	123[a]
September	2.0	119[a]
October	2.0	123[a]
November	2.0	119[a]
December	1.0	61[a]
Total:		10,685

[a] Flows derived using the Base Flow Approach.

[b] Flows derived to meet spawning and incubation needs.

[c] Additional water during a 14-day period to start no earlier than April 1 nor later than May 31, according to the following pattern:

Day	CFS	AF
1	40	79
2	150	298
3	670	1,329
4	1,000	1,983
5	670	1,329
6	320	635
7	160	317
8	110	218
9	80	159
10	60	119
11	50	99
12	30	60
13	20	40
14	20	40
		6,705

STREAM NAME: Poplar River

STREAM REACH: From the junction of the Middle and East Fork Poplar rivers to the Fort Peck Indian Reservation boundary -- 29 miles

LOCATION: Sec. 33, T36N, R48E to Sec. 12, T33N, R48E

DESCRIPTION OF STREAM REACH:

The physical characteristics of the stream reach and its drainage area are described in the general description of the Poplar River sub-basin. This reach is very similar to the East and Middle Forks of the Poplar River.

GAME FISH PRESENT: Walleye, northern pike, sauger, smallmouth bass

FISHERY:

Northern pike and walleye are the dominant gamefish species in this river reach. The long, deep pools provide the primary habitat for adults. Relatively large numbers of young-of-the-year and yearlings of both walleye and northern pike are also present. These younger fishes utilize the smaller pools and runs as well as the large, deep pools. Adult walleye typically weigh from one to two pounds, occasionally reaching five to six pounds. Northern pike range from two to five pounds, reaching 15 pounds on occasion. Tagging studies conducted on walleye indicate that this resident population depends on favorable instream conditions for their year-round survival.

Young-of-the-year smallmouth bass have been found at the Paulson Slab area, just downstream from the northern Reservation boundary. However, it is not known if these were produced by a sparse population of resident adults or adults that have migrated from downstream reaches to spawn.

Sauger undoubtedly are also present because they have been found in low numbers above and below this reach. On one occasion in the mid-1960s, fishermen reported sighting a paddlefish in a large pool at the Highway 13 bridge, five miles south of Scobey. This was apparently a rare occurrence and no paddlefish were observed during sampling efforts.

The reach supports an abundant, diverse community of non-game forage species including goldeye, carp, creek chub, northern redbelly dace, flathead chub, lake chub, emerald shiner, fathead minnow, longnose dace, river carpsucker, shorthead redhorse, white sucker, stonecat, brook stickleback and Iowa darter.

WILDLIFE:

See the wildlife description for the East Fork Poplar River.

INSTREAM FLOW METHODS:

Requested flows for April and May, the spawning and incubation period for walleye and northern pike, are those estimated to meet spawning and incubation needs (Montana Department of Fish and Game 1979). For the remaining months, see the discussions of the Dominant Discharge/Channel Morphology Concept and Base Flow Approach beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to help protect spawning and incubation habitats for gamefish, maintain the channel form, provide for the annual flushing of bottom sediments, and maintain survival habitat for game fish during the low flow months. Flows are also necessary to help protect the habitat of those wildlife species that depend upon the river and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	8.0	492[a]
February	8.0	444[a]
March	8.0	492[a]
April	70.0	4,165[b]
		8,055[c]
May	50.0	3,074[b]
June	11.0	655[a]
July	11.0	676[a]
August	11.0	676[a]
September	11.0	655[a]
October	11.0	676[a]
November	11.0	655[a]
December	8.0	492[a]
Total:		21,207

[a] Flows derived using the Base Flow Approach.

[b] Flows derived to meet spawning and incubation needs.

[c] Additional water during a 14-day period to start no earlier than April 1 nor later than May 31, according to the following pattern:

Day	CFS	AF
1	50	99
2	190	377
3	810	1,607
4	1,210	2,400
5	810	1,607
6	390	774
7	190	377
8	130	258
9	100	198
10	70	139
11	40	79
12	30	60
13	20	40
14	20	40
		8,055

STREAM NAME: West Fork Poplar River

STREAM REACH: From the county bridge 6 miles south of Peerless to the Fort Peck Indian Reservation boundary -- 15.4 miles

LOCATION: Sec. 15, T34N, R45E to Sec. 11, T33N, R46E

DESCRIPTION OF REACH:

This reach is very similar to the East and Middle Forks of the Poplar River. It differs only by having more abundant substrate gravel than the East Fork.

GAME FISH PRESENT: Walleye, northern pike, sauger, smallmouth bass

FISHERY:

Studies of general fish distribution in the West Fork revealed that game fish are not present in the middle reaches or in the upper reaches near the international border. Winter dissolved oxygen measurements from the West Fork in the area of Peerless were collected in an effort to explain the lack of game fish in this middle reach of river. The dissolved oxygen values in late winter were below one part per million. These values were below the threshold for survival.

Walleye, northern pike, sauger, and smallmouth bass are found in the lower reaches of the West Fork. Game fish populations were sampled in 1977 to develop population estimates. Sufficient numbers of walleye were collected to compute a statistically valid estimate of 149 fish per mile. These numbers are comparable to the 1977 population estimate for the East Fork Poplar River.

Insufficient numbers of northern pike, sauger, and smallmouth bass were collected to calculate population estimates. Most of the smallmouth collected were young-of-the-year and yearlings. Indications are that the relatively few adults present are spawning successfully. The population could increase significantly in the future as more fish reach spawning maturity.

In addition to the above listed game fish, the fish community of the West Fork Poplar River includes carp, shorthead redhorse, white sucker, black bullhead, stonecat, creek chub, northern redbelly dace, flathead chub, lake chub, emerald shiner, silvery/plains minnow, longnose dace, and goldeye.

WILDLIFE:

See the wildlife description for the East Fork Poplar River.

INSTREAM FLOW METHODS:

Fewer fish population data were available on the West Fork than on the East and Middle Forks. As a result, a direct comparison of flows and fish population estimates could not be made as was done for the other two forks. Because the West Fork is much like the Middle Fork, similar instream flows are requested for the walleye spawning and incubation period (April-May). Flow requests for the remaining months were derived using the Dominant Discharge/Channel Morphology Concept and Base Flow Approach discussed on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to help protect spawning and incubation habitats for gamefish, maintain the channel form, provide for the annual flushing of bottom sediments, and maintain survival habitat for gamefish during the low flow months. Flows are also necessary to help protect the habitat of those wildlife species that depend upon the river and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	AF
January	3.0	184[a]
February	3.0	167[a]
March	3.0	184[a]
April	30.0	1,785[b]
		7,935[c]
May	20.0	1,230[b]
June	4.0	238[a]
July	4.0	246[a]
August	4.0	246[a]
September	4.0	238[a]
October	4.0	246[a]
November	4.0	238[a]
December	3.0	184[a]
Total:		13,121

[a] Flows derived using the Base Flow Approach.

[b] Flows derived to meet spawning and incubation needs.

[c] Additional water during a 14-day period to start no earlier than April 1 nor later than May 31, according to the following pattern:

Day	CFS	AF
1	50	99
2	180	357
3	800	1,587
4	1,190	2,360
5	800	1,587
6	380	754
7	190	377
8	120	238
9	100	198
10	70	139
11	40	79
12	30	60
13	30	60
14	20	40
		7,935

Little Missouri River Basin

Figure 17 illustrates the Little Missouri River basin and the locations of the following streams discussed in this section.

Little Missouri River
Box Elder Creek
Little Beaver Creek
Beaver Creek (Wibaux County)

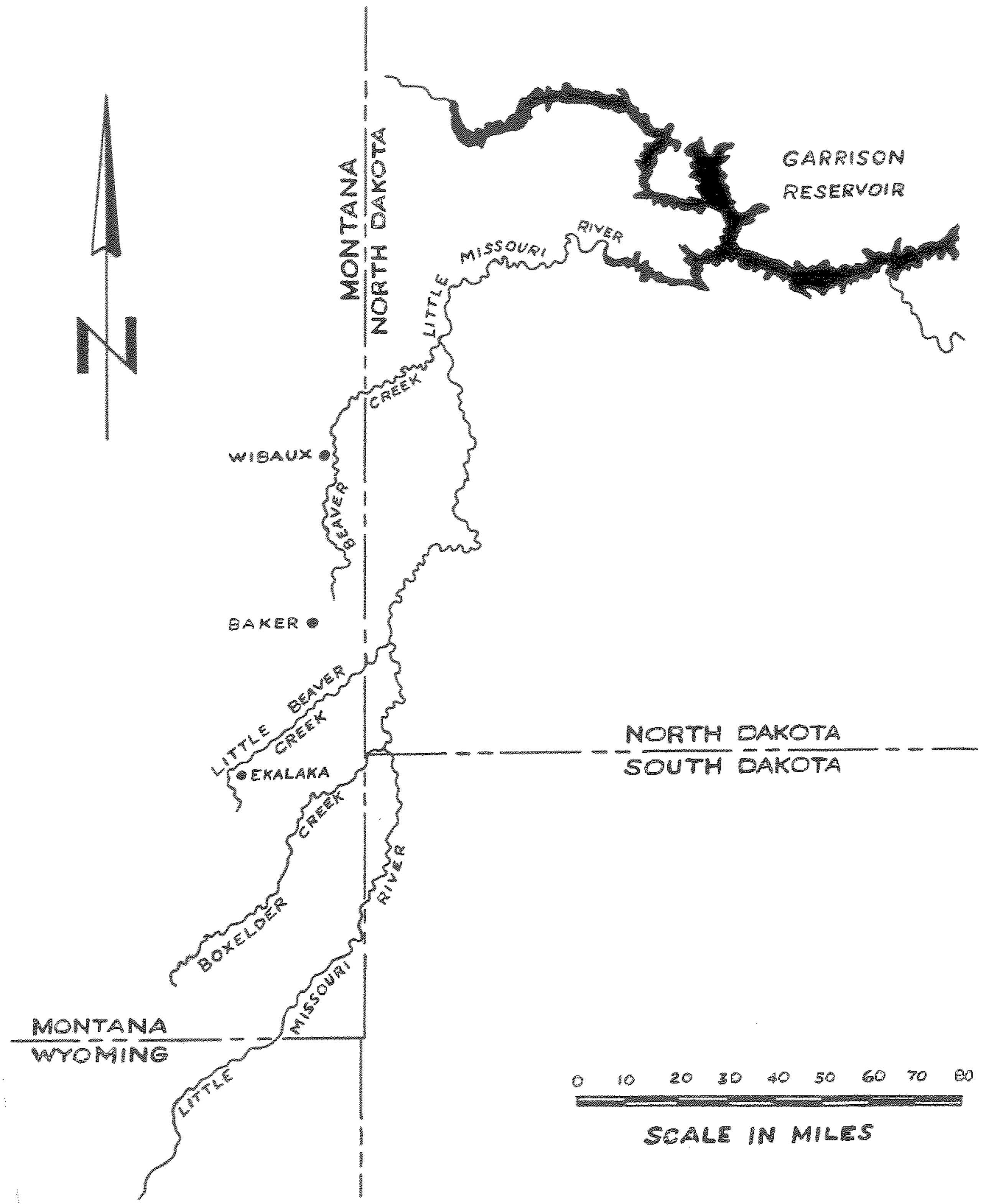

Figure 17. Map locating the Little Missouri River basin.

DESCRIPTION OF THE LITTLE MISSOURI RIVER BASIN

The Little Missouri River basin encompasses land in Wyoming, South Dakota, North Dakota and Montana. The basin drains approximately 9,500 square-miles, the majority of which lies in North Dakota. Within Carter, Fallon and Wibaux counties, Montana, the drainage area is 3,440 square-miles.

Major tributaries to the Little Missouri River include Thompson, Box Elder, Little Beaver, Beaver and Cherry creeks. Of these, Beaver and Box Elder are the largest. There are six other minor tributaries.

Elevations in the basin range from 4,000 feet at the headwaters to 2,000 feet at the confluence of the Little Missouri and Lake Sakakawea, a mainstem Missouri River impoundment in North Dakota. The upper reaches of the watershed in northwest Wyoming and southeast Montana are characterized by gently rolling prairie. Buttes and knolls may rise as much as 500 feet from the plains. Generally, the river valley is a series of terraces. Riparian zone vegetation is well-developed, consisting of grasses, sedges and woody shrubs. At the Bowman - Slope County line in North Dakota, the river valley turns into rugged, deeply incised badlands, extending for several miles on either side of the stream channel. The badlands become increasingly rough in a downstream direction. The basin ranges from 26 to 57 miles wide, averaging about 35 miles.

Climate of the Little Missouri basin is semi-arid, characterized by hot, dry summers and long, cold winters. About half of the precipitation arrives as rain between April and July while the other half arrives during the winter months. There may be extreme variation between years. As such, the climate is not conducive to sustained production of cultivated crops. Therefore, predominant land uses in the basin are rangeland and dryland farming. Relatively few acres are irrigated. This also reflects the poor surface water quality and the relatively deep groundwater aquifers. Revenue generated from livestock operations far exceeds that generated from crop production, but, together, they make up the majority of the economic activity in the basin.

Most of the land in the Montana portion of the basin is privately owned. However, there are tracts of land administered by the Bureau of Land Management and the U.S. Forest Service. The 1990 census indicated that the populations of the Montana counties in the Little Missouri River basin have declined by 18% since 1980. The 1990 census places the three-county population at 5,797 persons.

These prairie streams consist of long, deep pools separated by short riffles. Comprehensive information on streamflow and hydrology in the basin is limited. The only operating USGS gauges in the basin occur on the Little Missouri River at Camp Crook, South Dakota and on Beaver Creek near Trotters, North Dakota. In the past, gauging stations were operated on Box Elder Creek near the Montana-South Dakota border, Little Beaver Creek near Marmarth, North Dakota, Beaver Creek at Wibaux, Montana and on the Little Missouri River near Alzeda, Montana. From the hydrological records, it is known that, in general, the flow through these turbid, low-gradient streams is "flashy". Peak runoff usually occurs in March although smaller peaks may occur in June. Flows generally decrease to a minimum level throughout the rest of the year. In late-summer, flows over the few, isolated riffles may be immeasurable. Streamflow may increase rapidly after an intense rain, remain high for a short time, then recede after all surface runoff has passed.

Despite the harsh environment, a diverse fish community has adapted to the characteristics of these prairie streams. As many as 30 species have been documented in the Little Missouri River basin (Elser et al. 1980). The most important gamefish species are channel catfish, sauger, walleye and northern pike. There is reason to believe that sauger, walleye and channel catfish residing in Lake Sakakawea enter the Little Missouri River and its tributaries to spawn (Elser et al. 1979). Resident channel catfish, walleye and northern pike also spawn in these systems, finding refuge in long, deep pools during the non-spawning period. Both migrant and resident fishes provide opportunities for anglers. These fisheries are highly valued by citizens of the local communities. The Little Missouri River and its tributaries also sustain many forage species, including goldeye, flathead chub and creek chub.

Although considered a "Species of Special Concern" in Montana, the sturgeon chub has only been found in the North and South Dakota portions of the Little Missouri River. It is possible that the sturgeon chub also occurs in the Montana reach, although to date this has not been verified. Two other species of interest are the sand shiner and creek chub. Both have been documented in the Little Missouri River. Although these species are not considered "Species of Special Concern", both have limited distributions in Montana.

STREAM NAME: Little Missouri River

STREAM REACH: From the Montana-Wyoming border to the Montana-South Dakota border -- 90.0 miles

LOCATION: Sec. 36, T9S, R59E to Sec. 26, T4S, R62E

DESCRIPTION OF STREAM REACH:

The Little Missouri River originates in northeastern Wyoming and flows through the extreme southeastern corner of Montana. The river exits the state near Capitol, flowing in a northerly direction through South Dakota, and empties into an arm of Lake Sakakawea, a mainstem reservoir on the Missouri River in North Dakota. Within Montana, the Little Missouri has a drainage area of approximately 3,400 square- miles. Elevations range from 3,430 feet at the upstream end of the reach to 3,160 feet at the Montana-South Dakota border, a change of 270 feet (an average fall of 3 feet per mile).

The Little Missouri is a turbid, low gradient, meandering stream dominated by long pools separated by short riffles. Substrate in the pools consists primarily of silt and sand. Riffles are composed of gravel and cobble. Flow over riffles may cease during seasonal periods of low precipitation or drought. At this low flow, the stream is composed of a series of long pools, some of which are at least six feet deep. The banks are generally steep-sided, and woody shoreline vegetation is well developed. Dominant deciduous riparian vegetation includes plains cottonwood, green ash, buffaloberry and willow. Terrestrial herbaceous plants grow to the river's edge in many areas. Emergent aquatic plants such as sedges, rushes and horsetails are found along shallow margins. Submerged aquatic vegetation is limited, probably due to high turbidities and shifting substrates.

Climatological records kept at one station near the Little Missouri River indicate an average annual precipitation of 13.52 inches, most falling in the form of spring and early summer rains.

Most land along the stream is privately owned, though access is normally not a problem. Predominant land uses are non-irrigated cropland and rangeland. A portion of the drainage includes some irrigated cropland, pastureland and hayland.

The USGS gauge located on the Little Missouri River at Camp Crook, South Dakota, near the Montana border, has operated since 1903. The average annual flow for the 36 years of record was 127 cfs (92,000 acre-feet/year). Extremes ranged from 9,420 cfs in 1978 to zero flow at times. Another gauge, near Alzada, in the upper drainage, was operated from 1912-69. The average annual flow for the 49 years of record was 77.2 cfs (55,930 acre-feet/year). Extremes ranged from 6,000 cfs to no flow at times.

GAME FISH PRESENT: Sauger, channel catfish

FISHERY:

Twenty-two fish species reportedly inhabit the Little Missouri River; 17 species have been collected in the Montana portion. The sand shiner, an abundant species in the river, has a limited distribution in Montana. The sturgeon chub, a "Species of Special Concern" in Montana, has been collected in the South Dakota and North Dakota portions of the Little Missouri River.

Channel catfish and sauger are the only gamefish present in the reach, although immediately downstream in South Dakota largemouth bass and northern pike have been recorded. Ripe male and female sauger were found in the upper portions of the stream during electrofishing in April, 1990. A follow-up sampling effort one month later failed to detect sauger in upstream areas. This indicates probable upstream spawning movement. Adult sauger were present in small numbers throughout the summer. These fish were found in the large, deep pools common to the mid- and downstream sections of the reach. Late summer seining did not detect young-of-the-year sauger. This may have been due to sampling difficulties inherent to the large pools. Low spring flows in 1990 may have limited movement and spawning success of sauger. Rains in early May increased flows substantially, but did not correspond with the sauger spawning run. Knowledge of fish movement in the Montana portion of the river is limited.

Seining, passive capture, and electrofishing methods were used to document adult and young-of-the-year channel catfish within the reach. In early spring and summer, catfish up to 12 inches were generally found in riffle and run habitats. Larger fish occupied deep pools, which sustained the fish during periods of intermittent streamflow. Catfish are locally abundant in some of the pools. Young-of-the-year catfish were caught during late-summer seining. The presence of these fish documents the importance of the Little Missouri River as a spawning and nursery area. North Dakota researchers have recorded extensive movements of channel catfish out of Lake Sakakawea into the Little Missouri River. The environmental stability of the river is likely very important to channel catfish. Young-of-the-year green sunfish, longnose dace, sand shiner, river carpsucker, shorthead redhorse, white sucker and carp were also collected.

WILDLIFE:

The Little Missouri's well-developed riparian zone provides a unique habitat that contrasts with the surrounding semi-arid, shortgrass prairie. White-tailed and mule deer are abundant in the bottom lands and breaks of the river basin. Pronghorn antelope utilize the surrounding farm and rangeland.

Resident gamebird species found within the drainage are sharp-tailed grouse, sage grouse, pheasant and wild turkey. Migratory mourning doves and waterfowl are seasonally present. Deciduous trees provide a haven for resident and migratory songbirds. Several raptor species can be seen along the water course. Furbearers are abundant. Mink, muskrat, beaver, raccoon, red fox and coyote are relatively common.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain the channel form, provide for the annual flushing of bottom sediments, maintain survival habitat for sauger, channel catfish and other fishes during the critical low flow period, and help protect the habitat of those wildlife species that depend upon the stream and its associated riparian zone for food, water and shelter. In addition, the requested high flows will allow spring-spawning gamefish, particularly sauger and channel catfish, to ascend the Little Missouri River during their annual spawning migrations.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	5.0	307[a]
February	5.0	278[a]
March	5.0	307[a]
		27,491[b]
April	8.0	476[a]
May	8.0	492[a]
June	8.0	476[a]
July	8.0	492[a]
August	8.0	492[a]
September	8.0	476[a]
October	8.0	492[a]
November	8.0	476[a]
December	5.0	307[a]
Total:		32,562

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 21-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	10	20
2	15	30
3	20	40
4	75	149
5	290	575
6	1,450	2,876
7	2,540	5,038
8	2,320	4,602
9	1,670	3,312
10	1,150	2,281
11	940	1,864
12	760	1,507
13	600	1,190
14	430	853
15	280	555
16	240	476
17	200	397
18	280	555
19	240	476
20	200	387
21	150	298
		27,491

STREAM NAME: Box Elder Creek

STREAM REACH: From one mile west of Belltower, Montana to the Montana-South Dakota border -- 55 miles

LOCATION: Sec. 24, T2S, R59E to Sec. 29, T2N, R62E

DESCRIPTION OF STREAM REACH:

Box Elder Creek, a tributary to the Little Missouri River, originates in north-central Carter County in southeast Montana. The creek flows northeasterly across Carter County for 55 miles, crossing the extreme southeast corner of Fallon County before entering South Dakota. Box Elder Creek is a typical meandering, low-gradient prairie stream having a silty substrate. It has a drainage area of approximately 270 square-miles.

The topography of the Box Elder Creek basin ranges from the rolling, timbered hills of the Custer National Forest to broken flat lands. Elevations range from over 4,100 feet in the forest to 2,945 feet farther downstream. The stream cuts through sandstone clay loam, loam and sandy loam soils. The bottom substrate consists primarily of silt interspersed with areas of large cobble and bedrock. The climate of the region is characterized by hot, dry summers and cold winters. Cattle grazing and dryland farming are the major land uses.

Ninety percent of the land along Box Elder Creek is privately owned, but access is generally granted with permission. The basin drains some Bureau of Land Management, state and national forest lands. The creek is traversed by a number of bridges and concrete "low water" crossings located on gravel county roads.

A USGS gauge on Box Elder Creek, ½ mile upstream from the Montana-South Dakota state line, was operated for 14 years (September 1959 - September 1973). The average annual flow during this period was 89 cfs (64,550 acre-feet per year). Extremes ranged from 7,340 cfs on May 9, 1967 to zero at times. Water temperature extremes for the summer months were: June - maximum 74F and minimum 58F; July - maximum 79F and minimum 63F; August - maximum 78F and minimum 63F.

GAME FISH PRESENT: Sauger, northern pike, channel catfish

FISHERY:

In spring, sauger from the Little Missouri River are believed to migrate into Box Elder Creek to spawn. During early spring, 1990, when streamflows in Box Elder Creek were high enough to allow fish passage, nine ripe sauger were captured by electrofishing in the mid- to downstream portions of the reach. According to local anglers, fishing for sauger in Box Elder Creek is best at this time, with catch rates steadily declining to zero as early-summer flow regimes reduce the creek to an intermittent status. Fish sampling, using seining and electrofishing techniques, mirrored angler reports, as no adult or young-of-the-year sauger were captured for the remainder of the field season. Based on one field season of sampling, it appears that sauger migrate up Box Elder Creek, spawn, and move out shortly thereafter.

Only two northern pike were collected in Box Elder Creek. The two adults were captured in baited trap nets in the middle portion of the reach during late spring. No young-of-the-year northern pike were sampled. The stream conditions of Box Elder Creek may not be conducive to the propagation of northern pike, a cover-preferring ambush predator. The water is very turbid and aquatic vegetation is virtually non-existent.

Despite the intermittent nature of this stream, the large deep pools sustain channel catfish. Adults were captured by electrofishing in the mid- to downstream portions of the reach during late-spring and summer 1990, with three individuals being tagged and released. Local anglers reported poor fishing in 1990, blaming the lower-than-normal streamflow of Box Elder Creek. Numerous sets of baited trapnets produced poor results, yet successful channel catfish spawning was documented by the capture of young-of-the-year fish in late-summer. These data suggest that migrant channel catfish from the Little Missouri River utilize Box Elder Creek for spawning and rearing, even during years of low flow. Box Elder Creek is a sport fishery of significant importance to local anglers.

Resident game fish populations in Box Elder Creek are probably limited by intermittent stream flows, availability of spawning and rearing habitats, food supply, water quality and water temperature.

Twenty fish species were collected in Box Elder Creek. One of these, the creek chub, although native to Montana, is restricted to the Yellowstone and Little Missouri River systems. It is considered rare in Montana, yet it was found at a number of locations within Box Elder Creek.

WILDLIFE:

Big game animals found in the Box Elder Creek drainage include white-tailed deer, mule deer, and antelope. Resident upland game bird species include wild turkey, ring neck pheasant, sage grouse, sharp-tailed grouse and mourning dove. Box Elder Creek and its adjacent riparian zone provide nesting and rearing habitats for great blue heron, Canada geese, and a wide variety of shore birds and waterfowl. Furbearers found in the basin include coyote, red fox, beaver and muskrat. A variety of raptors, reptiles and amphibians also inhabit the area.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain the channel form, provide for the annual flushing of bottom sediments, maintain survival habitat for sauger, northern pike, channel catfish and other fishes during the critical low flow period, and help protect the habitat of those wildlife species that depend upon the stream and its associated riparian zone for food, water and shelter. In addition, the requested high flows will allow spring-spawning gamefish, particularly sauger and channel catfish, to ascend Box Elder Creek during their annual spawning migrations.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	4.0	246[a]
February	4.0	222[a]
March	4.0	246[a]
		16,334[b]
April	7.0	417[a]
May	7.0	430[a]
June	7.0	417[a]
July	7.0	430[a]
August	7.0	430[a]
September	7.0	417[a]
October	7.0	430[a]
November	7.0	417[a]
December	4.0	246[a]
Total:		20,682

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 17-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	25	50
2	55	109
3	170	337
4	340	674
5	850	1,686
6	1,820	3,610
7	1,480	2,936
8	1,220	2,420
9	860	1,706
10	640	1,269
11	380	754
12	160	317
13	120	238
14	55	109
15	35	69
16	15	30
17	10	20
		16,334

STREAM NAME: Little Beaver Creek

STREAM REACH: From Russel Creek confluence to the Montana-North Dakota border -- 61 miles

LOCATION: Sec. 18, T2N, R58E to Sec. 35, T6N, R61E

DESCRIPTION OF THE STREAM REACH:

Little Beaver Creek originates in southeast Montana in the rolling prairie hills of northeast Carter County, near Ekalaka. Little Beaver Creek flows northeasterly, emptying into the Little Missouri River at Marmarth, North Dakota. The stream's upper reaches are characterized by small intermittent pools of shallow to moderate depth. The meandering middle portion is dominated by long, well-formed pools, some of which reach depths of seven feet. These pools are separated by short riffles. Substrate in the pools consists primarily of silt and organic muck. Riffles are dominated by sand and gravel. Shorter pools of moderate depths and more frequent riffles characterize the stream's lower section.

Elevations range from 3,300 feet at the head of the reach to 2,890 feet at the lower end, a total change in elevation of 410 feet. Riparian vegetation consists mainly of grasses, sedges, and forbs in the upper and middle section. Snowberry, serviceberry, buffaloberry and Russian olive cover the steeper banks along the lower stream. Grasses and sedges are found along the streamside margins and on more gently sloping areas.

A precipitation summary for the last decade revealed an average annual accumulation of 15.23 inches. Yearly totals ranged from 7.68 inches to 24.37 inches. Most precipitation occurs in the spring months.

Land ownership along the stream is predominantly private, although access is usually not a problem. Numerous county roads and vehicle trails provide access to the stream. The predominant land uses are non-irrigated cropland and rangeland. Big game and upland bird hunting are important activities along the stream during the fall months.

A USGS gauge on Little Beaver Creek, five miles upstream from the creek's confluence with the Little Missouri River, near Marmarth, North Dakota, was operated for 41 years from 1938-1979. The average annual flow for this period was 44.6 cfs (32,310 acre-feet/year). Daily extremes ranged from 12,700 cfs to no flow at times in most years.

GAME FISH PRESENT: Northern pike, channel catfish

FISHERY:

Little Beaver Creek supports a diverse warmwater fish community, with 22 species collected within the reach. Some of these species, such as the sand shiner and creek chub, have a limited distribution in Montana. Sampling during the summer of 1990 revealed the presence of adult northern pike in the mid-sections of Little Beaver Creek. Large pools in this portion of the stream provide the habitat necessary for adult fish survival during periods of negligible flow. Northern pike sampled during summer, 1990, ranged in size from young-of-the-year to nine pound adults. Residents of nearby Ekalaka have recently taken trophy-sized northern pike approaching 18 pounds.

Young-of-the-year northern pike were sampled by seining and electrofishing methods in mid- and downstream areas. These fish were generally found in the shallower pools and stream margins and were associated with submerged aquatic vegetation and organic debris. Their presence indicates that Little Beaver Creek provides the necessary habitat for northern pike spawning and rearing. Yellow perch were also present in small numbers, but were restricted to upstream areas.

Channel catfish have been documented in the lower sections of the stream. A channel catfish spawning run was not observed during the spring of 1990 and no young-of-the-year channel catfish were collected. Precipitation was below normal and runoff may have been insufficient to permit channel catfish access from the Little Missouri River.

Landowners and residents of nearby Baker indicated that, in years of adequate flow, channel catfish ascend Little Beaver Creek from the Little Missouri River. When these fish are present, the stream's lower portions receive some local fishing pressure.

Young-of-the-year and adult river carpsucker were sampled in the stream. This species was characteristically found in the deeper pools and backwaters of the larger, more turbid Little Missouri River. Various sampling methods also produced young-of-the-year black bullhead, Iowa darter, brook stickleback, shorthead redhorse, white sucker and carp. Nine minnow species were collected in the 1990 field season.

WILDLIFE:

Big game species found within the Little Beaver Creek drainage include pronghorn antelope, mule deer and white-tailed deer. Furbearers are abundant. Mink, muskrat, beaver, raccoon, red fox and coyote are relatively common in the immediate vicinity of Little Beaver Creek. Upland gamebird species inhabiting the drainage include sharp-tailed grouse, sage grouse and Hungarian partridge. Doves are abundant along the stream's course throughout the summer and fall.

Blue-winged teal and mallards nest along the creek. Great blue herons are also commonly encountered. Raptors seen along the stream during the summer months include the American kestrel and Swainson's, red-tailed and ferruginous hawks.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain the channel form, provide for the annual flushing of bottom sediments, maintain survival habitat for northern pike, channel catfish and other fishes during the critical low flow period, and help protect the habitat of those wildlife species that depend upon the stream and its riparian zone for food, water and shelter. In addition, the requested high flows will allow spring-spawning gamefish, particularly channel catfish, to ascend Little Beaver Creek during their annual spawning migrations.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	AF
January	3.0	184[a]
February	3.0	167[a]
March	3.0	184[a]
		15,724[b]
April	3.0	179[a]
May	3.0	184[a]
June	3.0	179[a]
July	3.0	184[a]
August	3.0	184[a]
September	3.0	179[a]
October	3.0	184[a]
November	3.0	179[a]
December	3.0	184[a]
Total:		17,895

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 19-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	7	14
2	9	18
3	620	1,230
4	2,050	4,066
5	3,310	6,565
6	1,080	2,142
7	250	496
8	160	317
9	110	218
10	75	149
11	55	109
12	41	81
13	35	69
14	30	60
15	25	50
16	20	40
17	20	40
18	15	30
19	15	30
		15,724

STREAM NAME: Beaver Creek (Wibaux County)

STREAM REACH: From the confluence of Lame Steer Creek to the Montana-North Dakota border -- 69 miles

LOCATION: Sec. 8, T12N, R60E to Sec. 18, T16N, R60E

DESCRIPTION OF STREAM REACH:

Beaver Creek, a tributary to the Little Missouri River, originates in the tableland of northern Fallon County in eastern Montana. The creek flows northeasterly across Wibaux County into North Dakota. It is a typical meandering, low-gradient prairie stream having a silty substrate. This reach of Beaver Creek drains an area of approximately 380 square-miles.

The basin topography varies from rolling hills to flat lands ranging in elevation from 2,900 to 2,420 feet. Soils of the basin consist of loam, clay loam and sandy loam. The climate of the region is characterized by hot dry summers and cold winters. Precipitation averages 14 inches annually.

Virtually all land along Beaver Creek is privately owned, although stream access is generally granted with permission. State highways 7 and 261 parallel the creek for most of its length. In addition, the creek is crossed by a number of gravel county roads. Predominant land uses within the basin are cattle grazing and dry land farming. Water is diverted from Beaver Creek for irrigation, but this use is not extensive.

Stream habitat of Beaver Creek is typical of prairie streams. The deeply incised channel is characterized by short riffles and long, deep pools. Water velocities over the few defined riffles are generally low, with many riffles becoming dewatered by early summer. Some pools receive subterranean flow. Others are covered by dense mats of aquatic vegetation. Streambanks are vegetated with a variety of grasses, sedges and shrubs. Maximum and minimum water temperatures of Beaver Creek are typically 83F and 72F, respectively, for June; 78F and 57F, respectively, for July; and 79F and 57F, respectively for August.

A USGS stream gauge located on Beaver Creek at the town of Wibaux, Montana, was operated for 38 years (1938-1969, 1978-1983). The average annual flow during this period was 21 cfs (15,430 acre-feet/year). Extremes ranged from 3,780 cfs on March 21, 1938 to zero at times during most years.

GAME FISH PRESENT: Walleye, northern pike

FISHERY:

Resident gamefish populations in Beaver Creek are probably limited by intermittent streamflow and the availability of suitable spawning habitat. However, the large pools do sustain low numbers of walleye and northern pike that reach large sizes (Figure 18).

Walleye probably gained access into Beaver Creek from Lame Steer Reservoir, a shallow, waterfowl production area located on a tributary creek near the upstream boundary of the reach. In spite of the seemingly harsh environmental conditions within Beaver Creek, walleye in spawning condition and young-of-the-year were collected in April and late summer, 1990, respectively. Forty-nine walleye were tagged and released, with the largest weighing nearly 11 pounds.

The origin of northern pike in the Beaver Creek drainage is unknown. Northern pike are presently distributed from the middle to the downstream portions of the reach. Fifty-four northern pike, captured by electrofishing, were tagged and released. The largest weighed nearly 11 pounds. Successful reproduction of northern pike was documented by the collection of young-of-the-year fish at numerous locations in mid to late summer, 1990. Because fish were tagged after high flow, returns came from the same pools where fish were originally tagged. Therefore, the extent of northern pike movement throughout the stream is unknown.

Based upon reports from local anglers and information derived from the return of fish tags, the sport fishery of Beaver Creek appears to be of significant recreational and economic importance to the area. This is supported by the inclusion of local walleye fishing opportunities in the Wibaux Chamber of Commerce brochure.

Twenty-one fish species were collected in Beaver Creek. One of those, the creek chub, while native to Montana, is limited in distribution to the Yellowstone and Little Missouri River drainages in the extreme eastern part of the state. This fish, though considered rare in Montana, is plentiful in Beaver Creek.

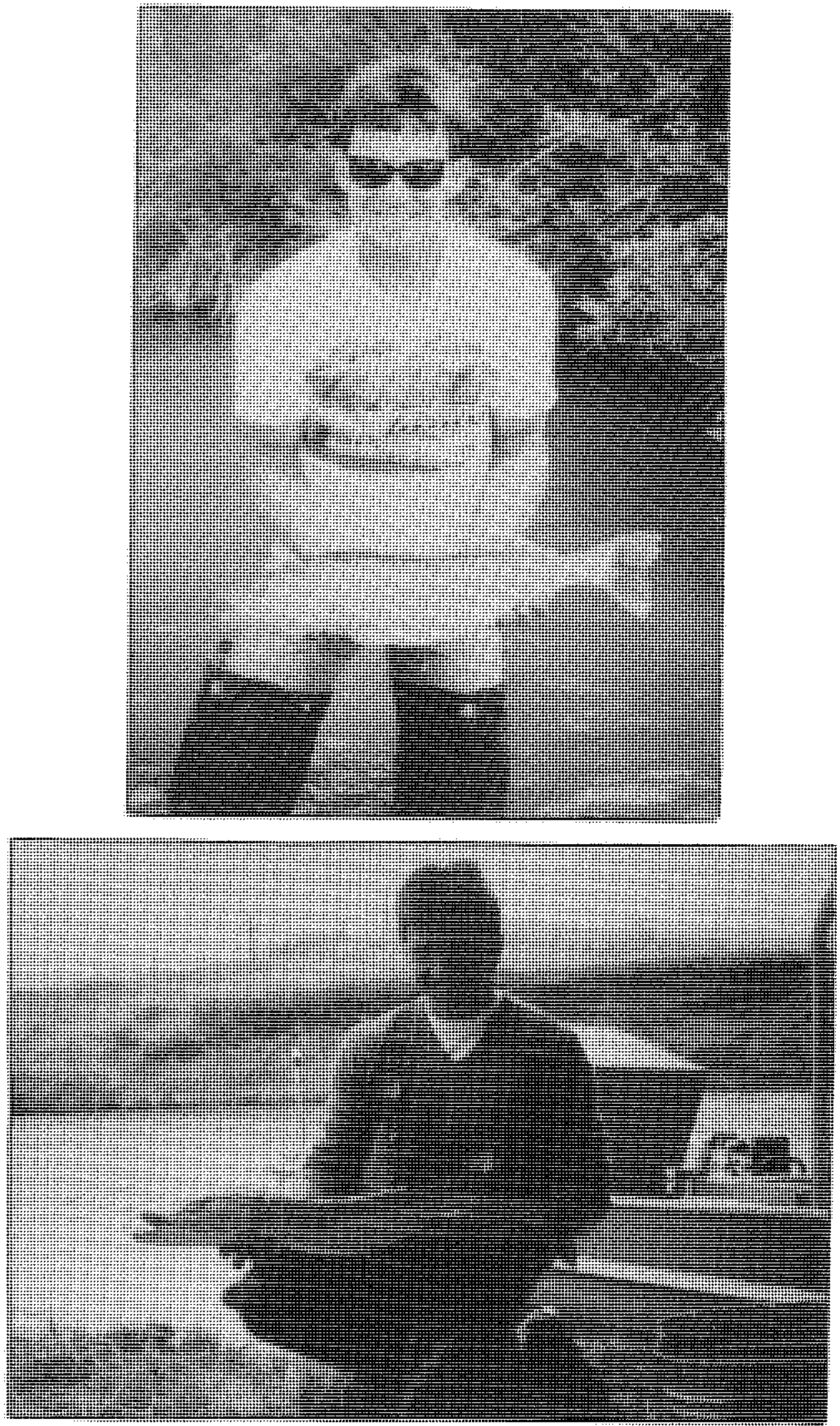

Figure 18. Eight pound walleye (top) and nine pound northern pike from Beaver Creek, 1990. Photos courtesy of Craig Barfoot.

WILDLIFE:

Big game animals found in the Beaver Creek drainage include white-tailed deer, mule deer and antelope. Upland gamebird species inhabiting the basin include wild turkey, sage grouse, sharp-tailed grouse, ringneck pheasant, mourning dove and Hungarian partridge. Beaver Creek and its adjacent riparian zone are utilized for nesting and rearing by great blue herons, Canada geese and a variety of other waterfowl species. Other wildlife species present within the basin include raptors, songbirds and furbearing mammals, such as coyote, red fox, beaver, muskrat and mink.

INSTREAM FLOW METHODS:

The Dominant Discharge/Channel Morphology Concept and the Base Flow Approach were used to derive flow requests. See the discussions beginning on pages 23 and 22, respectively.

WHY FLOW IS NECESSARY:

The requested flows are necessary to maintain the channel form, provide for the annual flushing of bottom sediments, maintain survival habitat for walleye, northern pike and other fishes during the critical low flow period, and help protect the habitat of those wildlife species that depend upon the stream and its riparian zone for food, water and shelter.

FLOW REQUEST:

Based on information discussed in the above INSTREAM FLOW METHODS section, the following flows are requested:

Time Period	Instream Flow CFS	Instream Flow AF
January	1.0	61[a]
February	1.0	56[a]
March	1.0	61[a]
		7,405[b]
April	0.7	42[a]
May	0.7	43[a]
June	0.7	42[a]
July	0.7	43[a]
August	0.7	43[a]
September	0.7	42[a]
October	0.7	43[a]
November	0.7	42[a]
December	1.0	61[a]
Total:		7,984

[a] Flows derived using the Base Flow Approach.

[b] Additional water during a 14-day period to start no earlier than March 1 nor later than April 30, according to the following pattern:

Day	CFS	AF
1	10	20
2	15	30
3	35	69
4	130	258
5	390	774
6	790	1,567
7	1,050	2,083
8	660	1,309
9	330	655
10	130	258
11	65	129
12	53	105
13	40	79
14	35	69
		7,405

THE RESERVATIONS ARE IN THE PUBLIC INTEREST

These reservations of water are in the public interest. The public benefits which will accrue from the reservations are:

1. continued perpetuation of the fish and wildlife resources, the very existence of which is in the public interest;

2. prevention of the gradual depletion of streamflows which are currently enjoyed by the public for recreational uses;

3. continued perpetuation of the fish and wildlife resources for current and future utilization by the public;

4. maintenance of water quality which contributes to a clean, healthful environment for the citizens of the state and the nation; and

5. protection of and continued utilization of existing water rights.

A showing that the reservations are in the public interest, including their direct and indirect benefits and costs, is provided in the discussion which follows.

I. Direct Benefits and Costs of the Reservations

The following is pursuant to the ARM 36.16.105C(1)(a) of the water reservation rules dated 12/31/88:

> In making a showing that the reservation is in the public interest, the application shall contain . . . an analysis of the direct benefits and costs associated with applying reserved water to the proposed beneficial use.

Direct benefits and costs are defined by ARM 36.36.102 (6) and (7) as:

> (6) Direct benefits mean all benefits to the reservant derived from applying reserved water to the use for which it is granted, and
>
> (7) Direct costs mean all costs to the reservant from applying reserved water to the beneficial use for the purpose granted.

The "use for which it is granted" is the perpetuation of existing biological populations within state waters and the recreational benefits derived by public utilization of these resources. Furthermore, since "the reservant" (DFWP) is a public agency charged with the protection and management of these resources and recreational opportunities, the benefits to the public and the Department are mutually inclusive.

A. Direct Benefits

1. Fisheries and Fishing Opportunities

About 4,400 miles of Montana streams, mostly located in the north-central and eastern portions of the state, support sauger, walleye, northern pike, smallmouth bass, channel catfish, shovelnose sturgeon, burbot (ling) and other warmwater fishes (Mussehl et al. 1986). Additional tributaries that contribute to the maintenance of streamflows and water quality in these streams may also support warmwater fish at some time during the year.

Warmwater streams are not heavily fished, so regulations have in general been liberal, except for the paddlefish and pallid sturgeon which are strictly regulated. Fish populations in warmwater streams are maintained through natural reproduction. Hatchery-reared fish have been planted occasionally to establish a species, but maintenance plants have not been used to support the recreational fishery.

Lower Missouri River

As there are few coldwater aquatic systems in the lower Missouri River basin, coldwater tributaries of the Milk River offer the only angling opportunities for stream-raised trout on the High-Line. Originating in the Bear Paws and the Little Rockies, these streams support brook, rainbow and brown trout. The large rainbows and browns in Clear Creek are notable. The Beaver Creek Recreation Area is especially popular with anglers from Havre. Whereas trout populations have been limited by dewatering and recent drought, natural production is expected to replenish populations and increase angling opportunities under more favorable water regimes.

The only other stream-trout angling in the lower basin occurs just downstream of the Fort Peck Dam tailrace. Colorful spawning rainbow trout, averaging nearly four pounds in weight, attract anglers from all over the state. As the number of trophy-sized spawners has increased significantly since 1983, this fishery will likely increase in popularity among anglers.

Paddlefish, native to the Missouri River, provide an important fishery resource. Populations in much of their historic range have been reduced or depleted by over-harvest, pollution, habitat alteration and blockage of migration routes. However, under strict regulation, Montana populations are some of the best in the entire Missouri River system (Gardner and Stewart 1987).

Paddlefish likely reside in the Missouri River year-round, although numbers are greatest in late spring and summer (Gardner and Stewart 1987). Some paddlefish appear to be sedentary, remaining in the dredge cuts for several years (Frazer 1985). Being highly mobile, paddlefish also use the Milk and Yellowstone rivers. Paddlers tagged in the dredge cuts and Missouri River are frequently harvested at Intake Dam on the Yellowstone, illustrating the need for adequate flows to enable long movements. The greatest migration occurs during spawning runs from April through May. It appears that spring run-off from the Milk River is particularly important in triggering migrations to spawning locations (Gardner and Stewart 1987). During good run-off years, paddlefish ascend the Milk River to spawn on flooded gravel bars.

Paddlefish angling opportunities are tied to spawning and high run-off events. Sport fish harvest by snagging occurs in the lower Missouri River but harvest rates are generally low due to limited access, great spatial distribution of fish and lack of barriers which concentrate migrants. The Frazer area has recently become popular. Fishing pressure will likely expand with the discovery of other concentration areas both up- and downstream. The resident paddlers near the dredge cuts area offer a unique bow-and-arrow fishery.

Paddlefish along with the pallid and shovelnose sturgeon are relics from an earlier geologic time. Sturgeon inhabited warm, turbid prairie rivers 200 million years ago and their historic range spanned the length of the Missouri River from Fort Benton to the mouth at the Mississippi River. Pallid sturgeon experienced the same hardships as paddlefish but did not fare as well. Pallids are rarely sighted or harvested by anglers. Only recently have they been studied by DFWP personnel. Therefore, little information is available to document the life history requirements of this fish. Limited monitoring has revealed that fish captured in the tailwaters below Fort Peck Dam moved at least 60-100 miles downstream. Such long movements require protected water levels.

Whereas the pallid sturgeon was recently classified as endangered under the federal Endangered Species Act, shovelnose sturgeon have fared much better. They are more numerous and prized by knowledgeable anglers. Shovelnose overwinter in the tailwaters below Fort Peck Dam. Shovelnose are abundant in the Missouri River from the dam to just downstream of Wolf Point and common throughout the rest of the Missouri River to the North Dakota border (Gardner and Stewart 1987).

The shortnose gar, another primitive fish, would also directly benefit from a reservation. Although secure in other parts of its range, the shortnose gar is endangered in Montana (MNHP 1990). Gardner and Stewart (1987) documented its rarity, noting one individual in Little Porcupine Creek, a Missouri River tributary. Historical records show only a handful of gar taken from the dredge cuts in the last 20 years (Brown 1971).

As these four species are creatures of prehistoric times, they are unique in today's world. Collectively the values of these primitive fish along with other aspects of the fishery warranted the Class I rating of the entire lower Missouri River. DFWP awards this rating only to those fisheries which it considers to have the highest resource values. The lower 100 miles of the Milk River were also rated as Class I. Significant portions of the Redwater, Poplar, and upper Milk rivers were rated as Class II because of high species diversity, important local angling interest, and because they provide valuable spawning habitat for mainstem Missouri fishes.

Warmwater species account for the majority of angling opportunities in the lower Missouri basin. The Milk River is noted for sauger, walleye, and northern pike fishing, particularly at its mouth during spring run-off. Analogous situations exist where Milk River tributaries empty into its main river channel. Angling pressure at these junctures can be substantial but falls off further upstream. Although these tributaries may not receive much attention from anglers except at their mouths, northern pike, walleye and sauger are present. In many cases, these species along with smallmouth bass are year-round residents. One of the most significant contributions these streams make to angling opportunity lies in harboring valuable spawning sites. To a large extent, the reproduction occurring in these tributaries sustains the sport fishery in the Milk River.

As many as 25 non-game species occur in tributaries of the Milk River. Such a diverse forage base may help support the sport fishery throughout the entire Milk River drainage. Forage fish populations are also maintained by natural production derived from tributaries. Many of these non-game species are sought for individual and commercial use as bait.

The Redwater and Poplar rivers also provide warmwater angling opportunities. Although overall fishing pressure is probably low relative to other streams, local anglers place great value on these systems. Instream flow reservations would help maintain angling opportunities, as fish populations are limited by extreme variations in flow. Instream flow reservations will help maintain these fisheries by preventing future flow depletions which could impair fish productivity and survival. Despite current limitations, walleye, northern pike and sauger do attain respectable sizes.

In addition to rainbow trout, the 10-mile-long tailwaters below Fort Peck Dam also support 34 other fish species. This valuable fishery is unique in that it supports both warmwater and coldwater species in a variety of semi-lake and river habitats. In a survey of summer recreationists at the dredge cuts area, 60% fished (DFWP 1987). Walleye and sauger are the most popular game fish in this stretch. Their use of certain predictable areas provides angler opportunities. Cisco, escaping from Fort Peck Reservoir, now contribute to the forage base for game fish below the dam. Previous introductions of rainbow smelt into Fort Peck Reservoir and subsequent escape through dam turbines drew sauger and walleye into the tailwaters area below Fort Peck Dam, enhancing the sport fishery (Gardner and Stewart 1987). It is thought that the cisco introduction will have similar effects. Lake trout from the dredge cuts contribute to the creels of winter ice fishermen. Northern pike are also found in the dredge cuts but their populations are somewhat limited by inconsistent spawning success.

Fort Peck Dam operations affect fish populations in this reach in different ways. DFWP has been working with the Corps of Engineers to modify dam operations to lessen the negative effects of flow changes on the fishery. These modifications along with maintenance of flows requested in this application would allow this fishery to reach its full potential.

Downstream from the tailwaters, the Missouri River supports an exceptional river sport fishery for shovelnose sturgeon, northern pike, burbot, sauger and walleye (Gardner and Stewart 1987). In fact, pike, burbot and sauger reach greater average and maximum weights in the lower Missouri River than in the wild and scenic stretch above Fort Peck Reservoir (Gardner and Stewart 1987).

Little Missouri River

The Little Missouri River and its tributaries harbor channel catfish, northern pike, walleye and sauger as the principal game species. Little Beaver Creek, in particular, produces trophy-sized northern pike in the vicinity of Ekalaka. Walleye and northern pike are of special interest in Beaver Creek. Channel catfish are sought by anglers but harvest opportunities have been sporadic due to inconsistent water availability. This problem is shared by the other species as well. Nonetheless, these fisheries contribute significantly to local recreational opportunities.

Use of Montana's warmwater streams by licensed anglers in 1985 was estimated to be about 78,700 angler-days, with residents of Montana accounting for 90% of the use (McFarland 1989). Streams of the lower and Little Missouri River basins supported an estimated 28,667 angler-days in 1985, which is about 36% of the state total for warmwater streams (Table 17).

Recent angler surveys support the contention that Montana's outstanding warmwater fisheries are an undiscovered resource that has only begun to be tapped by recreationists and the tourist trade. Montana's warmwater lakes, reservoirs and streams currently support a fraction (less than 10%) of the statewide fishing pressure and attract relatively few tourists (Table 18). Residents and non-residents alike overwhelmingly fish the state's salmonid (trout) waters, where about 90% of the total statewide angler-use occurs (Table 18).

Table 17. Angler use of streams in the lower and Little Missouri River basins during 1985 (from McFarland 1989).

Stream	Angler-days[1]
Missouri River (Fort Peck Dam to North Dakota border)	9,525
Milk River and tributaries	15,187
Redwater River	1,215
Poplar River	987
Big Muddy Creek	105
Little Missouri River and tributaries	1,648
Total	28,667
State Total (warmwater, non-salmonid streams only)	78,713
Percent of State Total	36.4%

[1] Total use is underestimated because only licensed anglers were sampled in the mail surveys that generated pressure estimates.

Table 18. Angler use in Montana during 1985 (from McFarland 1989).

Category	Annual Angler-days[1] Total	Resident	Non-Resident
Salmonid waters	2,191,598	1,694,654	496,944
Non-salmonid waters	190,785	178,104	12,681
Undesignated waters	61,055	43,953	17,102
Total	2,443,438	1,916,711	526,727

[1] Total use is underestimated because only licensed anglers were sampled in the mail surveys that generated pressure estimates.

The harvest of warmwater fish is also well below the resources potential. Warmwater species comprised only about 8% of Montana's total harvest of 1.85 million fish in 1985 (McFarland 1989). Many factors contribute to the current under-utilization of the state's warmwater fisheries in general and to the lower and Little Missouri River basins specifically:

1. Much of eastern Montana where the vast majority of warmwater fishing occurs is remote and far from the population centers concentrated in Montana's western half. Warmwater fishing areas are essentially isolated from much of the state.

2. Montana's prime warmwater fisheries are mainly within DFWP's administrative regions 6 (Glasgow area) and 7 (Miles City area). These two regions encompass about 39% of Montana's land area (Lonner 1990) yet support only about 15% of the population (Musseh1 et al. 1986). And unlike other DFWP regions of the state, the population is declining, from about 130,900 people in 1982 to a projected 127,500 in 1990 (Musseh1 et al. 1986). Actual 1990 census information for eastern Montana counties substantiates this decline (Montana Department of Commerce 1991).

   The local population having direct access to the warmwater resource is not only small in number when compared to other regions of the state, but is shrinking as well.

3. When pursuing outdoor recreation, Montanans (and Montana-bound tourists) are biased toward trout fishing and the mountain environs where trout waters are found. Trout have historically been "king" in Montana. Montanans lack a strong tradition for warmwater fishing.

4. Montana's warmwater fisheries are, in general, far from the destinations of the vast majority of tourists who flock to Montana's mountain regions where the tourist-related developments are mainly concentrated. Thus tourists are more strongly attracted to mountain areas where warmwater fishing is less available.

5. Montana is nationally recognized as the last bastion of wild trout fishing in the continental U.S. Montana's "Blue Ribbon" trout waters have long dominated the national outdoor media. Rivers harboring an abundance of wild, stream-bred trout are a highly prized recreational resource that, nationwide, are in short supply. However, many of our warmwater fisheries are on a par (uniqueness, quality, etc.) with the renowned trout fisheries. Yet, in the past, they have received little national or state recognition.

The relatively low angler-use of Montana's warmwater fisheries can lead to erroneous conclusions regarding the recreational importance of some of these waters. Angler use data often mask the significance of local waterways to the small rural communities of eastern Montana where fishing opportunities can be limited by the scarcity of fish-holding waters. A single water can be especially important to local residents, a relationship not evident from the relatively low levels of angler-use.

The overall significance of Montana's warmwater resource should be viewed in relation to the changing attitudes of Montana's anglers and the future potential for significant economic and recreational benefits. Indications are that Montana's warmwater fisheries, a resource long hidden from public view, are finally being discovered by Montanans and the tourist trade. Many factors point to a bright recreational and economic future for warmwater fishing in Montana:

1. <u>Growing Fishing Pressure</u>

   Preliminary fishing pressure estimates for 1990 indicate that angler-use of Montana's warmwater fisheries is increasing (McFarland 1991). While angler-use on all state waters remained relatively stable from 1985 to 1990, pressure on warmwaters increased by an estimated

11%. The increase was more pronounced for warmwater streams where overall angler-use increased by an estimated 29%. Even more pronounced was the increased use by non-residents. Between 1985 and 1990, non-resident angler-use increased by an estimated 65% on all warmwaters. For the same period, resident use increased by only about 7%. These increases point to the fact that warmwater fishing is a rapidly expanding recreational activity in Montana.

2. Proliferation of Warmwater Fishing Clubs

The rapidly growing popularity of Montana's warmwater fisheries is evidenced by the statewide proliferation of bass and walleye clubs that has occurred during the 1980s. Walleyes Unlimited of Montana, founded in 1983, is the largest of the state organizations, with 13 Montana chapters and a membership as high as 3,000 (Ross 1990). Bass clubs have been a part of Montana since the late 1970s and are now organized into 10 chapters, having 228 members, under the leadership of the Montana B.A.S.S. Federation, an affiliate of the National B.A.S.S. Federation since 1987 (McGuire 1990). National B.A.S.S. boosts 500,000 members nationwide and 1,000 Montana members, many of whom have not joined the local Montana B.A.S.S. chapters (McGuire 1990).

Warmwater fishing organizations now have an active voice in fisheries management decisions and are working effectively towards the expansion and betterment of the state's warmwater fisheries. This advocacy group did not exist ten years ago.

The popularity of bass, walleye and other warmwater species with Montana's resident anglers will continue to spread as the state's warmwater fisheries, some acclaimed as world-class, gain greater recognition and as more transplants from the mid-West and South settle in Montana and seek out their "native" fishes for their angling enjoyment.

3. Growth of Warmwater Fishing Tournaments

Warmwater fishing tournaments and derbies, primarily focusing on bass and walleye, are a rapidly expanding enterprise in the state. Only two permits to run warmwater derbies were requested in 1987 when the DFWP began regulating these events (Johnson 1990). In 1990, 14 permits were requested and issued (Johnson 1990). Derbies and tournaments are rapidly progressing from community fundraisers and local club competitions to national events where professional anglers on the touring circuit compete for substantial cash awards. Conflicts are also beginning to arise as sponsors compete for territories, saturating some bodies of water with multiple tournaments. DFWP has already recommended the denial of a permit application to protect resource values as well as the interests of local sportsmen. These new sources of conflict are another example of the ever-increasing pressures being exerted on Montana's warmwater fisheries.

4. Improved Media Coverage

In the recent past, most Montana anglers and the vast majority of non-residents were unaware of the state's high quality warmwater fishing opportunities. The tourist industry and media, long focusing on the state's "Blue Ribbon" trout fisheries, ignored a resource that, in many respects, measures up to our renowned trout fishing. The state's proliferating bass and walleye clubs have in recent years generated much publicity through their local and national publications and sponsorship of fishing tournaments. Increased coverage of Montana's warmwater angling opportunities in state and national outdoor publications calls attention to the potential economic and recreational value of this resource. Recent examples include: an article on paddlefishing in Field and Stream (August 1990), a summary of improved walleye fishing opportunities in Montana in the In-Fisherman Walleye Guide (1990), and a featured article on warmwater fishing opportunities in Montana Outdoors (July/August 1990).

5. Renewed Commitment by DFWP

Another measure of the growing importance of Montana's warmwater fisheries is the renewed commitment by DFWP to enhance and better manage this valued resource. In 1983, DFWP acquired and renovated the abandoned federal warmwater hatchery at Miles City at a cost of $5.15 million (Dotson 1990). In addition to the initial investment, over $218,000 annually is targeted for warmwater hatchery operations and maintenance (Dotson 1990). The Miles City Hatchery is slated to rear forage fish and six species of warmwater sport fish, emphasizing walleye, smallmouth bass and largemouth bass. The rearing capacity for walleye alone is 42 million fry and 1.8 million fingerlings annually (Dotson 1990). In 1990, the hatchery supplied 20.4 million walleye fry for stocking in six Montana waters (Dotson 1990). Eight waters received an estimated 43 million fry in 1989 (Dotson 1990).

Initially, the warmwater fishing stocking program emphasized the establishment of reliable egg sources. Toward that end, intensive effort was focused on Fort Peck, Yellowtail and Tongue River reservoirs. Despite the accent on warmwater lakes and reservoirs, warmwater rivers and streams benefit from the strong lake/reservoir stocking program. The excellent fisheries in many of Montana's warmwater lakes and reservoirs sustain and further develop both resident and non-resident interest in warmwater angling. As interest in warmwater angling flourishes, Montana's streams and rivers will receive more attention. As noted earlier, preliminary estimates of warmwater stream angler use in 1990 illustrate the increased interest in warmwater stream fishing (McFarland 1991).

Starting in 1991, a few experimental plants will be made in warmwater streams for which reservations are sought in this application. In the lower Missouri River basin, the Milk River (in Hill County) will receive 15,000 catfish and 10,000 smallmouth bass fingerlings. In the Little Missouri River basin, Beaver Creek (in Wibaux County) will be stocked with 10,000 largemouth bass and 10,000 smallmouth bass fingerlings (Dotson 1991). Although outside the lower and Little Missouri River basins, the lower Yellowstone, Tongue and Big Horn rivers will also receive plants of smallmouth bass and walleye in 1991. The evaluation of the success of these plants could take three to five years. In addition, DFWP will evaluate the potential success of using hatchery-reared fish to enhance existing populations in other warmwater rivers and streams. If successful, the stocking of warmwater fluvial systems may intensify (Dotson 1991). The well-established populations in warmwater lakes and reservoirs would serve as the brood source for future plants to fluvial systems, further illustrating the benefits of strong warmwater lake/reservoir programs to the budding warmwater stream fishing industry.

6. <u>An Expanding Resource</u>

Montana's already outstanding warmwater fishing is getting better due to the enhanced warmwater management program. Fort Peck Reservoir, Montana's largest body of water at 240,000 acres, is an example of recent successes (Wiedenheft 1990). Annual hatchery plants of up to 31.9 million walleye young have created a nationally-acclaimed walleye fishery in a water having limited potential for natural reproduction. In conjunction, two forage species, the cisco and spottail shiner, were introduced to provide an added food source for the expanding walleye population. Growth rates of walleye and other reservoir game fish have improved dramatically following the development of self-sustaining forage fish populations. This translates to enhanced angling opportunities.

Tongue River Reservoir is another example where walleye plants have greatly enhanced the fishery (Stewart 1990). Monitoring of the walleye population by DFWP in 1985 showed about one walleye captured per 10 gill net sets. Following extensive plants of up to 2 million young annually, 150-300 walleyes per 10 gill net sets are now being achieved. The fishery for crappie, a panfish that has over-populated the reservoir, has also profited. Walleye predation decreases the number of crappie and allows the remaining fish to grow faster and reach a more desirable size for the sport fishery. DFWP is attempting to further improve the reservoir sport fishery by introducing spottail shiners to increase the food base. The potential impacts of forage fish introductions are being assessed for other warmwater reservoirs that suffer from a shortage of forage species.

The paddlefish, a species being evaluated for possible inclusion as a nationally threatened or endangered species, is not faring well outside of Montana where most populations are disappearing. Montana's populations appear secure, which in part reflects long-term population monitoring by DFWP and the subsequent implementation of innovative and highly restrictive angling regulations to curb the harvest (Stewart 1990). The paddlefish is one example of a native Montana fish that depends on effective management for its continued well-being in the state. Its current secure status in Montana can, in part, be considered a management success. These successes are the framework upon which the warmwater resource will continue to expand.

7. <u>Nationwide Popularity of Warmwater Fishing</u>

The most popular freshwater sport fish in the nation is the bass. About 16.8 million anglers fish for bass (FWS 1988). Walleye fishing, with about 5.3 million participants (FWS 1988), is perceived by many to be the fastest growing sport fishery in the U.S. Panfish, perch, crappies, catfish and pike claim about 46 million enthusiasts (FWS 1988). In comparison, 11.8 million anglers fish for trout (FWS 1988), the sport fish most commonly associated with Montana.

The magnitude of the potential user group that Montana's fledgling warmwater tourist industry could draw on is staggering. This group far exceeds the trout user group that is currently relied upon by the tourist industry. To capitalize on the immense national interest, Montana's warmwater fishing resource must be aggressively promoted, luring anglers away from more traditional warmwater destinations. Initial efforts are beginning to pay off.

According to Scott Ross of the Glasgow Chamber of Commerce and Walleyes Unlimited of Montana, increased media attention has fueled a nationwide curiosity about Montana's non-salmonid resources, which is beginning to translate into visits from anglers who come exclusively to fish for warmwater species. In fact, the Fall 1990 issue of Walleyes Unlimited of Montana reported that the publisher of Walleye Magazine (a national trade magazine based in Ohio) spent two weeks in Montana sampling warmwater fishing opportunities. Long-term drought in the mid-West has also led warmwater fishing enthusiasts to choose Montana as an alternative vacation site; they are enjoying quality experiences and returning home liking what they saw (Ross 1990). While opportunities abound, the tourist industry has only begun to tap the economic benefits afforded by Montana's warmwater resource.

2. Recreation

Lower Missouri River

Many recreational activities would directly benefit from a reservation. In the lower Missouri, swimming is a favored recreational activity, particularly in the dredge cuts below Fort Peck Dam. Water levels in the dredge cuts are directly controlled by flows in the mainstem Missouri. Forty percent of respondents listed swimming as their main activity during a visit to the dredge cuts (DFWP 1987). In fact, 87% noted water access as being important to their enjoyment. An instream flow reservation will maintain this prominent recreational activity.

During the winter, scuba diving takes place in the tailrace of Fort Peck. Generally, there are at least a few divers out most weekends viewing and photographing pallid sturgeon, shovelnose sturgeon, and paddlefish. Organized scuba events occur once or twice a winter in the river and/or reservoir.

This, too, is an important recreational activity which would not be possible without minimum instream flows.

Rivers and streams in Montana provide exceptional recreational benefits to a broad spectrum of the public. Fifty-six percent of all Montanans fish and over 30% float in rafts, canoes, or kayaks (Frost and McCool 1986).

Preserving instream flows will also directly benefit recreational floating by maintaining current water depth and velocities on those streams large enough to accommodate canoes, rafts and other types of floating craft. Flows which are sufficient to enable these craft to operate will benefit recreational floaters as well as fisherman who float to fish these waters.

In a 1989 survey of recreationists in the upper and middle Missouri River basins, a substantial share of respondents indicated that they took fewer trips in 1988 because of drought-related low instream flows (Duffield et al. 1990). In addition, respondents also indicated that the quality of their recreational experience was lower because of inadequate flows. It is likely that recreationists in the lower Missouri River basin were similarly affected. Maintenance of instream flows by a reservation would help maintain the recreational integrity of the streams in the lower basin during drought.

Adequate instream flows also are important for the convenience and safety of floaters. Hazards, such as large boulders, logs, gravel bars, rip/rap and diversion structures, can often be avoided by floaters if stream flows are high enough to allow maneuvering. The requested flows would contribute to maintenance of water levels sufficient to reduce such inconveniences and safety hazards on floatable streams.

The Milk River drainage includes some of the most remote waters left in Montana. Occupying the old Missouri River channel before continental glaciation, the Milk winds through prairie country. History buffs are awarded views of wide open spaces and wildlife, much the same as it was for Lewis and Clark (Fischer 1979). Being the longest tributary of the Missouri, the Milk offers floats through long stretches removed from human development. Protection of instream flows in the Milk River tributaries addressed in this application will help maintain the flows necessary to accommodate floaters on the Milk.

The lower Missouri River also offers floaters isolated water with spectacular views (Fischer 1979). Rough river breaks blend into wooded riparian banks as the Missouri reaches the North Dakota border. The lower Missouri is often overlooked in favor of the wild and scenic stretch above Fort Peck

Reservoir. However, this lower reach is an excellent alternative for those wanting to avoid the crowds. Wildlife viewing opportunities are also good, contributing to the quality of this float. The Missouri River played a key role in early Montana history, transporting early explorers, fur trappers, and finally settlers to the western frontier. This rich historical heritage can be shared by floaters of any level of expertise.

Little Missouri River

Limited information exists on recreational activity in the Little Missouri River basin. However, that is not to say that it doesn't occur. On the Little Missouri River, many boating-related uses are rated as secondary activities by the Montana Rivers Information System (MRIS 1991). Canoeing, rafting, tubing, swimming and boat fishing undoubtedly contribute to local recreational opportunities. The only other activities rated higher were viewing and picnicking. On Beaver Creek, swimming was noted as a primary activity whereas tubing was secondary (MRIS 1991). Although the basin in general may not draw visitors specifically for its river recreation, undoubtedly these favorite summer pastimes are enjoyed by the local inhabitants and travelers passing through the area. The same arguments outlining the benefits of instream flows to river-related recreation on the lower Missouri also apply to the Little Missouri River.

3. Riparian Areas

Instream flow reservations will help maintain the levels of water required to maintain the health and vigor of the plant and animal life that comprise the existing riparian communities along the lower Missouri River and Little Missouri River basin streams included in this application.

The often shallow-rooted, water-loving plants found in riparian areas depend upon adequate instream flows to maintain shallow, streamside aquifers. Because of the close connection with this water source, riparian areas contain highly diverse plant communities. As the most productive wildlife habitats in North America, riparian areas are utilized extensively by big game, furbearers, waterfowl, songbirds and small mammals. The biological abundance and diversity found within riparian areas attract increasing numbers and kinds of persons who recreate along streams (i.e. photographers, bird-watchers, science students, hunters, berry-pickers, and naturalists).

The cottonwood communities along the Lower Missouri River are of special interest. The river bottoms near Wolf Point sustain some of the oldest Plain's cottonwoods in Montana

(MRIS 1991). Other stands of large, old cottonwoods are found at the Bainville Oxbow and the Highway 16 bridge. Similar to other members of the riparian plant community, cottonwoods require minimum flows for maintenance. Moreover, regeneration and perpetuation of the stand requires high spring flows. Protection of instream flows will help preserve these unique natural features.

4. Economics

Lower Missouri River Basin

Of the many recreational benefits provided by the rivers and streams in the lower basin, fishing is an integral part. Warmwater stream fishing is a valued opportunity. Brooks (1991) in surveying both resident and non-resident anglers in the fall, 1989, calculated the net economic value of warmwater stream fishing to be $65 per day. Although the survey only included the Milk, lower Yellowstone, and middle Missouri rivers, the $65/day estimate could be applied with confidence to the warmwater streams included in this application (Brooks 1991). The site values listed in Table 19 were calculated by multiplying the value of a fishing day on a warmwater stream (Brooks 1991) by the fishing pressure (annual angler days determined by McFarland (1989).

Those calculated site values underestimate actual values because the fishing pressure was underestimated (McFarland 1989). The site values could also be misleading in that they do not reveal the high values placed on local fishing opportunities by citizens of the rural communities. Compared to other angling site values in Montana, the values in the lower Missouri basin are modest. However, earlier discussions emphasized that the warmwater fishing resource is under-utilized in general. Once the excellent warmwater fishing opportunities in Montana are more actively promoted, the net economic value will likely exceed $65/day (Brooks 1991).

Instream flow reservations would help maintain these economic values by protecting the fishery resources from which they are derived.

Table 19. Net recreational fishing values of streams in the lower Missouri River basin.

Stream	Annual Angler Days	Value per day ($)	Annual Site Value ($)
mainstem Missouri River	9,525	65	619,125
Milk River and tributaries	15,187	65	987,155
Redwater River	1,215	65	78,975
Poplar River	987	65	64,155
Big Muddy Creek	105	65	6,825
Basin Total	27,019	65	1,756,235
State Total[1]	78,713	65	5,116,345
Basin % of State Total	34.0%		34.0%

[1] Warmwater, non-salmonid streams
Source: Brooks (1991) and McFarland (1989).

Little Missouri River Basin

The concepts outlined above would also apply in this basin. Net economic value of the Little Missouri River and its tributaries is $107,120 per year (1648 annual angler days x $65/day). This represents 2.0% of the state total.

5. Summary

The lower and Little Missouri rivers and their tributaries are tremendous recreational and aesthetic assets to the people of Montana and the rest of the nation. The resources of these river systems also constitute an economic asset for Montana. In order to protect these resources and provide future opportunities to enhance these public benefits, it is essential that the instream flows requested in this application be granted.

In addition to fishing, streams provide many other recreational benefits. Floating, camping, picnicking, swimming, birdwatching, sightseeing and hunting are all popular recreational activities conducted along the lower and Little Missouri rivers. However, there is little data available that allows for economic analyses of the values of stream recreation other than fishing. The economic values would, therefore, be significantly higher if all other river-based recreational activities were also evaluated. Even still, warmwater fishing in Montana has yet to reach its full potential. As Montana becomes more well-known for its warmwater angling opportunities, the benefits of maintaining instream flows will amplify.

B. Direct Costs

Some stream reaches of the lower and Little Missouri River basins do not have gauges at appropriate locations to adequately monitor streamflows. Once reservations are granted, monitoring of streamflows on stream reaches will be necessary for protection of the granted flows. This may require installation of additional stream gauges or relocation of existing gauges. Cost of installing gauges would range from $200 to $17,500 per gauge, depending on the level of technology required for the monitoring intensity level desired. Annual operating costs for each monitoring station would range from $500 to $6,800, depending on the complexity of the monitoring program. These figures are discussed in greater detail in the "Stream Gauging Costs" section included in the MANAGEMENT PLAN.

Other direct costs to DFWP include inhouse costs of collecting data, preparing the application, paying appropriate EIS fees to DNRC, cost of hearings on the application and inhouse operations to implement whatever program is required to protect the granted reservations.

II. Indirect Benefits and Costs of the Reservations

The following is pursuant to ARM 36.16.105C(1) (a) of the water reservation rules:

> In making a showing that the reservation is in the public interest, the application shall contain . . . A discussion of the indirect benefits and costs associated with applying water to beneficial use that considers the effects on (i) future economic activity, (ii) the environment, (iii) public healthy and safety, and (iv) the economic opportunity costs that the requested flow may have to parties other than the reservant.

Indirect benefits and costs are defined in ARM 36.16.102 (12) and (13) as:

> (12) "Indirect benefits" means the benefits of applying reserved water to beneficial use that accrue to other uses or to parties other than the reservant, and,
>
> (13) "Indirect costs" means the costs of applying reserved water to beneficial use that accrue to other uses or to parties other than the reservant.

For the purpose of this application "indirect", therefore, refers to "uses or to parties other than" DFWP, and the DFWP reservations will be the means "of applying reserved water to beneficial use."

The economic considerations of these requirements, subsections (i) and (iv), are discussed below under **A. Effects of the Reservation on Future Economic Activity**, and under **C. Economic Opportunity Costs of the Reservation**, respectively. The indirect economic **benefits** of the reservation are covered in **A.**, while indirect economic **costs**, including foregone opportunity costs, are addressed in **C.** Non-economic considerations, as per sections (ii) and (iii) above, are presented in **B. Effects of the Reservation on the Environment, Public Health, Welfare, and Safety**.

When establishing and prioritizing water reservation requests, a major criterion utilized by the Board of Natural Resources and Conservation is an evaluation of the effects that a reservation may have upon "other uses or parties." The following discussion, therefore, presents the overall indirect benefits and costs of the DFWP reservation and its specific effects upon municipal, agricultural, and industrial water users.

A. Effects of the Reservation on Future Economic Activity

1. An Overview of Indirect Economic Benefits

The instream flows requested in this application are necessary to protect recreational and aesthetic benefits provided by the rivers and streams of the lower and Little Missouri River basins. Protection of these amenities also significantly contributes to the economic well-being of Montana.

Tourism, one of the fastest growing segments of Montana's economy, is directly related to the amenities of the state's natural environment, particularly those provided by rivers and streams. In 1986, nearly 2.8 million non-residents visited Montana, generating over $475,000,000 in income for the state (Montana Department of Commerce 1988). In 1988, non-resident travelers spent $658,000,000 (Yuan et al. 1989). With the continued aggressive promotion by the tourism industry, Montana will likely attract increasing numbers of travelers in the future.

Most major highways in Montana closely parallel rivers and streams. It is along these waterways that visitors gather many of their impressions of the state. According to a tourism survey conducted by Montana State University (Brock et al. 1984), 95% of non-residents visiting Montana perceived Montana as good or excellent in terms of the state's outdoor recreation amenities. Maintaining the instream flows requested in this application would help protect the outstanding scenic and recreational values of the lower and Little Missouri Rivers and help ensure that tourists would continue to speak highly of the state's recreational resources.

Since word of mouth is often the best advertisement for any commodity, satisfied tourists would, in turn, stimulate continued growth for businesses supported by non-residents. Recent labor statistics revealed that growth in tourism-related service sector jobs in Montana is already significant. In the lower Missouri basin alone, 700 jobs were generated by non-resident travel in Montana during 1988 (Yuan et al. 1989). Thus the recreational and aesthetic attributes of rivers not only enrich the quality of life of Montana residents, they also generate a steady source of revenue as other staples of Montana's economy such as agriculture, mining or the wood products industry fluctuate (Powers 1987).

Tourists spent an estimated $19 million while traveling in the lower Missouri River basin during 1988 (Yuan et al. 1989). As 73% of non-residents visited Montana during spring and summer (Yuan et al. 1989), many likely utilized the water resources for recreation, whether angling, picnicking, or viewing wildlife. Therefore, rivers and streams, in contributing to the quality of the environment which attracts visitors from all across the nation, also foster local economic growth and stability.

2. Economic Benefits to Other Uses or Parties

a. Municipalities/Businesses

Municipalities in the lower and Little Missouri River basins would benefit from DFWP reservations because of increased assurances about the future availability of drinking water. Maintenance of instream flow levels would help sustain water levels at city intake structures and infiltration galleries. If incremental streamflow depletions were to continue as in the past, relocation of these supply structures and/or development of alternative water supplies could be necessary. Either of these alternatives would be costly for municipalities.

Even those municipalities depending on ground water sources would benefit from DFWP reservations. Surface waters can recharge ground water aquifers. Thus if instream flows were protected, these municipalities would benefit because of the increased potential of ground water recharge by surface waters.

The effects of DFWP reservations upon the availability of surface drinking water supplies are important considerations to be weighed during reservation deliberations. However, the economic benefits of the reservation to streamside communities also extend beyond the issue of municipal water supply sources.

Montana's diverse economic base along with its natural resources make Montana an excellent business environment (Moisey et al. 1990). In 1988, 200,000 people traveled to Montana for purely business reasons. Of those surveyed, 6% identified river floating as a recreational activity enjoyed during their visit (Moisey et al. 1990). In addition, 136,000 traveled to Montana for a combination of business and pleasure. Of those surveyed, 67% participated in fishing and fishing-related recreation. Other recreational activities identified were photography, hiking/walking and visiting historic sites. This business travel has an economic significance of at least $146,900,000 (Moisey et al. 1990). These authors said that marketing efforts should concentrate on convincing business travelers to stay longer and to travel with friends and family. Therefore, Montana must offer something to induce travelers to stay longer and bring their families. The quality of the environment and the diversity of outdoor experiences possible in Montana has had much to do with the past successes of travel promotion campaigns. Indeed, much of the recreational activities enjoyed by these business travelers relate back to the outdoor amenities. Certainly flowing waters and the associated river corridors contribute much to the quality of outdoor amenities in Montana.

The commercial lodging bed tax collection provides evidence of the increasing numbers of Montana visitors, whether business or pleasure travelers. Collections show increasing trends across the counties of the lower and Little Missouri River basins. By patronizing local lodging facilities, travelers contribute to local economies. Furthermore, travel and tourism in Montana are synonymous with outdoor recreation (Thomas 1991). Virtually all information requests received by the Montana Travel Promotion Office specify some type of outdoor recreational activity such as fishing, hunting or skiing. This provides further evidence that the quality of the environment is a big part of the successful tourism industry in the state.

In the case of the lower and Little Missouri River basins, the expansion of the warmwater fishing industry in Montana has already been discussed. The granting of a DFWP instream flow reservation will maintain the warmwater angling opportunities. Thus, more travelers could be attracted to eastern Montana where the majority of warmwater angling occurs.

b. Industry

Hydropower is a major beneficiary of DFWP reservations. Maintaining instream flows through water reservations would protect financial benefits to existing electrical generation at publicly-owned facilities. Water in the lower Missouri and Little Missouri rivers powers five major hydropower generating facilities owned by the federal government in North and South Dakota. Table 20 presents the average generating capacity and the cumulative electrical generation per acre-foot of water as it passes from Fort Peck Dam to the five federal facilities downstream.

There are varying concepts of how water in streams and reservoirs are most appropriately valued. The value of an acre-foot of water passing through the seven hydropower facilities in the entire Missouri River drainage would depend on the sale price of electricity.

According to the Western Area Power Administration (WAPA), the price of electricity ranges from 9.86 mils per kilowatt-hour (KWH) for "firm" power to 16.5 mils per KWH for "surplus" power (Shirk 1991). Based on the cumulative generation of electricity through the Missouri River mainstem dams (Table 20), the value of an acre-foot of water would range from $7.66 to $12.82.

Table 20. Kilowatt-hour (KWH) generation per acre-foot (AF) of water (median water or most probable runoff) of federal power generating facilities on the lower Missouri River.

Power Plant	Average Generation (KWH/AF)	Cumulative (KWH/AF)
Fort Peck	164	289
Garrison	148	437
Oahe	154	591
Big Bend	56	647
Fort Randall	95	742
Gavins Point	35	777

Source: Schirk (1991).

Although there are no hydroelectric facilities on the Missouri River in Montana below Fort Peck Dam or on the Little Missouri River, economic benefits of DFWP reservations accrue to downstream facilities in other states. Shirk (1991) estimated that a total of 7.4 billion KWH of electricity were generated by the federal facilities included in Table 20. When the price of electricity, as quoted by WAPA (Shirk 1991), is applied to the electrical production rates at those facilities, the total value of wholesale power produced ranges from $72,657,430 to $121,586,932 per year (7.4 billion KWH per year x 9.86 mils/KWH to 16.5 mils/KWH) (Table 21). These estimates are conservative.

Other power is produced by private facilities, which typically receive a much higher sale price for their electricity (Frantz 1991). For example, the Central Montana Electric Power Cooperative currently purchases firm power from federal hydro projects through WAPA for 9.28 mils/KWH, based on the weighted average of the composite yield from actual sales (Frantz 1991). The Cooperative also purchases coal-fired steam power from Montana Power Company (MPC) for about 41 mils/KWH. About 34% of the power purchased from MPC is hydro and about 45% is steam. The remaining 21% is power purchased from qualifying facilities. The Cooperative then sells a blend of hydro and steam power to consumers in the Missouri basin for 26 mils/KWH. If the supply of hydropower were to be reduced because of instream flow reductions, the replacement cost of the power from steam plants at current rates would be at least 4 times the cost of hydropower (41 mils/KWH divided by 9.28 mils/KWH). The overall price of electric power to these consumers is obviously held down by the availability of much cheaper hydropower (Frantz 1991).

Table 21. Wholesale value of firm and surplus power produced by the federal hydropower facilities on the lower Missouri River (in millions of dollars).

Facility	Firm	Surplus
Fort Peck	9.20	15.40
Garrison	17.68	29.59
Oahe	18.50	30.96
Big Bend	7.42	12.42
Fort Randall	13.66	22.86
Gavins Point	6.19	10.40

Source: Shirk (1991).

Instream flows requested in this application and those required for existing hydropower facilities in downstream states are mutually supportive. The reservations would preserve the electrical generating capacity of the hydropower plants on the Missouri River, which currently provide some of the most economical electrical power in the western states.

DFWP reservations in the lower and Little Missouri basins would also stabilize industrial waste treatment costs. Sufficient water volumes are necessary to dilute and assimilate wastewater discharges from existing facilities. The Montana Department of Health and Environmental Sciences (DHES) only grants discharge permits to waste treatment facilities where sufficient streamflows dilute the wastes. Each discharge permit specifies that receiving waters would be protected as long as streamflow does not fall below the 7-day, 10-year low flow limit for a given stream. (The 7-day, 10-year low flow is the lowest flow that would occur at a probability of once every 10 years for a consecutive

7-day period.) If the flow of the receiving water falls below this level, waste discharges would not necessarily be curtailed even though the biological integrity of the streams would no longer be preserved (Bahls 1988).

Instream flow reservations would help prevent streams which receive wastewater discharges from dropping below the low flow limit established to prevent water quality degradation and damage to aquatic ecosystems. If flows no longer provide adequate dilution and assimilation of wastewater discharges, damage to aquatic ecosystems could only be prevented by suspending the discharges. To prevent permitted facilities from discharging wastes during these periods could pose serious logistical and economic consequences. Either the treatment facilities would need to more rigorously treat various chemical compounds and organic materials in wastewater, or effluent would have to be disposed of some other way. Either alternative would be costly. Using instream flows to prevent damage to aquatic ecosystems would be more cost effective than upgrading waste treatment facilities or disposing of wastewater on land.

Municipalities would also benefit from stabilized waste treatment costs attributed to instream flow protection. Many municipalities in the lower and Little Missouri River basins possess wastewater discharge permits.

Lower Missouri River Basin

Of the 24 permits issued in the lower basin, 17 were issued to municipalities while only 7 were issued to industries. Table 22 summarizes all facilities permitted by the Montana Pollution Discharge Elimination System (MPDES).

Little Missouri River Basin

There are only four MPDES permits in the basin. Two are municipal and two are industrial (Table 23).

Table 22. Municipal and industrial permits in the lower Missouri River basin issued through the MPDES.

Permittee	County	Receiving Water	Expiration Date
Municipal Permits			
Chinook	Blaine	Milk River	04-30-94
Harlem	Blaine	Milk River	03-31-94
Harlem WTP[1]	Blaine	Milk River	05-31-92
Havre	Hill	Milk River	05-31-93
U.S. BIA	Hill	Box Elder Creek	03-31-94
Circle	McCone	Redwater River	11-30-93
Dodson	Phillips	Dodson Creek	05-31-93
Malta	Phillips	Milk River	01-31-94
Saco	Phillips	Beaver Creek	05-31-93
Brockton	Roosevelt	Missouri River	04-30-94
Poplar	Roosevelt	Missouri River	06-30-94
Wolf Point	Roosevelt	Missouri River	06-30-93
Fort Peck	Valley	Milk River	03-31-92
Glasgow WTP[1]	Valley	Milk River	03-31-92
Glasgow	Valley	Milk River	05-31-93
Hinsdale	Valley	Milk River	07-31-94
Valley Co. SID	Valley	Milk River	05-31-93
Industrial Permits			
Bear Paw Livestock	Blaine	Milk River	04-30-94
Charles Schwenke	Blaine	Milk River	06-30-94
Nash Bros. Feedlot	Daniels	Poplar River[2]	06-30-94
Robert Blankenship	Dawson	stock pond	05-31-93
Malta Ready Mix	Phillips	Milk River[3]	05-31-93
Valley Vu Feedlot	Richland	Missouri River[3]	06-30-94
Hinsdale Livestock	Valley	Milk River[2]	06-30-94

1 WTP refers to Waste Treatment Plant
2 Via unnamed drainage
3 Via irrigation ditch

Source: Water Quality Bureau, Montana Department of Health and Environmental Sciences, Helena, Montana, 1991. Computer list of MPDES permits.

Table 23. Municipal and industrial permits in the Little Missouri River basin issued through MPDES.

Permittee	County	Receiving Water	Expiration Date
Municipal Permits			
Ekalaka	Carter	Russell Creek	04-30-94
Wibaux	Wibaux	Beaver Creek	11-30-94
Industrial Permits			
American Colloid	Carter	Thompson, Willow, Sheldon Creeks	04-30-94
Darrell Johnson	Fallon	Little Beaver Creek	01-31-91

Source: Water Quality Bureau, Montana Department of Health and Environmental Sciences, Helena, Montana, 1991. Computer list of MPDES permits.

c. Agriculture

Current agricultural water right holders in both the lower and Little Missouri River basins would benefit from DFWP reservations because of increased legal and physical assurances about future delivery and supply of water for crops and livestock. The long-term stability that would be provided to these landowners has not been quantified economically. Yet, it would substantially influence property values and crop production rates. In addition, legal costs resulting from disputes between junior and senior water users may be avoided. In lieu of this, the discussion of these economic benefits is incorporated into the discussion about non-economic benefits of the reservation (II.B.), beginning on page 168.

B. Effects of the Reservation on the Environment, Public Health, Welfare, and Safety

1. An Overview of Indirect, Non-Economic Benefits

The scenic and recreational values of rivers are largely a function of their water quantity (instream flows), water quality, and riparian areas. As has been previously discussed, the DFWP reservations would help preserve these attributes, which are vital components of the lower and Little Missouri basins' natural environment. However, protection of the natural environment through adequate instream flows does far more than just preserve hydrologic conditions and biological abundance. It also benefits the **human environment** as well as the public's health, welfare, and safety.

The combination of exercise and relaxation that is part of fishing, floating, and other water-based recreation benefits physical health, while providing welcome relief from the mental stresses of everyday life. The sociological benefits of river recreation are also important. River outings provide opportunities for families and friends to socialize or meet new people in a relaxed and aesthetically pleasing setting. Sharing these pleasant experiences benefits and expands interpersonal relationships.

Many people float rivers only to fish, but others enjoy the cultural and historical aspects associated with flowing streams throughout the lower and Little Missouri basins. Retracing the journeys of early explorers like Lewis and Clark and others would certainly require adequate instream flows for present-day river navigators. Yet, just as importantly, these streamflows also help preserve the natural setting or viewing backdrop of river bottoms, which has other important cultural and historic implications.

In stories and songs--from Native American lore to the writings of today's authors and poets--rivers are never described merely as physical conduits where water runs downhill. Rather, it is the beauty or strength of rivers and/or the influence of rivers upon individuals and societies that resonate through human memory.

The rivers and streams of the lower and Little Missouri basins, therefore, not only provide ongoing recreational and health benefits, they are also vital and important linkages with our past. These flowing waters and the riparian vegetation that they nourish are as much a part of the historical, social and cultural environment of the basins as are any human-fabricated structures or devices. The DFWP instream flow reservations would, therefore, help protect irreplaceable components of the human environment.

In the sections which follow, other indirect non-economic benefits of the reservations to other water uses or parties are described. It is important to note that **there are no non-economic <u>costs</u> of the reservation to the environment, public health, welfare, or safety.**

2. Non-Economic Benefits to Other Users or Parties

a. Municipalities

The instream flows requested in the DFWP reservation application would continue to enhance the human environment for residents of municipalities in the lower and Little Missouri River basins. Adequate streamflows would help enhance the visual attributes of river bottom lands by keeping riparian plant communities healthy and viable and by providing habitat for wildlife and birds that residents enjoy observing.

The attractiveness of a stream is also closely tied to its water level. Discharge levels below those requested in this application would exacerbate the problems of dewatered channel reaches as well as decreases in total living space available for fish and other aquatic life. The reservations would help preserve both the volume and surface area of streams, thereby perpetuating sport fishing and, where presently conducted, river floating opportunities. These amenities are irreplaceable social, aesthetic and recreational benefits of the reservations to citizens of municipalities that border flowing streams. The opportunity to fish, float or swim, to observe wildlife, birds, or to simply enjoy the serenity of waters beneath the shade of cottonwoods in a city park, contribute immeasurably to the quality of life in these communities.

A major public health benefit of the DFWP reservations lies in protecting municipal water supplies. Many municipalities in the lower Missouri River basin utilize surface water or shallow, streamside aquifers as their drinking water sources. The reservations would help maintain stream discharge levels necessary to dilute the toxic effects of hazardous materials and microbial organisms entering these streams. Some herbicides and pesticides used by farmers, ranchers, weed districts and homeowners persist in the environment for a long time. Leaks, spills or improper application as well as improper storage and disposal of these chemicals contaminate surface and ground waters. Unless adequate dilution is available, concentrations of these substances in public water supplies may reach levels harmful to human health.

The benefit of maintaining streamflows to dilute toxic substances is illustrated by the occurrence of arsenic throughout the length of the Missouri River in Montana. High concentrations of this metal originate from geothermal sources in Yellowstone National Park and enter the Missouri River via the Madison River (Knapton and Horpestad 1987). Previous studies have shown that arsenic concentrations in the Madison and Missouri rivers were inversely related to the quantity of water contributed by their tributaries (Knapton and Brosten 1989).

Although arsenic concentrations are diluted with increased distance downstream from the source, concentrations in water discharged from Fort Peck still exceed state standards for ambient water. The average concentration for the last 1.5 years has been 4.0 micrograms per liter (ug/l), whereas state standards are 0.2 ug/l (Horpestad 1991). The Milk River and other tributaries provide some dilution. However, in 1983, 1984 and 1985, arsenic concentrations in the Missouri River near Culbertson still exceeded standards by an average of 1.98 ug/l (Horpestad 1991).

Glasgow and Culbertson obtain their municipal water from the lower Missouri River. Human health concerns exist because the allowable limit of arsenic in ambient water is 0.2 ug/l. At these elevated levels of exposure, there are concomitant increases in potential carcinogenic effects. DFWP reservations will help protect the quality of public water supplies for these communities.

Most of the municipalities in the lower Missouri River basin and all of the municipalities in the Little Missouri basin procure their water from ground water sources. As such, arsenic concentrations in surface waters are of no consequence. Though not directly affected by surface water quality, those communities would also benefit from a DFWP reservation. Many of their wells are in shallow, streamside alluvium where groundwater is recharged by surface waters. A reservation will help protect the integrity of these public water supplies.

b. Industry

Five federal hydroelectric dams in other states impound Missouri River waters below Fort Peck Dam: Garrison, Oahe, Big Bend, Fort Randall and Gavins Point.

Maintaining instream flows in the lower and Little Missouri rivers will benefit public welfare by assuring reliable water delivery for power generation at those downstream facilities.

Maintenance of instream flows in the lower and Little Missouri rivers would also help ensure full navigation seasons on the mainstem Missouri. As is the case with hydropower, benefits to the public welfare are derived from the assurance of water delivery for navigation in downstream states.

c. Agriculture

Regardless of the amount of water apportioned for instream flow reservations, existing water rights in the lower and Little Missouri River basins would at all times be honored. In fact, if DFWP's reservations are granted, existing water users in both basins would be further assured of future surface and groundwater availability. Reserved instream flows would help maintain water levels at existing headgates and would provide a legal buffer to any future water development plans by new water users. During low flow years, maintenance of existing streamflows could also help ease conflicts between junior and senior water users in the basin.

Instream flows recharge shallow, alluvial groundwater tables that adjoin rivers and streams. Maintenance of these vital groundwater systems provides additional benefits to agriculture.

The riparian vegetation supported by shallow groundwater (e.g. willows, cottonwoods, birch, aspen) all have extensive root systems that stabilize stream banks and channels. The soil stability provided by healthy, well-managed riparian areas not only prevents erosion, but healthy riparian areas also diminish potential flood damage to crops and farm buildings.

Finally, streamside aquifers are often utilized as water supplies for irrigation or domestic livestock. The reservations would help sustain existing water table levels, thereby protecting the availability and/or quantity of these shallow groundwater supplies.

C. Economic Opportunity Costs of the Reservations

1. Introduction

Agriculture is by far the largest offstream consumptive water user in Montana, accounting for approximately 97.6% (15.41 million acre-feet) of the total water diverted (Montana Department of Natural Resources and Conservation [DNRC] 1986). Twenty-two percent is consumed. In the Missouri basin in Montana, agriculture accounts for an even larger share of the water diverted by consumptive users--approximately 99% (7.99 million acre-feet). Of this diverted water, about 22% (1.76 million acre-feet) is actually consumed (DNRC 1986).

These percentages are comparable to the lower and Little Missouri River basins (DNRC 1986). In the lower basin, 99.7% of the water withdrawn from surface waters is for agricultural purposes (irrigation and livestock). Twenty-two percent is consumed. In the Little Missouri River basin, 99.9% of the water withdrawn from surface sources is devoted to agriculture and 51.0% is consumed. Surface water withdrawal for municipal and industrial uses is insignificant.

Groundwaters are typically sought for municipal and industrial uses. In the lower Missouri River basin, 62% of the water withdrawn for these two purposes is derived from below ground. In the Little Missouri River, the total is even higher at 98.8% (DNRC 1986).

The above calculations were made using estimates of water use during 1980 (for the counties of the lower and Little Missouri River basins) which were summarized in DNRC (1986). However, 1990 Federal Census Bureau figures indicate that county populations in the lower Missouri River basin declined an average of 12.1% over the last decade. Roosevelt County was the only county in the lower basin to show a population increase (5.1%). Nonetheless, growth in Roosevelt County occurred in rural areas; none of the larger communities posted population gains. County populations in the Little Missouri River basin declined an average of 17.8% (Montana Department of Commerce 1991). In light of the population declines, estimated water use in 1990 probably would not exceed estimated surface and groundwater uses during 1980.

Given the population declines in the counties of the lower and Little Missouri River basins, water demands for agricultural, municipal and industrial uses have likely decreased overall. Nonetheless, the following section discusses potential economic opportunities which could be lost if DFWP is granted the reservations requested in this application.

2. Economic Costs to Other Uses or Parties

a. Municipalities

Future water demands for municipalities are difficult to predict because of problems associated with growth projections. Also, uncertainties about the cost-effectiveness of future surface water supplies stem from water treatment requirements.

Giardiasis, an intestinal disorder, is spread by mammalian feces. During the past decade, its incidence has increased dramatically in surface waters of the Northern Rockies. Because of giardiasis and other water quality considerations, the 1986 Amendments to the Federal Safe Drinking Water Act require that all surface drinking water supplies be subjected to additional filtration by the early 1990s. Treatment costs for surface drinking water sources will inevitably increase. Therefore, the economic attractiveness of these sources for future drinking water supplies will decrease.

Presently, 13 municipalities in the lower and Little Missouri River basins are planning to supply more water for commercial, residential and industrial needs (Dolan 1991).

Lower Missouri River Basin

Eleven communities have submitted water reservation applications for additional water to meet future municipal needs. Table 24 summarizes these applications and the water source petitioned. Culbertson applied for a diversion of 200 acre-feet per year from the lower Missouri River to meet demand for municipal growth and rural distribution. Because this amount will increase water quantities requiring treatment, the community will have to increase the capacity of its treatment facility. This will require some financial investment. Hill County Water and Sewer District is seeking a small amount of water from the Milk River despite the basin closure.

Those communities seeking ground water sources to meet increased demands will not be affected by a DFWP reservation. All communities, except Circle, plan to meet increased water needs by drilling shallow, alluvial wells. In fact, water availability for these communities will only be enhanced by a surface water reservation which will help maintain the recharge of shallow aquifers. Because of surface water quality concerns, the town of Circle intends to drill a deep well rather than utilize the shallow Redwater River aquifer.

Table 24. Municipal water reservation requests in the lower Missouri River basin and the petitioned source (Dolan 1991).

Community	Source
Chinook	shallow well, Milk River alluvium; diversion, Milk River[1]
Circle	deep well, aquifer
Culbertson	diversion, Missouri River
Harlem	shallow well, Milk River alluvium; diversion, Milk River[1]
Havre[2]	shallow well, Milk River alluvium
Hill Co. Water District	diversion, Milk River
Malta	shallow well, Milk River alluvium
Plentywood	shallow well, Big Muddy Creek alluvium
Poplar	shallow well, Poplar and Missouri river alluvium
Scobey	shallow well, Poplar River
Wolf Point	shallow well, Missouri River alluvium

1 Applications request surface diversion of mainstem Milk River water during high flows. Water would be diverted to an offstream storage site.

2 Havre currently leases water stored in Fresno Reservoir from the U.S. Bureau of Reclamation. Its application seeks formal recognition of this water use through the reservation process.

Little Missouri River

Only two communities in the Little Missouri River basin require additional water to meet future municipal demands. Wibaux and Ekalaka both seek to develop deep wells in the Fox Hill aquifer. Wibaux also plans to drill a shallow well in the Beaver Creek alluvium to irrigate city parks. Granting of DFWP instream flow reservations would not conflict with the needs of either community.

b. Industry

Lower Missouri River Basin

Within the 10-state Missouri River basin, the largest industrial use of water is thermoelectric power generation. In 1978, 0.443 million acre-feet of water was diverted for the cooling water needs of coal-fired plants (O'Keefe et al. 1986). There are no existing thermoelectric plants in the basins included in this application.

However, other energy developments have been proposed. The Major Facility Siting Act of 1973 (Section 75-20-101 et seq. MCA) established a review protocol for proposals to construct and operate certain kinds of facilities for generating, converting or transmitting energy in Montana. The intent of the review process is to consider potential impacts on the environment, population distribution and public welfare. Before construction, the Board of Natural Resources must certify the public need for, and the environmental compatibility of, new facilities (McLane 1983). The legislation requires developers to submit, 10 years in advance, their long range plans outlining conceptual blueprints for development. In some cases, only two years prior notification are required. Pursuant to the Act, a number of plans for development were filed for areas included in the lower Missouri River basin:

1. Basin Electric Power Cooperative, in considering two coal-fired power plants, identified Circle, Montana as a preferred site. However, because of uncertain economics and revised energy-need assessments, no action on the project has occurred since 1983. Basin Electric has not yet filed for a water right permit.

2. Wesco Resources Inc. has been conducting feasibility studies of its proposed synthetic natural gas facility in McCone County. However, no action has been taken since at least 1983.

3. In 1974, Dreyer Bros., Inc. proposed a coal strip mine and a possible synthetic fuels plant (known as Circle West) in McCone County. Protracted decisions on water availability and the type of fuels to be produced have delayed the project indefinitely (McLane 1983). Furthermore, coal deposits in that area are of low quality (Golnar 1991).

4. Farmers Potash Company submitted long range plans to DNRC for the coal-burning facility of a proposed potassium chloride fertilizer project in Daniels County. Although applications for water from the Poplar River and Beaver Creek were filed in 1976, as of 1983, the economic feasibility of the project had not been determined.

Although these projects have all been brought to the attention of DNRC, none has been acted on in recent years (McLane 1991). Thus, no conflict for water use is anticipated. No other proposals have been submitted more recently than those outlined above. It would be at least five to six years before a proper review could be conducted and any serious attempt at development undertaken (Hart 1991).

Although oil and gas development is not subject to the Major Facility Siting Act, it is also tracked by DNRC. Of all the oil and natural gas wells drilled in Montana during 1989, 48.0% were drilled in counties of the lower Missouri River basin (DNRC 1990a). Drilling operations require water (Halvorson 1991). However, little use of surface waters from major rivers or perennial tributaries occurs. All water used during drilling is derived from farm or ranch ponds and wells. In some cases, river water may be purchased from existing water right holders. Total water use during 1989 was 47.7 acre-feet for drilling operations in the counties of interest (Halvorson 1991). Halvorson (1991) estimated that 0-5% may have come from surface sources. Therefore, a maximum of 2.4 acre-feet would have been taken from surface waters. If economies change and oil and gas activity increases to levels comparable to 1981, surface water use may reach 11 acre-feet per year. However, current uses may be significantly lower, perhaps even zero (Halvorson 1991).

Mining and the processing of mined products are important industries in the upper and middle Missouri River basins. However, in the lower basin, there is only one active hard rock mine operation. The Zortman-Landusky mine in Phillips County produces an average of 50,000 tons of ore per day (Webster 1991). Cyanide leach processing requires 500 gallons of water per minute at the Zortman site and 200 gallons per minute at the Landusky site. Both sites utilize ground water. Pegasus Gold Inc. recently identified the Beaver Creek drainage in the Little Rockies as a potential site for expansion of their operation. This future expansion is of interest because DFWP seeks a water reservation for Beaver Creek in this application. Current operation plans indicate that all ore extracted from this drainage would be processed at existing facilities, rather than at a newly constructed facility in the Beaver Creek drainage. As such, Pegasus has applied for a 95 gallons per minute water use permit at the Zortman site. The application is still pending.

Gravel and sand extraction are the most prominent forms of mining in the lower basin. The Department of State Lands currently permits 373 operations in the counties of the lower basin. Actual extraction procedures do not require water (Burke 1991). Extracted material is usually taken to a separate site for processing. Secondary processing may include rinsing to remove fine sediments. Companies typically secure a water source in such a way that a DFWP reservation would not interfere with their use. However, water may be required for dust abatement during certain projects such as highway and road construction. Contractors usually procure the needed water by making arrangements with existing water right holders. Sources include stock ponds, municipal fire hydrants and irrigation ditches. These construction projects are temporary uses and the water quantities used are small (Burke 1991).

DFWP reservations in the lower Missouri River basin would not impact existing or future energy developments and mining operations if groundwater sources would adequately meet the needs. However, future energy development and mining could be affected if surface waters are required. Given the low quality of coal in the basin, the small amount of water required for drilling of oil and natural gas, the limited hard rock mining potential in the basin, and the extremely small amount of water used during gravel/sand extraction operations, a DFWP reservation would not significantly impair future energy and mining activities in the lower basin. Furthermore, the purchase of existing water rights and a change in beneficial use is a possible way of satisfying future industrial water needs. Also, future surface water needed for new mines and other operations would be less restricted if water storage facilities were utilized.

Little Missouri River Basin

Although there are no thermoelectric facilities in the Little Missouri basin, one facility has fallen under the Major Facility Siting Act requirements. Tenneco Coal Gasification Company, in proposing a coal gasification plant, identified the preferred site as approximately 5 miles southeast of the town of Wibaux. The synthetic fuel plant would require about 10,000 acre-feet of water per year. Interbasin transfer of water from the Yellowstone to the Little Missouri has been a long-standing question. In addition, the company applied for a water use permit for 6,800 acre-feet per year on Beaver Creek, a stream included in this application. In deciding whether to proceed with construction, Tenneco was evaluating its Great Plains Gasification Plant in North Dakota, the first plant of its kind in the nation. Delays in resolving the question of interbasin transfer of water and in securing funding for the project have delayed the start-up date since 1983 (McLane 1983). Furthermore, there has been no recent change in status (McLane 1991). No other proposals have been brought to the attention of DNRC and no water use conflicts with the DFWP reservations are expected.

Oil and gas activity in the Little Missouri basin is limited. Only 2.1% of oil and natural gas wells drilled in 1989 were drilled in Carter, Fallon and Wibaux Counties (DNRC 1990a). As the previous discussion indicated, drilling requires water. The total amount of water used in 1989 was 3.22 acre-feet. Again, assuming that 0-5% may come from surface waters, the maximum amount used may have been 0.16 acre-feet (Halvorson 1991). If oil and gas activity increases to 1981 levels, the maximum could be 1.74 acre-feet. Total amount of surface water use was probably significantly less and may approach zero (Halvorson 1991).

Mining and the processing of mined products are also limited in the Little Missouri basin. No hard rock mining permits have been issued in this area. However, there are 117 permitted gravel and sand mining operations (Burke 1991). The above discussion concerning water uses during gravel mining also applies in this basin. Water use during extraction is negligible, but highway projects may require small amounts of water for dust abatement.

DFWP reservations in the Little Missouri basin would not impact existing or future energy developments if ground water sources would adequately meet the needs. Future development may be affected if surface waters are necessary. However, given the limited potential for hard rock mining development, that little water is required for oil and gas operations, and that gravel/sand extraction doesn't require water, a DFWP reservation would not impair those future activities in this basin.

c. Agriculture

Lower Missouri River Basin

In the lower basin, revenues from agriculture contribute to local economies. Livestock revenues have exceeded crop production revenues since at least 1983. In addition, livestock receipts account for 25% of the state total whereas crop receipts only account for 12%. Relative to revenues earned in the upper and middle Missouri basins (discussed in a previous DFWP application), these values in the lower Missouri River are small. Table 25 summarizes agriculture receipts in the lower basin.

Irrigated land in the lower Missouri River basin comprises about 12.3% of all irrigated land in the state (Table 26). Non-irrigated land in the basin makes up 34.8% of all dryland agriculture within the state (Table 26). The amount of land irrigated in the lower basin is approximately half of the amount irrigated in the upper (24%) and middle basins (25%). Although the amount of dryland farming in the lower basin exceeds the 2.4% in the upper basin, the middle basin has the greatest amount of dryland agriculture in the entire Missouri River basin (40%) (DFWP 1989).

Instream water reservations would not affect existing agricultural uses in the basin, nor would they necessarily preclude development of additional irrigation through the use of groundwater or water stored in offstream reservoirs. A DFWP reservation could limit future expansion of irrigation, but only if new surface water sources are needed. When this application was prepared, only three conservation districts in the lower Missouri River basin had submitted reservation applications for agricultural development (Dolan 1991). The Sheridan County district is requesting groundwater sources from an ancient Missouri River channel. Roosevelt and McCone County districts are both requesting a surface diversion from the Missouri River for development of river bottoms for agricultural production. The Roosevelt County district is petitioning for 73,115 acre-feet (per year) of water to irrigate 24,879 acres. The McCone district submitted a request for 35,000 acre-feet of water from the Missouri River to irrigate an additional 13,294 acres.

This acreage represents an 18% increase in the irrigated land base within the lower basin. Despite this large increase, it would only boost the amount of irrigated land in the lower basin from 12.3% to 14.6% of the state total. That represents a 2.3% increase over the percent of the state total reported in Table 26. The Richland and Valley county districts both plan to submit applications similar to the Roosevelt and McCone districts. As yet, final acreage and water estimates have not been determined (Dolan 1991). Blaine, Daniels and Dawson county districts also intend to submit applications for surface water diversions from a number of other streams included in this application. These diversions would be for small projects (Dolan 1991). Final plans and estimates of acreage and water amounts were also not available at the time this application was prepared.

Little Missouri River Basin

In the Little Missouri River basin, average livestock receipts far exceed crop production receipts (Table 27). Furthermore, relative to activity in the rest of the state, livestock and crop receipts contribute only modest amounts to the state's total agricultural revenue.

Most agricultural land in the Little Missouri River basin is non-irrigated (Table 28). Irrigated land in this basin contributes only 0.8% to the state total of irrigated land base while non-irrigated land contributes only 3.8%.

As discussed above, DFWP water reservations would not affect existing agricultural uses, nor would they necessarily preclude development of additional irrigation through the use of ground water or water stored in offstream reservoirs. A reservation could limit further agricultural development if surface water sources are necessary. In the Little Missouri River basin, there has been some interest in water development for agricultural uses. Wibaux, Carter and Fallon conservation districts have considered future irrigation projects requiring surface diversions from streams included in this application. However, no plans or water requirements had been finalized and submitted to DNRC when this application was prepared.

Table 25. Livestock and crop cash receipts and six year average (AVG) receipts in the lower Missouri River basin[1] (thousands of dollars).

Year	Livestock Receipts	State Total	% State Total	Crop Receipts	State Total	% State Total
1983	91,489	778,168	11.8	217,239	830,158	26.2
1984	96,670	822,056	11.8	156,360	651,675	24.0
1985	103,026	902,860	11.4	108,522	427,853	25.4
1986	83,615	757,090	11.0	126,244	471,769	26.8
1987	99,266	868,588	11.4	162,305	608,063	26.7
1988	109,921	955,415	11.5	115,215	569,853	20.2
AVG:	97,331	847,358	11.5	147,648	593,229	24.9

[1] Includes Blaine, Daniels, Dawson, Hill, McCone, Phillips, Richland, Roosevelt and Valley counties.

Source: Montana Crop and Livestock Reporting Service.

Table 26. Acres of irrigated and non-irrigated land and seven year average (AVG) in the lower Missouri River basin[1].

Year	Irrigated	State Total	% State Total	Non-irrigated	State Total	% State Total
1983	180,880	1,538,900	11.8	2,464,500	7,151,400	34.5
1984	205,440	1,805,600	11.3	2,406,200	7,377,400	32.6
1985	198,720	1,635,200	12.1	2,153,300	5,977,500	36.0
1986	195,820	1,601,000	12.2	2,725,000	7,814,200	34.9
1987	207,310	1,618,500	12.8	2,662,400	7,623,000	34.9
1988	194,060	1,648,100	11.8	1,932,300	5,469,500	35.3
1989	291,650	2,073,300	14.1	2,725,000	7,687,500	35.4
AVG:	210,554	1,702,942	12.3	2,438,385	7,014,357	34.8

[1] Includes Blaine, Daniels, Dawson, Hill, McCone, Phillips, Richland, Roosevelt and Valley counties.

Source: Montana Crop and Livestock Reporting Service.

Table 27. Livestock and crop cash receipts and six year average (AVG) receipts in the Little Missouri River basin[1] (thousands of dollars).

Year	Livestock Receipts	State Total	% State Total	Crop Receipts	State Total	% State Total
1983	25,604	778,168	3.3	13,529	830,158	1.6
1984	27,468	822,056	3.3	14,634	651,675	2.2
1985	32,211	902,860	3.6	10,598	427,853	2.5
1986	28,780	757,090	3.8	6,523	471,769	1.4
1987	32,555	868,588	3.7	10,519	608,063	1.7
1988	34,983	955,415	3.6	3,770	569,853	0.7
AVG:	30,267	847,357	3.6	9,929	593,229	1.7

[1] Includes: Carter, Fallon and Wibaux counties.

Source: Montana Crop and Livestock Reporting Service.

Table 28. Acres of irrigated and non-irrigated land and seven year average (AVG) in the Little Missouri River basin[1].

Year	Irrigated	State Total	% State Total	Non-irrigated	State Total	% State Total
1983	12,400	1,538,900	0.8	264,500	7,151,400	3.7
1984	12,100	1,805,600	0.7	309,600	7,377,400	4.2
1985	12,600	1,635,200	0.8	244,800	5,977,500	4.1
1986	16,000	1,601,000	1.0	340,500	7,814,200	4.4
1987	17,850	1,618,500	1.1	307,300	7,623,000	4.0
1988	11,500	1,648,100	0.7	127,100	5,469,500	2.3
1989	17,500	2,073,300	0.8	296,600	7,687,500	3.9
AVG:	14,279	1,702,942	0.8	270,057	7,014,357	3.8

[1] Includes Carter, Fallon and Wibaux counties.

Source: Montana Crop and Livestock Reporting Service.

III. Effects of Not Granting the Reservations

A. Loss of Irretrievable Resources and Economic Opportunity

Not granting the DFWP reservations would cause irreplaceable losses to the widespread benefits associated with the protection of adequate instream flows in the lower and Little Missouri River basins. Incremental streamflow depletions would continue to reduce critical components of the natural environment, including fish, wildlife, riparian areas and water quality. This, in turn, would reduce the recreational activities supported by these resources, including fishing, floating, hunting and sight-seeing. The human environment would be similarly impacted through loss of scenic values and diminution of the basins' cultural, historical and social environments.

Not granting the DFWP reservations would preclude a unique opportunity to support and protect, collectively, the public interest, the environment and business interests. Denial of the reservations would be particularly incongruous at a time when the newly established "bed-tax" is beginning to fund multi-million dollar, nationwide advertising campaigns for recreation and service sector businesses. Future increases in the warmwater angling industry will directly benefit communities in the lower and Little Missouri River basins. If instream flows are not protected now and the water is used for other purposes, then the future potential of this industry will not be realized. This would constitute a significant lost opportunity because the warmwater fishing industry in Montana is just beginning to develop.

Without instream flow protection, other significant benefits to municipalities, agriculture and industry would also be diminished. New consumptive uses of water would continue to reduce downstream water availability. The recharge of streamside aquifers, the assimilative capacity of streams and the viability of riparian ecosystems and sub-irrigated croplands would be diminished. Industrial and municipal waste treatment costs could increase. The potential for contamination of public drinking water supplies by hazardous chemicals would become more likely. Water disputes between consumptive users could worsen as water availability at headgates declines. The effects of not granting the reservation would, therefore, be cumulative, and in many cases irretrievable, to a broad spectrum of resources and water users in the lower and Little Missouri basins.

B. Alternative Actions that Could be Taken if the Reservations are not Granted

1. No Action

A no-action alternative regarding water reservations in the lower and Little Missouri River basins would result in the same costs to recreation, fish and wildlife, economics, aesthetic qualities and other public amenities that were just described in the "Effects of not Granting the Reservation" section. Other alternative actions that could reasonably be taken to protect these amenities and economic assets are described below. With the possible exception of Alternative 2, (intensification of water conservation and management practices) these alternatives either are more costly, would be less immediate, lack legislative mandates or would be more limited in applicability than would granting the DFWP reservations as requested in this application.

2. Intensification of Water Conservation and Management Practices

Examples of water conservation practices include better maintenance and lining of ditches, converting irrigation projects from flood to sprinkler systems, limiting the use of sprinklers during windy periods, and diverting only the amount of water actually needed for adequate crop production. The latter involves installation and/or better management of water diversion and delivery systems, including efficient operation and use of headgates and flumes to accurately measure water delivered to users; better information and education about water needs for specific crops throughout the basin's widely varying soils, climatic and topographic conditions; better irrigation scheduling; and increased utilization of water commissioners. If the state was to offer to pay for the infrastructure necessary to improve efficiency in agricultural water use which, in turn, would reduce offstream diversion rates, then instream flows would theoretically increase.

Proper water conservation and management practices not only enhance water efficiency, they also reduce soil erosion by preventing overland (sheet) runoff from croplands and minimizing volumes of silt-laden irrigation direct return flows. As such, application of the above measures should be encouraged regardless of any other legal directions elected during the reservation process.

Although worthwhile and necessary, good water conservation and management practices do not represent a viable alternative to reserving instream flows. In many instances, any water salvaged, and thus left instream, may simply be diverted by other offstream users. Under recent law (SB 265, 1991 session), a water right holder is now able to retain the right to the salvaged water for beneficial use or to sell or lease the salvaged water. Salvaged water leased for instream flows would benefit fisheries, but has certain limitations as described below.

3. Buying or Transferring Water Rights

It is uncertain whether DFWP or any other state agency may acquire instream water rights, other than through leasing or a water reservation, for the purpose of maintaining a minimum flow, level or quality of water. It is possible that DFWP could acquire a water right through the transfer of existing rights to instream uses. The existing rights would be obtained through purchase or donation and transferred to instream uses through the administrative change process. However, a recent Montana Supreme Court opinion denied a claim by DFWP for a pre-1973 existing right for instream or inlake purposes. The Court held that a pre-1973 instream or inlake right did not exist because there was no diversion, notice or intent. Whether or not a diversion is a requirement for fish, wildlife and recreational purposes after the enactment of the 1973 Water Use Act is an open question which would undoubtedly require litigation to resolve.

4. Leasing Water Rights

The legislature can, and has, acted on transfers to instream purposes in passing House Bill 707 (Chapter 658, Laws of 1989). This act created a water leasing study, potentially leading to pilot leases. Leasing of existing rights for instream use may evolve as a useful tool. Section 85-2-436(2), MCA states that, for purposes of the water leasing study, water leasing is the exclusive means by which DFWP may seek to change an appropriation right to an instream flow purpose. However, it is important to recognize both the potential benefits and limitations of this concept.

The following examples illustrate potential applications of DFWP's ability to lease water rights.

A stream where present water users would be willing to lease their consumptive rights as part of a water conservation program is the first example. Specifically, water users would receive annual lease payments and farm their lands as usual. In accordance with lease agreements, water salvaged through conservation measures would be left instream. The annual lease payments would provide compensation to landowners for becoming more efficient while they continue to irrigate the same amount of land.

A second example is where water users would lease a diverted water right for instream purposes in low flow years and, therefore, would farm their lands as usual except in low flow years. Then, in those low water years, the normally diverted water would be left instream. The lease payments would provide compensation to landowners for any irrigated crop losses suffered during low flow years. During the term of the lease, crop losses could also be reduced if the landowners planted non-irrigated crops following years when snowpack is low enough to curtail normal irrigation practices.

A third example used where a stream is chronically dewatered is to lease a water right every year during the irrigation season to maintain fishery flows which would otherwise not occur. Lease payments would reflect the loss in crop revenues from the irrigated land.

The leasing of water is not a viable, basin-wide approach for enhancing instream flows. The administration and logistics of this program are exceedingly complex and the costs could be high. This alternative probably is best applied in small drainages that are severely dewatered and where present offstream users are willing to lease their rights. DFWP's experience with implementing HB707 since its passage in 1989 has illustrated the limitations of leasing for enhancing instream flows. In contrast, the reservation process provides an opportunity to protect instream values when <u>future</u> consumptive uses are considered. The reservation system cannot deal with present water shortages but can protect against exacerbating these shortages.

5. Constructing Offstream Water Storage Facilities

The construction of dams that would store runoff waters and release them during the summer is an often overrated alternative for enhancing instream flows. Construction, operation and maintenance costs are usually prohibitive and there is considerable uncertainty about agreed-upon releases ever reaching critical downstream reaches. The water release arrangement for Painted Rocks Reservoir is an example.

Located on the West Fork of the Bitterroot River, this state-owned facility was originally constructed for irrigation use. Since part of this use has never materialized, DFWP has routinely purchased water to be delivered to Bell Crossing on the Bitterroot River near Stevensville, relieving a chronically dewatered downstream reach of the river. However, until a water commissioner was appointed by the court in the mid-1980s, most of this purchased water was diverted for offstream use before reaching Bell Crossing.

In addition to cost, the hydrogeology of the drainage considered for a reservoir site must be considered before the project can be built. Constructed storage facilities must be able to provide the instream benefits attributed to the project. Therefore, the availability of suitable storage sites is a major factor in any analysis of the instream flow benefits of storage. The case of the proposed irrigation/recreation reservoir on the Little Boulder River illustrates this point. During the environmental analysis of this proposal, it was found that the thick unconsolidated gravels of the Boulder Valley cause the river to be a "losing stream" (i.e. in most reaches it loses more surface water than it normally receives as recharge during summer low-flow conditions). Much of the water released from this proposed reservoir would have, therefore, recharged the valley's groundwater instead of augmenting instream flows (Reichmuth 1984). Similar hydrogeologic conditions may occur in the lower and Little Missouri River basins.

Reservoirs often have environmental repercussions, including:

1. Detrimental effects to downstream fisheries resulting from altered temperatures of stored waters;

2. detrimental effects to stability and diversity of stream channels and riparian areas because of reduced frequencies of flushing flows;

3. increased depletion of surface water because of increased evaporation rates; and

4. concentration of dissolved solids (salinity) and other contaminants like nutrients and pesticides within reservoirs due to surface evaporation.

Another factor which may limit the construction of new storage project is the budget priority for allocation of state water storage development funds contained in SB 313, 1991 session. Planning and construction of new storage facilities is the last priority -- preceded by the need to solve high hazard dam problems and improve and expand existing storage facilities.

Water storage may be a feasible means to obtain instream flows in certain cases, but due to considerations of cost, site suitability and environmental effects, it cannot be considered a substitute for acquisition of instream flows through the reservation process.

6. Revising the Process for Evaluating Water Right Permit Applications

For water applications or transfer of water rights exceeding 5.5 cfs and 4,000 acre-feet per year, MCA 85-2-311 (3) (c) requires that certain "public interest" and "reasonable use" criteria be met before approval to divert the water is granted. Criteria to be evaluated include demands on future water supply; needs to preserve instream flows; benefits to the applicant and the site; effects on water quality which include the potential for creating saline seep; the feasibility of using other (low-quality) water; and consideration of other adverse environmental impacts.

Although the above prerequisites for issuing such water use permits would certainly help protect instream flows from large offstream diversions, it does not represent a widely applicable alternative to the water reservation process. Applications for water use large enough to trigger the above criteria are very uncommon. In fact, of the 8,321 surface water use permits issued by DNRC since July 1973, 81% have been for quantities less than 1.0 cfs. Only 39 permits (0.5%) could have triggered the public interest criteria (DNRC 1991).

Also, 487 permits (5.8%) were issued which were 5.5 cfs or more, but they did not meet the 4,000 acre-feet volume requirement. Thus, use of the public interest criteria was not required.

To be an effective component of an instream protection strategy, the evaluation of water use permits must, therefore, be revised to include the review of much smaller requests. The public interest/reasonable use criteria should be triggered by the potential effects of a new permit upon a given stream's available flow and upon the cumulative basin-wide impacts of all existing water appropriations rather than by an arbitrary flow/volume amount. Unfortunately, there are few streams in the state that have enough stream gauging data to document existing available flows. Nor have enough streams been adjudicated, which makes documentation of existing use extremely difficult.

Finally, even if evaluation of permit application were to be revised to incorporate some smaller "triggering criteria", this alterative should only be considered as a supplement to the protection of instream flows through water reservations. Unless these criteria were applied to <u>every</u> water use application in the lower and Little Missouri River basins (an unlikely situation in the foreseeable future), many "small" water use permits (i.e. those still not surpassing the revised criteria) could continue to be granted without adequate consideration of immediate and cumulative effects on fish and wildlife resources. Furthermore, the state's policy decision of how much instream water to reserve for the future is a function of the reservation process that is not addressed systematically, if at all, in the water permitting process.

7. Closing Basins

Montana water law (MCA 85-2-319) states that DNRC "may, by rule, reject permit applications or modify or condition permits issued in a highly appropriated basin or sub-basin", but "only upon a petition signed by at least 25% or 10, whichever is less" of present water users in the basin or sub-basin. The petition must allege that, throughout or during certain times of the year, there are no unappropriated waters in the basin, the rights of present users will be adversely affected, or further uses will interfere unreasonably with other already permitted uses or uses for which water has been reserved. Upon receiving a petition, DNRC must either deny it, or if needed, conduct a water availability study and initiate rule-making proceedings.

A petition to close the Musselshell River Basin has been submitted to DNRC by the Deadman's Basin Water Users Association. A water availability study is being conducted and a predictive model is being developed to better examine the concerns raised in the petition and to determine if rule-making proceedings will be necessary.

On March 30, 1983, DNRC closed the Milk River mainstem to any further applications "for direct diversion without storage of waters . . . for irrigation or any other consumptive use." The department acted to close the river (except for some reaches during runoff periods), pursuant to MCA 85-2-321, a legislatively-mandated water availability study and rule-making procedure directed specifically at the Milk River Basin (DNRC 1983).

The Rock Creek basin (tributary to the Clarks Fork of the Yellowstone River) was closed on February 9, 1990 from June 1 - September 30 of each year, following a petition to DNRC by concerned water users who claimed that no unappropriated water was available during the irrigation season (DNRC 1990b). The water availability study conducted by DNRC to confirm water availability took into account the DFWP instream flow reservation on Rock Creek granted by the Board of Natural Resources and Conservation on December 15, 1978.

The basin closure proceedings occurred because of concerns raised by existing <u>offstream</u> water users in already "highly appropriated" basins. There is no opportunity in Montana water law for the general public or state agencies to initiate action to close basins because of instream flow concerns. If such an opportunity existed, perhaps the over-appropriated conditions in the above basins could have been prevented. Under current law, by the time closures are initiated and administratively implemented, there may be no water available for instream flow needs. In fact, by definition, the process is implemented only after water is no longer available for instream uses. As such, this procedure is not a viable alternative to the timely implementation of instream flow reservations.

8. Application of the Public Trust Doctrine

The Montana Supreme Court applied the public trust doctrine in two 1984 decisions involving the public's right to use water courses for recreational pursuits such as fishing and floating. The Court held that "under the public trust doctrine and the 1972 Montana Constitution, any surface waters that are capable of recreational use may be so used by the public without regard to streambed ownership or navigability for non-recreational purposes" [Montana Coalition for Stream Access v. Curran, 210 Mt. 38, 53, 682 p.2d, 163 (1984)]. To implement these decisions, the 1985 Montana Legislature passed the Stream Access Law. The Montana Supreme Court has found the public trust doctrine embodied in the provision in Article IX, Section 3(3) of the 1972 Montana Constitution specifying that all waters of the state "are the property of the state for the use of its people" [Galt v. State of Montana, 731 p. 2d 912, 44 St. Rep. 103, 106 (1987)]. In this case, the Court generally rejected arguments by landowners that the Stream Access Law was an unconstitutional taking of private property without just compensation by upholding the majority of the statute. The Court has not addressed whether the public trust doctrine applies to established water rights and would thus require recognition of instream values in the exercise of those rights.

The limits to, and effectiveness of, the public trust doctrine for protecting instream flows in Montana remains largely untested, As an absolute protection strategy, it should probably be considered only as an alternative of last resort. Hopefully, the spirit and intent of the doctrine will guide and direct the final decision for an adequate amount of instream flow protection for fish, wildlife, and recreation in the lower and Little Missouri River basins through the water reservation process.

MANAGEMENT PLAN

ARM 36.16.106(2) states "A management plan shall accompany all reservation applications for instream uses(s), as defined in ARM 36.16.102(14), and shall include an explanation of how reserved instream flows will be protected from future depletions by later priority date water users."

The following addresses that requirement.

Monitoring Instream Water Reservations

Implementation of a reservation monitoring/protection program will be an evolving process. A water reservation granted by the Board, by law, cannot affect any existing water users. In the lower Missouri River basin, the priority date of all reservations has been established by the Legislature as July 1, 1985. In the Little Missouri River basin, the established priority date is July 1, 1989. Only subsequent (junior) water use permit holders will be affected by DFWP's reservations. Existing rights are not affected and only the status quo of streamflow conditions at the time the reservations are granted is maintained. Because our requests would allow some new future depletions, the status quo is the "best" condition that can be maintained. If new depletions do occur, future streamflows could be less than existing flows during some time periods.

The basis for our protection program is what we call the "Reach Concept." Stream reaches for waters in this application extend from upstream to downstream boundaries as identified in the individual stream write-ups. A reach, as defined by DFWP, merely serves as a means to identify those junior water users who will be subject to the instream reservation, which is intended to be monitored at a site near the reach's downstream boundary. A reach does not represent a stream segment having the same flow regime and instream flow requirement throughout its length.

There is one potential problem with DFWP's reach concept. If all upstream junior users are keying to a flow level at the lower end of the reach, the potential exists for a single, large, new consumptive user in the headwaters to severely dewater an upper stream segment without materially impacting flow in the lower reach where the instream flow is monitored and protected. Whether or not this shortcoming poses a real threat to future streamflows is yet to be seen.

From a practical standpoint, the protection of water reservations is key to any instream flow program, and monitoring of those flows is the key to protection. It makes little difference whether a granted flow is for a short reach or a long reach of stream. A monitoring site which can be used to trigger the protective procedures (placing a "call" on the water) must be established. Placing a "call" only on junior users above a monitoring site will affect actual streamflow within the reach proportionally, depending on the location and the amount of their appropriations. It makes no difference whether there is more than one reach or what length the reach is; the junior users are the only ones affected by DFWP's reservations.

Once the reservations in the lower and Little Missouri basins are granted, mainstem river segments will initially be monitored using established USGS gauges. Tributaries having existing gauges will be similarly handled. We will also look at the necessity of installing new gauges. For tributary streams and reaches without gauges, we would initially monitor flows at the nearest downstream gauge. Junior users in tributary streams above the respective gauge could potentially be notified if the granted flows are not being met at that gauge. As the number of junior users on ungauged reaches increases and the total effects of those new diversions become more significant, our monitoring program will be expanded.

The reservations will not increase water availability; they will, at best, only preserve an existing flow condition. As previously mentioned, this existing condition begins on the date the reservations' priority is established. We affect water availability for only those users who are issued subsequent (junior) permits, whereas senior water users are unaffected. We protect streamflows at whatever level occurs after all senior users have exercised their rights and after junior users have further reduced flows to the granted amounts of the instream reservation. In those cases where senior users are already capable of depleting flows below the granted amounts of the instream reservations, little water will be available for junior users.

Placing a "Call" on the Water

DFWP is in the best position to determine the extent of a monitoring/enforcement program for granted instream reservations. We will proceed in a manner similar to what has evolved in the Yellowstone Basin and with our "Murphy Rights."

The first step is to monitor new applications for water use permits which will be junior to the reservations. DFWP notifies each applicant, either through a letter or the objection process, that an instream flow reservation exists in the supply source and that, at some future time, he/she may be asked to cease water use because of low stream flows. DNRC conditions all junior water use permits to water rights in existence at the time the permit is issued. In most cases where DFWP objects, the permit is also specifically conditioned to senior DFWP instream flow reservations.

In some cases where granting the requested permit would significantly impact our reservations, we object and request the permit be denied.

If a drought or low flow year is eminent, DFWP obtains from DNRC a current listing of all water users who are junior to the reservations. An initial letter is sent to them in June advising them of flow conditions and informing them that they might be subject to a "call" on their junior water. If flow conditions deteriorate and fall below the reservations, DFWP sends a second letter to notify junior users that they must cease their diversions until flows again rise above the reservations. A stream gauge is assigned to them so they can monitor flow levels, and they are given phone numbers of DFWP and the closest DNRC Water Rights Field Office so they can readily obtain up-to-date flow information.

Shutting off junior users will not always increase flow levels in a drought year and flows may remain below the reservations for the entire irrigation season. DFWP realizes its reservations cannot always be met under drought conditions (as we experienced in 1988).

To date, when DFWP has called for its water, it has relied on voluntary compliance by junior users. A more efficient system must eventually be developed which will ensure junior user compliance. The use of water commissioners may be a means to accomplish this. Also, DNRC has authority to enforce compliance by junior permit holders and we have relied on this process to obtain compliance by junior users who had not heeded our written call for the water.

Finally, DFWP is responsible for protecting reservations once they are granted. How, when, and where this is done depends on several factors:

1. Need. How many junior water users are there to protect against?

2. DFWP Funds Available. Funding levels may vary. Our ability to contract with USGS for gauging stations will depend upon the annual availability of these funds.

3. USGS Funds Available. Federal funding levels (USGS matching money) are often uncertain due to budget reduction efforts by the federal government. Our ability to contract with USGS will also depend on its level of funding.

A broader base of funding at the state level would enable a stronger gauging network to be established in the long term and would provide benefits to all Montana water users.

Stream Gauging Costs

There are a number of ways to obtain stream gauging data, ranging from observations of a simple staff gauge to the more sophisticated satellite stations which make "real time" flow data available.

One of the requirements of any flow monitoring program used to protect instream water rights is to have flow data available when it is needed, usually on a daily basis. This is necessary so that junior water users can be kept informed of their water use possibilities. To meet these needs, DFWP has utilized staff gauges which are read daily by observers who then report the flow levels by telephone. Also, "real time" stations have been established by the USGS and National Weather Service at a number of gauging stations in Montana. DFWP has access to this information through the Helena office of the USGS. Whatever system is used, access to the data when needed is important. (There are many other existing USGS gauge stations in Montana which cannot be as readily accessed.)

Another consideration when establishing a monitoring program is the expense of obtaining the needed flow data. If new gauging stations have to be established or existing stations moved to a more desirable location, the type of stations needed and their associated costs must be considered.

The following is a discussion of the approximate costs of installation and operation of various types of stream gauging equipment. These include:

(1) staff gauges or wire weight gauges;
(2) continuous streamflow gauging station with a yearly published record; and
(3) "real time" stations.

These costs are approximate (as of 1991) and may need revision at the time a gauging program is actually implemented.

Staff gauge/wire weight gauge - This is the lowest level and least expensive means of obtaining streamflow data. A staff gauge or wire weight gauge is installed at a suitable stream site. A number of streamflows are measured at the site at different flow levels to develop a rating curve of streamflow vs. stage (water level). Once a suitable rating curve is established for the site, an observer (usually a local inhabitant) reads the elevation of the water level on the staff gauge or from the wire weight gauge and reports the information by telephone on a daily basis to DFWP.

The cost of installation of a staff gauge is about $200 if done by DFWP. Operation cost is approximately $500 per year depending upon the availability of observers and their distance from the gauge site. This type of installation is usually operated for only 2-3 months each year during the irrigation season. The USGS charges $800 to install a staff gauge and $6,800 for a full year of operation.

A wire-weight gauge costs approximately $1,500 to install by the USGS. Annual operation cost is the same as for a staff gauge.

<u>Continuous Streamflow Station with Published Record</u> - This level of gauging requires the installation of a continuous recording instrument within a permanent housing facility at the stream site. A staff gauge or wire weight gauge is also installed. A number of streamflow measurements are made at different levels of flow to establish a rating curve for the station and, again, a stage/ discharge rating curve is established for the station. Once the rating curve is established, an observer can read the gauge height at the station and report the reading daily to DFWP. The gauge height can then be converted to actual streamflow from the rating curve. An advantage of this type of installation over a staff gauge or wire-weight gauge installation is the continuous recording of streamflow which then becomes a permanent record published annually by the USGS.

The cost of such an installation varies depending upon site characteristics. A typical installation without a cableway costs approximately $12,500. The cost of a cableway depends on the specific site but could be $15,000 or more. A typical gauge installation consists of recorders placed in a permanent building at the stream site. A manometer (pressure activated system) or other automatic measuring device is required to measure the level of streamflow, which is then recorded.

Stilling well installations are flow recorders installed in small shelters mounted over an 18-inch well. These installations are limited to sites on small streams, canals, etc. where freezing problems are minimal. A small stilling well installation using new equipment costs approximately $5,000 per year. If surplus equipment can be used, the installation would cost about $3,500.

<u>"Real Time" Stations</u> - This type of installation is basically the same as the typical continuous streamflow installation described above with the exception that either telephone or satellite telemetry equipment is also installed at the site. Telephone systems require access to a phone line. A LARK recording unit receives flow data from the site and makes it available to anyone who telephones the station. The stage of the stream is transmitted over the phone line to the caller who then converts the stage height to actual streamflow using the stage-discharge relationship for that site. The approximate installation cost of

a LARK unit is $2,500 plus the cost of a phone line which varies site-by-site. Phone line costs can be substantial. Again, the LARK cost is in addition to the installation costs for the typical continuous flow station described above.

Another type of recording unit is an Electronic Data Logger with a telephone modem attached which can be accessed by telephone to obtain the stage of the stream. The data logger itself is part of the typical installation and is included in those costs. If a modem is desired, there is an additional cost of $800. Operation costs are the same ($6,800 per year) as for other installations.

Satellite installations or DCP's (Data Collection Platforms), allow the USGS to obtain gauging data via satellite. Sophisticated data recording equipment stores flow information every 15 minutes and transmits the data via satellite to a central receiving station. The information is then accessible via computer by USGS offices in Montana. Satellite telemetry can be purchased for about $5,000 - $6,000. This is in addition to the costs of the typical gauging station installation cited above. The operation cost is $6,800 per year, plus an additional cost to service the satellite equipment. If 24-48 hour servicing is required, the additional cost may be as high as $2,500 per year. If weekly servicing is adequate, the additional charge is approximately $600 per year.

The 1991 USGS cost to operate all of the types of stations just described is $6,800 per year. This will increase to $7,100 in 1992. These are total costs. DFWP funds this program 50/50 through our cooperative agreement with the USGS. The costs to DFWP, therefore, are one half the costs shown above. The USGS pays the other 50%. Installation costs are also shared equally under the same agreement.

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Appendix A

Dominant Discharge Values Derived by the U.S. Geological Survey

(Provisional Data)

Rock Creek at mouth
near Saco, MT.

Day	Mean Daily Discharge
1	15
2	25
3	80
4	780
5	2180
6	2960
7	1970
8	1320
9	760
10	480
11	310
12	200
13	140
14	100
15	80
16	55
17	45
18	35
19	25
20	20
21	20

Battle Creek at mouth
near Chinook, MT

Day	Mean Daily Discharge
1	45
2	95
3	470
4	930
5	1970
6	1330
7	650
8	180
9	130
10	90
11	75
12	65
13	60
14	50

Frenchman River at
mouth near Saco, MT.

Day	Mean Daily Discharge
1	10
2	30
3	50
4	70
5	150
6	290
7	450
8	740
9	1320
10	1010
11	760
12	580
13	470
14	360
15	280
16	200
17	160
18	120
19	90
20	70
21	60

Beaver Creek at mouth
near Saco, MT.

Day	Mean Daily Discharge
1	10
2	10
3	40
4	160
5	400
6	1160
7	920
8	440
9	320
10	240
11	200
12	160
13	120
14	85
15	75
16	55
17	45
18	30
19	25
20	20
21	15

Little Beaver Creek near Marmath, ND

Day	Mean Daily Discharge
1	2
2	3
3	7
4	9
5	620
6	2050
7	3310
8	1080
9	250
10	160
11	110
12	75
13	55
14	41
15	35
16	30
17	25
18	20
19	20
20	15
21	15

PROVISIONAL

Box Elder Creek at Webster, MT

Day	Mean Daily Discharge
1	6
2	25
3	55
4	170
5	340
6	850
7	1820
8	1480
9	1220
10	860
11	640
12	380
13	160
14	120
15	55
16	35
17	15
18	10
19	5
20	4
21	3

Beaver Creek near Trotters, ND

Day	Mean Daily Discharge
1	10
2	15
3	35
4	130
5	390
6	790
7	1050
8	660
9	330
10	130
11	65
12	53
13	40
14	35

PROVISIONAL

Little Missouri River at Camp Crook, SD

Day	Mean Daily Discharge
1	10
2	15
3	20
4	75
5	290
6	1450
7	2540
8	2320
9	1670
10	1150
11	940
12	760
13	600
14	430
15	280
16	240
17	200
18	280
19	240
20	200
21	150

Poplar River at Fort Peck Reservation boundary, near Scoby, MT

Day	Mean Daily Discharge
1	50
2	190
3	810
4	1210
5	810
6	390
7	190
8	130
9	100
10	70
11	40
12	30
13	20
14	20

PROVISIONAL

Poplar River above confluence of East Fork Poplar River, near Scoby, MT

Day	Mean Daily Discharge
1	40
2	150
3	670
4	1000
5	670
6	320
7	160
8	110
9	80
10	60
11	50
12	30
13	20
14	20

W.F. Poplar River at Fort Peck reserveration boundary, near Richland, MT.

Day	Mean Daily Discharge
1	50
2	180
3	800
4	1190
5	800
6	380
7	190
8	120
9	100
10	70
11	40
12	30
13	30
14	20

PROVISIONAL

Redwater River near Vida, MT.

Day	Mean Daily Discharge
1	5
2	100
3	1040
4	1680
5	2010
6	1010
7	200
8	70
9	60
10	50
11	40
12	40
13	40
14	30

Redwater River above confluence of E.F. Redwater River, near Vida, MT.

Day	Mean Daily Discharge
1	5
2	90
3	890
4	1440
5	1730
6	870
7	170
8	60
9	50
10	40
11	40
12	30
13	30
14	30

PROVISIONAL

East Poplar River at mouth, near Scobey, MT.

Day	Mean Daily Discharge
1	2
2	6
3	10
4	60
5	280
6	540
7	330
8	200
9	80
10	60
11	20
12	9
13	7
14	6

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Appendix B

Water Availability Data for Streams in the Lower and Little Missouri River Basins

Provisional Data Compiled by the U.S. Geological Survey, Helena, Montana

Site Name	Month	Q.90	Q.80	Q.50	Q.20	QM
Beaver Creek above Lower Lake near Harve, MT	October	3	4	7	12	9
	November	4	4	7	12	9
	December	2	2	6	11	7
	January	4	5	7	8	7
	February	7	7	8	13	10
	March	7	8	18	33	20
	April	12	14	23	39	27
	May	17	18	23	126	54
	June	14	19	38	74	49
	July	3	4	11	31	18
	August	2	3	5	13	8
	September	2	2	4	10	7
	Annual	--	--	--	--	19
Clear Creek at Clear Creek Road crossing, near Lohman, MT	October	0	0	.2	2	1
	November	0	.1	.5	3	2
	December	0	.1	.6	3	2
	January	0	0	.5	1	2
	February	0	.1	.9	6	6
	March	.5	.8	9	34	23
	April	.7	1	6	23	16
	May	.2	2	6	32	29
	June	.1	.5	6	27	20
	July	0	.1	2	10	5
	August	0	0	.1	2	1
	September	0	0	0	.7	1
	Annual	--	--	--	--	9
Little Box Elder Creek at mouth at Clear Creek road, near Harve, MT.	October	0	0	.2	3	1
	November	0	0	.3	3	1
	December	0	0	.3	2	1
	January	0	0	.2	1	2
	February	0	0	.7	6	4
	March	.4	3	6	18	11
	April	.6	1	5	17	11
	May	.1	1	3	18	15
	June	.1	.4	3	15	11
	July	0	0	1	7	5
	August	0	0	.2	2	1
	September	0	0	.2	1	1
	Annual	--	--	--	--	5
Peoples Creek at Barney Olsen Road, near Dodson, MT.	October	0	0	.5	2	1
	November	0	0	.5	2	1
	December	0	0	.4	2	.9
	January	0	0	.4	1	1
	February	0	0	1	6	4
	March	.5	2	7	18	13
	April	3	4	7	18	11
	May	.6	1	4	17	12
	June	.4	1	6	20	12
	July	0	0	2	8	4
	August	0	0	.2	2	1
	September	0	0	0	.9	1
	Annual	--	--	--	--	5
Poplar River at Fort Peck reservation boundary, near Scobey, MT.	October	2	7	16	21	17
	November	5	8	16	22	17
	December	0	4	9	15	11
	January	0	0	2	9	8
	February	0	0	4	15	16
	March	3	39	122	298	192
	April	41	50	119	443	255
	May	27	34	52	99	74
	June	13	20	39	73	64
	July	3	6	16	31	35
	August	1	1	3	14	12
	September	1	1	4	13	11
	Annual	--	--	--	--	59
Poplar River above confluence of East Poplar River, near Scobey, MT.	October	.3	1	4	6	4
	November	1	2	4	6	4
	December	0	.7	2	4	2
	January	0	0	.4	2	1
	February	0	0	.6	4	4
	March	.4	13	62	207	115
	April	14	18	60	353	168
	May	8	11	20	47	32
	June	3	5	13	31	26
	July	.5	1	4	10	12
	August	.2	.2	.5	3	3
	September	.2	.2	.7	3	2
	Annual	--	--	--	--	31

Site Name	Month	Q.90	Q.80	Q.50	Q.20	QM
Battle Creek at mouth, near Chinook, MT.	October	0	0	.5	16	7
	November	0	0	.3	10	5
	December	0	0	.3	7	4
	January	0	0	.1	2	2
	February	0	0	1	14	12
	March	0	.1	15	93	54
	April	0	4	31	85	146
	May	0	.5	34	116	75
	June	0	.1	21	47	40
	July	0	.1	12	26	14
	August	0	.1	.5	8	6
	September	0	0	.3	7	24
	Annual	--	--	--	--	32
Rock Creek at mouth, near Saco, MT.	October	1	2	7	13	8
	November	3	4	7	10	8
	December	2	2	3	5	3
	January	0	0	.8	3	2
	February	0	0	2	11	16
	March	1	18	151	738	354
	April	39	59	239	1130	508
	May	16	20	46	164	84
	June	9	14	34	115	70
	July	2	5	13	59	36
	August	0	0	3	10	16
	September	0	0	.4	6	15
	Annual	--	--	--	--	93
Frenchman River at mouth, near Saco, MT.	October	0	0	3	12	9
	November	.6	2	5	10	6
	December	0	.1	2	6	3
	January	0	0	.3	3	2
	February	0	0	.7	6	15
	March	3	11	69	181	137
	April	21	47	217	686	418
	May	9	15	54	177	126
	June	0	1	19	85	53
	July	0	0	11	34	37
	August	0	0	4	11	8
	September	0	0	2	7	5
	Annual	--	--	--	--	68
Beaver Creek at mouth, near Saco, MT.	October	0	.2	5	38	27
	November	2	2	5	18	11
	December	2	2	5	13	8
	January	1	2	3	8	7
	February	2	2	9	58	47
	March	6	21	80	339	204
	April	2	5	25	225	198
	May	3	18	91	643	329
	June	4	7	35	207	133
	July	2	3	27	129	85
	August	1	2	14	29	18
	September	.2	.2	2	21	48
	Annual	--	--	--	--	93
Beaver Creek at Ft. Belknap Indian Reservation, near Zortman, Mt.	October	.2	.3	.4	.5	.4
	November	.2	.3	.5	1	.3
	December	.1	.2	.3	.5	.3
	January	0	0	.2	.3	.2
	February	0	.1	.2	.3	.2
	March	.2	.3	.5	.5	.5
	April	.2	.3	.5	1	.5
	May	.2	.2	.5	2	1
	June	.1	.2	1	3	2
	July	.1	.3	.5	1	1
	August	.1	.1	.5	1	.5
	September	.2	.2	.4	.5	.5
	Annual	--	--	--	--	.6
Redwater River above confluence of E.F Redwater, near Vida, MT	October	.7	1	3	6	4
	November	2	2	3	4	4
	December	.6	1	3	4	3
	January	0	0	.6	2	2
	February	.6	1	3	67	52
	March	7	14	77	221	213
	April	5	9	24	62	109
	May	4	5	11	34	21
	June	2	4	13	101	70
	July	.6	2	6	52	35
	August	.6	.7	2	6	4
	September	1	1	1	4	3
	Annual	--	--	--	--	43

PROVISIONAL

PROVISIONAL

Site Name	Month	Q.90	Q.80	Q.50	Q.20	QM
W.F. Poplar River at Fort Peck reservation boundary, near Richland MT.	October	1	3	6	8	7
	November	2	3	6	8	7
	December	0	2	4	6	4
	January	0	0	1	4	3
	February	0	0	2	6	6
	March	1	14	40	89	60
	April	15	17	39	127	77
	May	10	12	18	33	25
	June	5	8	14	25	22
	July	1	3	6	12	13
	August	.7	.7	1	6	5
	September	.7	.7	2	5	4
	Annual	--	--	--	--	19
Redwater River nr Vida, Mt	October	.9	1	3	7	4
	November	2	2	4	5	4
	December	.7	2	3	4	3
	January	0	0	.9	2	2
	February	.7	2	4	83	64
	March	10	17	95	274	263
	April	6	12	30	77	135
	May	5	6	14	43	27
	June	2	5	16	125	87
	July	.7	2	7	64	43
	August	.7	.9	2	7	5
	September	1	1	2	4	4
	Annual	--	--	--	--	53
Missouri River nr Culbertson, MT	October	4150	5670	10400	16500	11800
	November	3640	4990	9020	12900	9140
	December	1670	5570	8740	11500	8230
	January	1450	5060	9030	12700	8620
	February	1410	3180	9220	14200	9170
	March	3560	5290	10400	14700	10200
	April	4570	7430	10600	16900	11500
	May	2360	4880	8470	14700	9560
	June	2820	5310	8620	13800	9560
	July	5090	6420	9920	13400	10900
	August	6350	7590	11600	17100	12700
	September	4700	7100	11600	18200	12500
	Annual	--	--	--	--	9440
Little Missouri River at Camp Crook, SD.	October	2	3	4	18	55
	November	3	3	5	8	8
	December	2	3	5	7	5
	January	1	1	3	6	6
	February	1	2	6	39	68
	March	15	38	192	613	359
	April	8	26	72	532	282
	May	9	17	71	639	319
	June	9	22	230	790	418
	July	5	14	46	119	86
	August	1	4	16	71	38
	September	2	2	5	53	40
	Annual	--	--	--	--	140
Box Elder Creek at Webster, MT	October	2	2	5	12	32
	November	3	4	6	8	7
	December	2	2	4	6	5
	January	2	2	3	6	4
	February	.9	1	5	48	44
	March	15	21	95	398	211
	April	11	17	58	285	257
	May	7	15	48	255	149
	June	13	25	123	263	174
	July	3	6	32	72	50
	August	1	2	10	37	22
	September	.9	2	5	27	21
	Annual	--	--	--	--	81
Little Beaver Cr nr Marmath, ND.	October	0	.4	2	6	10
	November	.3	1	3	4	3
	December	0	.5	2	3	3
	January	0	0	1	4	4
	February	0	.3	3	46	27
	March	9	14	52	266	149
	April	5	9	28	133	113
	May	5	6	16	49	42
	June	5	15	53	138	83
	July	2	4	15	37	29
	August	.2	1	4	9	10
	September	0	.3	3	14	13
	Annual	--	--	--	--	41

Site Name	Month	Q.90	Q.80	Q.50	Q.20	QM
Beaver Creek near Trotters, ND.	October	0	0	.3	2	1
	November	0	0	.4	2	3
	December	0	.2	1	2	1
	January	0	0	.6	2	2
	February	.1	.7	5	63	39
	March	8	14	71	429	181
	April	4	7	23	140	111
	May	.8	1	8	24	14
	June	.9	3	10	55	35
	July	.1	.6	5	25	39
	August	0	0	.3	3	2
	September	0	0	.3	2	.7
	Annual	--	--	--	--	36
Missouri River below Fort Peck, MT.	October	3500	5310	10300	15300	11500
	November	3690	4870	9010	13100	8830
	December	1550	5450	9320	11300	8320
	January	1450	4670	9860	12600	8710
	February	1180	2820	8240	13800	8660
	March	1470	3480	7620	11100	7420
	April	1770	3830	7240	10300	7300
	May	1860	3890	6960	11900	7900
	June	1290	3690	7900	12600	8160
	July	3530	5620	10100	13200	10200
	August	5710	7570	12100	18100	12700
	September	4290	6360	11400	18300	12200
	Annual	--	--	--	--	9330
East Poplar River at mouth, near Scobey, MT.	October	2	3	4	4	4
	November	2	3	4	4	4
	December	2	3	4	4	3
	January	2	2	4	4	3
	February	2	3	4	5	4
	March	4	4	5	74	33
	April	4	4	9	163	68
	May	5	9	15	37	20
	June	4	4	5	26	18
	July	3	3	4	6	5
	August	3	3	4	5	5
	September	3	3	4	4	4
	Annual	--	--	--	--	14

PERSONS INVOLVED IN THE DEVELOPMENT OF THIS APPLICATION

Name	Present Location
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Thurston Dotson	Helena
Ken Frazer	Billings
Bill Gardner	Fort Benton
Kent Gilge	Chinook
Chris Hunter	Helena
Howard Johnson	Helena
Bob McFarland	Bozeman
Bob Needham	Glasgow
Fred Nelson	Bozeman
Carolyn Sime	Helena
Liter Spence	Helena
Phil Stewart	Miles City
Bill Wiedenheft	Fort Peck
Part-time Fisheries Personnel	
Dwane Wannamaker	Chinook
Permanent Wildlife Personnel	
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