INSTREAM FISH FLOW EVALUATION FOR THE NORTH, MIDDLE, SOUTH FORKS AND MAINSTEM OF THE FLATHEAD RIVER

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TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Con.t)

TABLE OF CONTENTS (Cont.)

LIST OF TABLES

LIST OF TABLES (Cont.)

LIST OF FIGURES

INTRODUCTION

The Montana Department of Fish, Wildlife and Parks (MDFWP), under provisions of an act passed by the 1969 Montana Legislature, filed for instream water rights for the purpose of preserving fish and wildlife habitat in eight sections of the upper Flathead River system. Recent advances in the development of instream flow methodologies have enabled the MDFWP to more accurately define the flows that are needed to maintain the high quality trout and salmon fishery of the Flathead River at the existing level. In 1980, the Department began to requantify the instream flow needs of cold-water sports fish in these same eight sections of the river with funds provided by the Environmental Protection Agency, U.S. Forest Service, and Bureau of Reclamation. This report provides a description of each river section, its fish and wildlife populations, instream flow methods used and present flow recommendations compared to these requested in 1970 or 1971. The eight sections of the Flathead River discussed in this report include:

A. Mainstem River

Reach I - Flathead Lake to the confluence of the South Fork.

Reach II - Confluence of the South Fork to the confluence of the Middle Fork.

B. Middle Fork River

Reach I - Confluence of the North Fork to the confluence of Bear Creek.

Reach II - Confluence of Bear Creek to the confluence of Cox Creek.

C. North Fork River

Reach I - Confluence of the Middle Fork to the confluence of Bowman Creek.

Reach II - Confluence of Bowman Creek to the Canadian border.

D. South Fork River

Reach I - Headwaters of Hungry Horse Reservoir to the Powell-Flathead County line.

Reach II - Powell-Flathead County line to the headwaters at the confluence of Youngs and Danaher Creek.

METHODS

INSTREAM FLOW METHODOLOGIES

The best and most accurate method for determining the instream flow needs for fish and wildlife purposes is to derive the actual flow and biological relationships from long-term data collected in drought, normal and above normal water years. While this approach has been tried on a few selected waterways in Montana, it is not a practical means of deriving future recommendations due to the excessive time, cost and man-power required to collect field data. Consequently, flow recommendations for most waterways are derived from instream flow methods that are more compatible with existing budget and time constraints, yet provide acceptable and defendable recommendations. The method employed by MDFWP divides the annual flow cycle for headwater rivers, such as the Flathead River, into two separate flow periods. They consist of a relatively brief snow runoff or high flow period, when a large percentage of the annual water yield is passed by the river, and a non-runoff or low flow period which is characterized by relatively stable base flows. The high flow period generally occurs during the months of April, May, June, and July, while the remaining months encompass the low flow period. Separate flow recommendations are derived for each period.

Method for High Flow Period - Dominant/Channel Morphology Concept

It is generally accepted that the major force in the establishment and maintenance of a particular channel form in view of its bed and bank material is the annual high flow characteristics of the river. It is the high spring flows that determine the shape of the channel rather than the average or low flows.

The major functions of the high spring flows in the maintenance of channel form are bedload movement and sediment transport. It is the movement of the bed and bank material and subsequent deposition which are capable of covering already established bars with finer material which leads successively to vegetated islands. Increased discharge associated with spring runoff also results in a flushing action which removes deposited sediments and maintains suitable gravel conditions for aquatic insect production, fish spawning and egg incubation.

Reducing the high spring flows beyond the point where the major amount of bedload and sediment is transported would interrupt the ongoing channel processes and change the existing channel form and bottom substrates. A significantly altered channel would affect both the abundance and species composition of the present aquatic populations by altering the existing habitat types.

Several workers (Leopold, Wolman and Miller 1964, US Bureau of Reclamation 1973, and Emmett 1975) adhere to the concept that the form and configuration of river channels are shaped by and designed to accommodate a discharge. The discharge which is most commonly referred to as a dominant discharge is the bankful discharge (Leopold, Wolman and Miller 1964, Emmett

1975). Bankful discharge is defined as that flow when water just begins to overflow onto the active floodplain.

Bankful discharge tends to have a constant frequency of occurrence among rivers (Emmett 1975). The recurrence interval for bankful discharge was determined by Emmett (1975) to be 1.5 years and is in close agreement with the frequency of bankful discharge reported by other studies (Leopold, Wolman and Miller 1964, Emmett 1972).

It is not presently known how long the bankful flow must be maintained to accomplish the necessary channel formation processes. Until studies further clarify the necessary duration of the bankful discharge, a duration period of 24 hours is chosen.

A gradual rising and receding of flows should be associated with the dominant discharge and the shape of the spring hydrograph should resemble that which occurs naturally. U.S.G.S. flow records were used to determine the time when the high flow period and peak flow normally occurs. Flows are increased from a base flow level to the dominant discharge in two-week intervals at the 80th percentile flow level, corresponding to the natural timing of the high flow period. For the Flathead River, April 16 through July 31 encompasses much of the high flow period.

The 80th percentile is the flow that is exceeded in eight of 10 years or, in other terms, in eight years out of 10 there is more water than the 80th percentile flowing in the river. The 80th percentile was chosen in part because of its compatibility with irrigation systems, a good water supply is considered necessary in about eight years out of 10, on the average (MDNRC 1976). It is also our belief that the high flow months can withstand substantial withdrawals and not alter the basic functions of channel maintenance.

Method For Low Flow Period

Wetted Perimeter/Inflection Point Method

The wetted perimeter/inflection point method, as applied to riffle areas, was chosen for deriving low flow recommendations for the trout rivers of Montana. Wetted perimeter is the distance along the bottom and sides of a channel cross-section in contact with water (Figure 1). As the flow in the stream channel decreases, the wetted perimeter also decreases, but the rate of loss of wetted perimeter is not constant throughout the entire range of flows.

An example of a relationship between wetted perimeter and flow for a riffle cross-section is illustrated in Figure 2. There is a point, called an inflection point, on the plot of wetted perimeter versus flow at which the rate of loss of wetted perimeter is significantly changed. In the example (Figure 2), this inflection point occurs at an approximate flow of 500 cfs. Beyond the inflection point, large changes in flow cause only very small changes in wetted perimeter. Below the inflection point, the river begins to pull away from the riffle bottom, exposing the bottom at an accelerated rate. The flow recommendation is selected at or beyond this

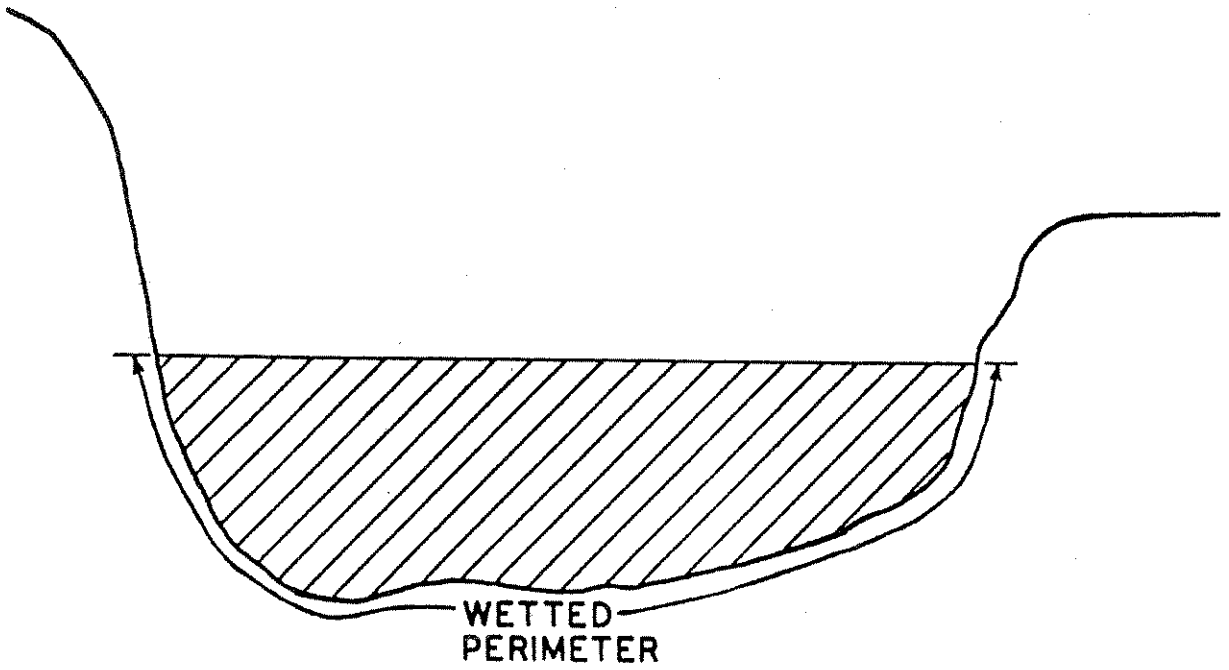

Figure 1. The wetted perimeter in a channel cross-section.

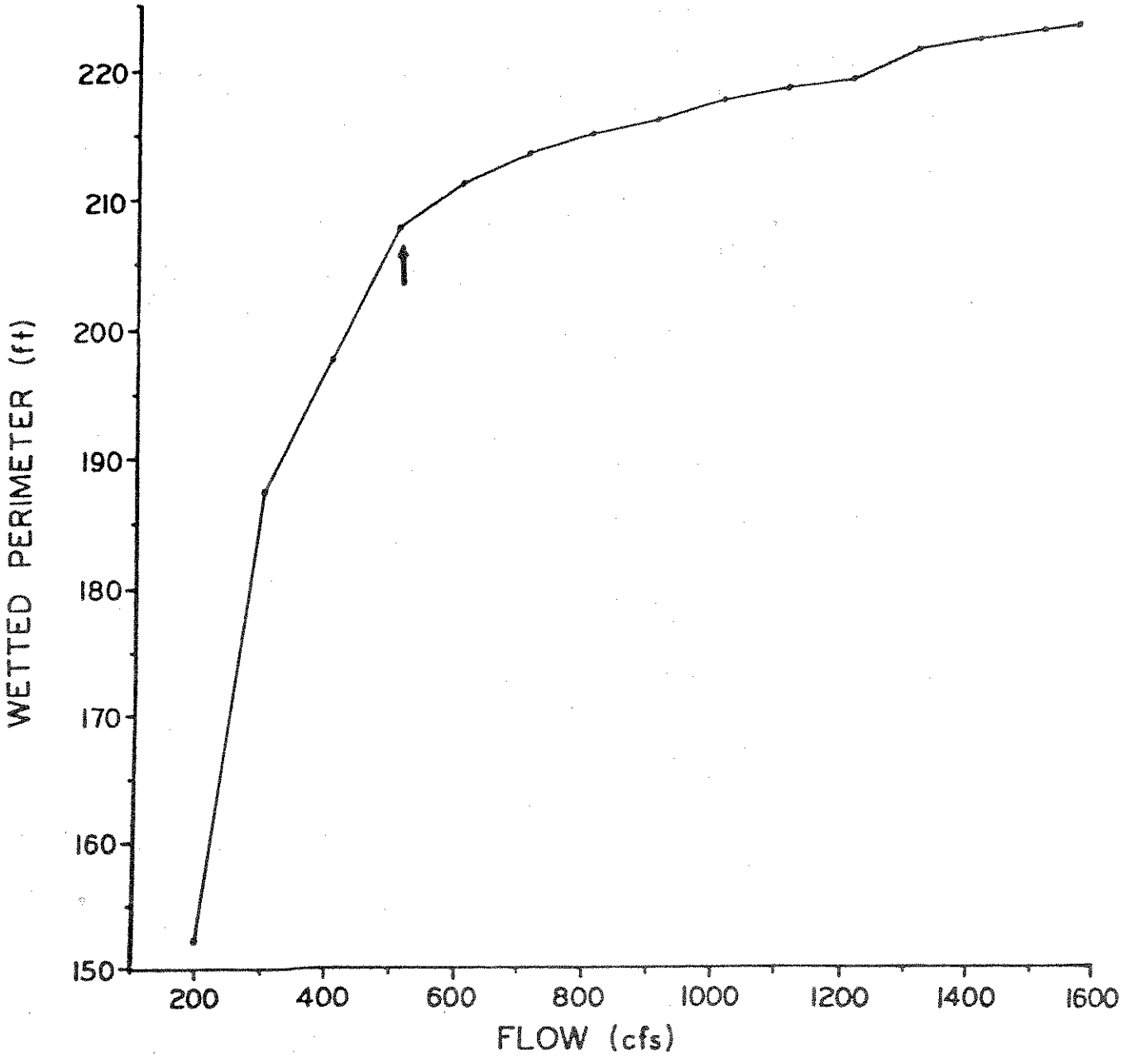

Figure 2. An example of a relationship between wetted perimeter and flow for a channel cross-section.

inflection point.

The maintenance of suitable flows in riffles is essential for the well-being of trout populations since the production of aquatic invertebrates, the principle food of trout, primarily occurs in riffle areas (Hynes 1970). It has also been demonstrated that riffles are critical areas for spawning sites of trout and shallow inshore areas are required for the rearing of trout fry (Sando 1981). Once flows are reduced below the inflection point, the riffle bottom is being exposed at an accelerated rate and the area available for food production and trout spawning and rearing greatly diminishes. At flows beyond the inflection point, the area available for these essential life processes is considered to approach the optimum.

Riffles are also the area of a stream most affected by flow reductions (Bovee 1974 and Nelson 1977). Consequently, the maintenance of suitable riffle conditions for food production and trout spawning and rearing areas will also maintain suitable conditions in pools and runs, areas normally inhabited by adult trout. Because riffles are the habitat most affected by flow reductions and are essential for the well-being of trout populations, they should receive the highest priority for instream protection.

The Montana Department of Fish, Wildlife and Parks completed a study in 1980 that validated the wetted perimeter method as applied to the trout rivers of southwest Montana (Nelson 1980a, 1980b and 1980c). In this study, instream flow recommendations were derived from the actual trout standing crop (numbers and pounds) and flow relationship for five reaches of four nationally acclaimed wild trout rivers. These recommendations were compared to those derived from the wetted perimeter/inflection point method. The study results showed that flows less than the inflection point are undesirable as recommendations since they lead to substantial reductions of the standing crops of adult trout.

The flow at the inflection point is not necessarily the preferred recommendation for all trout rivers. The "Blue Ribbon" rivers would generally require a higher flow in order to maintain the sport fishery resource at the existing level. For those rivers having a lower resource rating, the flow at the inflection point may be a satisfactory recommendation. In general, flows less than the inflection point are undesirable as flow recommendations regardless of the existing state of the river resource.

The wetted perimeter-flow relationships for the riffle areas are derived using a wetted perimeter predictive (WETP) computer program developed in 1980 by the MDFWP (Nelson 1980d). The WETP program uses a minimum of two sets of stage (water surface elevation) measurements taken at different known discharges (flows) to establish a least-squares fit of log-stage versus log-discharge. Once the stage-discharge rating curve for each cross-section is determined, the stage at a flow of interest can be predicted. This rating curve, when coupled with the cross-section profile, is all that is needed to predict the wetted perimeter at most flows of interest.

The program should be run using three sets of stage-discharge data collected at a high, intermediate and low flow. Additional data sets are desirable, but not necessary. The three measurements are made when runoff is receding (high flow), near the end of runoff (intermediate flow) and during late summer-early fall (low flow). The high flow should be considerably less than the bankful flow while the low flow should approximate the lowest flow that normal occurs during the summer-fall field season. Sufficient spread between the highest and lowest calibration flows is needed in order to compute a linear, sloping rating curve.

The WETP program can be run using only two sets of stage-discharge data. This practice is not recommended since substantial "two-point" error can result. However, when only two data sets are obtainable, the higher discharge should be at least twice as high as the lower discharge.

The WETP model is invalidated if channel changes occur in the study area during the data collecting process. For this reason, the collection of the field data needed for calibrating the program should be completed during the period beginning when runoff is receding and ending with the onset of runoff the following year. The stream channel is expected to be stable during this period.

Kokanee Spawning/Incubation Requirements

A study to quantify the flow needs of kokanee salmon in the regulated portion of the Flathead River was begun in April 1979 and will continue until April 1, 1986. The study is focusing on the quantification of the spawning and incubation flows that are needed to produce adequate numbers of kokanee fry which, in turn, would maintain a stable lake fishery and an adequate run of spawning adults.

At present, the investigation has yielded considerable information on spawning requirements in the Flathead River, which will be further refined during the next three years. Conclusions and recommendations presented here represent the best available information on flows required to maintain and stabilize the kokanee fishery.

The greatest potential damage to kokanee spawning success occurs in years when there is a large disparity between the flows at the time of spawning and the lower mid-winter flows. Eggs deposited in redds in shallow water are subsequently dewatered. Examination of dewatered redds in 1981 and 1982 showed almost complete mortality of green eggs deposited 0.2 feet above the water line after being dewatered for 40 hours. Mortality can occur sooner during periods of extreme cold.

The most desirable flow regime for kokanee would be a relatively constant flow from mid-October through April for spawning, incubation, and emergence. Historical minimum flows in a median or normal water year, occurred during the months of February and March at a flow of about 3,300 cfs at the U.S.G.S. gauge at Columbia Falls.

In order to ensure that excessive redd dewatering and subsequent egg mortality does not occur, the maximum flow during the spawning period (October 15 to December 15) should not exceed 4,500 cfs at Columbia Falls. During the spawning and incubation period (October 15 to April 15), the minimum flow should not fall below 3,500 cfs. The resultant flow differential of 1,000 cfs increases operational flexibility for Hungry Horse Dam during the fall, while at the same time ensures that kokanee spawning success and egg survival will not be severely impacted. This flow regime has been adopted by the Northwest Power Planning Council under Section 804(a)(1) of their Columbia River Basin Fish and Wildlife Program (1982).

The natural occurring high flows during the months of April and May are essential in transporting kokanee fry downstream to Flathead Lake. The flow recommendations derived for the high flow period using the dominant discharge/channel morphology concept would meet the downstream passage requirement during the period fry are moving to the lake.

Summary of Instream Flow Methodologies

For the high flow period of April 16 through July 31, the flow recommendations are based on the 80th percentile flows using the dominant discharge/channel morphology concept. For the low flow period of August 1 through April 15, the recommendation is based on the wetted perimeter/inflection point method. The kokanee spawning and incubation period of October 15-April 15 is within the low flow period. The low flow recommendation of 3,500 cfs at Columbia Falls, which was derived from the wetted perimeter/inflection point methodology, would adequately address the needs of kokanee during this period.

SAMPLING

Three techniques; electrofishing, snorkeling and redd surveys were used in surveying fish populations and estimating fish abundance in various sections of the Flathead drainage. Because a major portion of the fish population in the Flathead system consisted of migratory fish, it was not possible to make total population estimates. Electrofishing and snorkeling results represent the relative abundance and population structure of the fish species present in the sampling area only at the time of sampling. Snorkeling was preferred to electrofishing as a technique for obtaining population and fish abundance information in streams of the Flathead drainage. These streams were characterized by extreme clarity and low conductivity and many of them had access problems. In wilderness area and Glacier National Park, where regulations prohibit electrofishing equipment, snorkeling was an effective and practical method for obtaining abundance estimates for most species of fish. Snorkeling has been used with success in other drainages with high water clarity (Graham et al. 1980).

Snorkeling was used to obtain fish abundance estimates in two ten-mile sections of the Middle Fork River between the mouth of Bear Creek and the mouth of Cox Creek during late summer, 1980. One study section was

upstream from Schafer Meadows (from the headwaters to above Cox Creek) and one was downstream (two miles below Schafer Meadows to Granite Creek). In these sections, observers made fish counts in every third pool, run and pocketwater feature and every fifth riffle feature. In late summer 1981, two separate 1.8 mile sections of the Middle Fork River below Bear Creek were snorkeled to obtain fish abundance estimates.

Two sections of the North Fork River were snorkeled during the summer of 1980 to obtain fish abundance estimates. The lower section extended from Big Creek to Red Meadow Creek. The upper section extended from Red Meadow Creek to the Canadian border.

In late August 1981, snorkeling was utilized to obtain fish abundance estimates in portions of two 3,000-meter sections of the upper South Fork River. The lower section was below the mouth of the White River (near the Flathead-Powell County line) and the upper section extended downstream from the mouth of Gordon Creek.

Due to the large size and volume of the lower mainstem Flathead River, snorkeling was ineffective for estimating trout and whitefish abundances. Snorkeling was still used to count kokanee spawners in this section, but most trout and whitefish population data was collected using a boat-mounted electrofishing unit.

McMullin and Graham (1981) completed a study in 1980 on the mainstem Flathead River to document the relative abundance and movement of various gamefish species. During the study, three areas of the mainstem between the mouth of the Middle Fork and Flathead Lake were sampled. Seasonal population trends, relative abundance and movement patterns were assessed for cutthroat, rainbow and bull trout as well as mountain whitefish and kokanee.

Annual redd surveys for bull trout and kokanee salmon, made during and shortly after the spawning season, were good indicators of the strength of the adult spawning population for that year. These counts provided a means of comparing spawning abundance from year to year in different parts of the drainage (Fraley and Graham 1982, McMullin and Graham 1981, Shepard et al. 1982).

SURVEY SITES AND CALIBRATION FLOWS

The wetted perimeter/inflection point method was applied to a riffle area located near the middle of Reach I of the mainstem Flathead River (T28N, R21W, Sec. 10). The WETP program was calibrated to field data collected at flows of 1,910, 7,440 and 26,200 cfs.

The wetted perimeter/inflection point method was applied to four riffle-run areas located throughout Reach II of the mainstem Flathead River (T31N, R19W, Sec. 7; T30N, R19W, Sec. 6; T30N, R19W, Sec. 4; T31N, R19W, Sec. 32). The WETP program was calibrated to field data collected at flows between 1,765 and 26,400 cfs.

On the Middle Fork River, the wetted perimeter/inflection point method was applied to a riffle-run area located near the downstream boundary of Reach I. The WETP program was calibrated to field data collected at flows of 914, 2,154, and 7,755 cfs.

The wetted perimeter/inflection point method was applied to four riffle-run areas in the downstream portion of Reach II of the Middle Fork River (T29N, R15W, Sec. 31 and T28N, R16W, Sec. 1 and 12). The WETP program was calibrated to field data collected at flows of 193, 1,460 and 3,624 cfs.

On Reach I of the North Fork River, the wetted perimeter/inflection point method was applied to a four riffle-run area located near the downstream boundary of the reach (T31N, R20W, Sec. 1; T32N, R20W, Sec. 36; T31N, R17W, Sec. 7). The WETP program was calibrated to field data collected at flows of 1,350, 7,870 and 10,800 cfs.

The wetted perimeter/inflection point method was applied to four riffle-run areas located near the downstream boundary of Reach II of the North Fork River (T32N, R21W, Sec. 22, 23 and 26). The WETP program was calibrated to field data collected at three flows between 263 and 6,020 cfs.

The wetted perimeter/inflection point method was applied to three riffle-run areas located near the downstream boundary of Reach I of the South Fork River (T26N, R16W, Sec. 36). The WETP program was calibrated to field data collected at flows of 808, 6,160 and 8,890 cfs.

Reach II of the South Fork River was not surveyed.

FISH AND WILDLIFE RESOURCES

FISH DISTRIBUTION AND MOVEMENT

There are at least 22 fish species present in the Flathead River upstream from Flathead Lake (Table 1). The bull trout, westslope cutthroat trout and kokanee are the most important game species found in the river. To adequately assess habitat requirements necessary to maintain the fishery for these species, it is important to understand their life histories and movement patterns within the river system. A brief review of life histories and movement is presented below.

Bull and Cutthroat Trout

The bull trout population in the Flathead drainage is almost entirely adfluvial, living in a lake as subadults or adults and migrating into tributaries to spawn. The migratory pattern of bull trout is similar in the North, Middle and South Forks. These fish reside in Flathead Lake or Hungry Horse Reservoir, begin moving up the lower Flathead or upper South Fork River in early spring, and start to arrive in their spawning tributaries as early as late June. Many fish may hold in the North, Middle and South forks until September before ascending the tributaries. Most spawning occurs during September and early October after which spawners

Table 1. A list of fish species in Flathead Lake and the Flathead River upstream from Flathead Lake and their relative abundance. C = common, U = uncommon, and R = rare.

Fish species	Scientific name	Abundance	
		Flathead River	Flathead Lake
Cutthroat trout		C	C
Westslope	*Salmo clarki lewisi*	C	C
Yellowstone	*Salmo clarki bouvieri*	R	R
Bull trout	*Salvelinus confluentus*	C	C
Rainbow trout	*Salmo gairdneri*	U	R
Brook trout	*Salvelinus fontinalis*	R	R
Lake trout	*Salvelinus namaycush*	R[1/]	C
Kokanee	*Oncorhynchus nerka*	C[1/]	C
Lake whitefish	*Coregonus clupeaformis*	U[1/]	C
Pygmy whitefish	*Prosopium coulteri*	U[1/]	C
Mountain whitefish	*Prosopium williamsoni*	C	C
Arctic grayling	*Thymallus arcticus*	R	-
Slimy sculpin	*Cottus cognatus*	C	C
Shorthead sculpin	*Cottus confusus*	C	?
Mottled sculpin	*Cottus bairdi*	?	?
Longnose sucker	*Catostomus catostomus*	U	C
Largescale sucker	*Catostomus macrocheilus*	C	C
Peamouth	*Mylocheilus caurinus*	C	C
Northern squawfish	*Ptychocheilus oregonensis*	C	C
Northern pike	*Esox lucius*	R[2/]	R
Redside shiner	*Richardsonius balteatus*	R[2/]	C
Largemouth bass	*Micropterus salmoides*	R[2/]	U
Pumpkinseed	*Lepomis gibbosus*	R[2/]	R
Yellow perch	*Perca flavescens*	R[2/]	C
Black bullhead	*Ictalurus melas*	R[2/]	R

1/ Refers to seasonal abundance.

2/ Common in some sloughs along the lower river.

return rapidly to Flathead Lake or Hungry Horse Reservoir.

Three basic life history patterns have been identified throughout the range of westslope cutthroat trout. These patterns are migratory between lakes and streams, migratory from small tributaries to main rivers, and non-migratory stocks (Behnke 1979) which are referred to as adfluvial, fluvial and resident, respectively.

Adfluvial westslope cutthroat spawners begin moving up the lower Flathead as early as February and probably move into tributaries sometime in April or May. They spend a varying amount of time on the spawning grounds and most return to the main river around the time of peak runoff. Adult adfluvial cutthroat were found entering North Fork tributaries in May (Fraley et al. 1981). Block (1955) found spawners in North Fork streams on June 17 and Johnson (1963) felt cutthroat spawning peaked in mid-June. Time spent in the river between the tributaries and Flathead Lake appears quite variable. Snorkeling transects in the main North Fork showed very few adult adfluvial cutthroat remained in the river during July. It is thought that adfluvial cutthroat spawners move up the South Fork as early as May and probably move into tributaries sometime in May, June, or July. They spend varying amounts of time on the spawning grounds, returning to the main South Fork by mid-August. Time spent in the South Fork between the tributaries and Hungry Horse Reservoir appears quite variable.

Juvenile cutthroat and bull trout spend from one to four growing seasons in the tributaries before moving into the main river. The majority spend two to three seasons in the tributaries. Adfluvial juvenile trout migrate from streams in late spring and early summer. They may spend several months in the river before entering Flathead Lake or Hungry Horse Reservoir.

Kokanee

Large numbers of migrating kokanee normally first appear in the lower Flathead River during September. The timing of the initial appearance is fairly constant, but the subsequent migration rate of kokanee varies from year to year (McMullin and Graham 1981).

Most kokanee spawning occurs between mid-October and mid-December in the Flathead River system. Following spawning, the adults die. Eggs deposited in the gravel develop over the winter and the fry emerge and move downstream to Flathead Lake during the spring, primarily in April and May. After three to five growing seasons in the lake (four for the majority), the adult fish return to the spawning grounds to complete the life cycle.

This life cycle results in kokanee being present in the river in some form (egg, fry, or adult) during at least eight months of the year. Adequate flows from September through April for migration, spawning, incubation and emigration are all vital to the existence and continued contribution of kokanee to the fishery.

FISH ABUNDANCE

Mainstem Flathead River

Because the fish population in the mainstem Flathead River is composed predominantly of migratory fish, the abundance of the different species in this section of the river vary with the migratory patterns of each species and with the time of year. The information below is based on the study conducted by McMullin and Graham (1981).

Spawning adult cutthroat trout enter the mainstem Flathead River in October and hold in the main river until water temperatures and increasing flows trigger upstream migration in the spring. Spawning takes place in tributaries of the upper drainage during May and June.

Juvenile cutthroat move downstream from the upper drainage to Flathead Lake beginning in April, continuing throughout most of the year with the peak of migration to the upper mainstem above the South Fork occurring in July. Juvenile cutthroat were collected in relatively large numbers in the mainstem through late autumn.

Adult bull trout from Flathead Lake appear to migrate upstream through the mainstem in response to increasing spring flows and temperatures, moving into the lower mainstem in April with peak migrations occurring in May and June. Adults spawn in tributaries of the upper drainage during September and October.

Juvenile bull trout emigrate from upper drainage tributaries in late spring through the summer. The downstream rate of movement of juvenile bull trout after they leave the tributaries has not been well documented. Some juveniles are present in the mainstem throughout the year.

The mountain whitefish is the most abundant game species in the Flathead River. Whitefish spawn in riffle areas of the mainstem in the fall. Dense concentrations of whitefish overwinter in the mainstem but movement patterns are complex and not well understood.

Over 100,000 kokanee migrated through the lower Flathead River enroute to spawning grounds in the Middle Fork and McDonald Creek during September and October 1981. In addition, large numbers of kokanee spawners were still entering the lower river during November, 1981 and some spawning probably occurred from mid-October through mid-December at various sites throughout the river system.

During 1981, the reach from Flathead Lake to the South Fork was searched for kokanee spawning sites (redds). About 8,000 redds were located with 1,000 of these in spring-fed areas and the rest located in the river channels where water level fluctuations could potentially cause dewatering of eggs and stranding of fry. Redds were located in water depths ranging from 0.1 feet to 12 feet and were distributed along the entire reach with concentrations in the areas where the greatest amount of channel development occurs.

The kokanee numbers in the mainstem below the South Fork were down drastically from the levels estimated for the mid-1970's. This was due, at least in part, to a change in the operation of Hungry Horse Dam since 1967 which has resulted in high flows during the spawning season and low flows during incubation. The flow regime for Hungry Horse Dam adopted by the Northwest Power Planning Council (1982) is expected to bring these kokanee numbers back up to previous levels.

The reach of the mainstem from the confluence of the South Fork to the confluence of the Middle Fork is used as a corridor by kokanee spawners enroute to the Middle Fork and its tributaries, but very little or no spawning occurs within this reach.

Rainbow trout are most abundant in the upper mainstem with abundance progressively decreasing downstream.

Middle Fork River

The mountain whitefish was the most abundant fish species in the study sections below Bear Creek. They were followed by westslope cutthroat and juvenile bull trout (Table 2). Juvenile bull trout are difficult to observe while snorkeling due to their habits of lying on the river bottom and under cover, therefore, juvenile bull trout are usually underestimated. Five mature (greater than 18 inches) bull trout were observed below Bear Creek during the snorkel counts.

The densities of fish varied somewhat on different counting days in the sections of the Middle Fork River above Bear Creek, but were relatively high for cutthroat trout and mountain whitefish (Table 3). Adult and larger juvenile bull trout were observed throughout the sections. Smaller juvenile bull trout were again undercounted.

A total of 2,300 kokanee redds were counted in the Middle Fork River during 1981. Approximately 1,000 of these were located above McDonald Creek and 1,300 below. A total of 718 redds were counted in Beaver and Deerlick creeks in 1981. These are two tributaries to the Middle Fork located above McDonald Creek. A total kokanee redd count was not made in McDonald Creek, but a median estimate of 97,000 kokanee was obtained in a snorkel count made in October, 1981. An additional 5,000 to 7,000 dead kokanee were also seen.

A total of 300 bull trout redds were counted in the Middle Fork drainage in 1980 and 237 were counted in 1981. In 1980, 258 redds, representing 86 percent of the total spawning in the Middle Fork drainage, were located in tributaries upstream from Bear Creek. In 1981, 183 or 77 percent of the redds counted were located in tributaries upstream from Bear Creek.

North Fork River

In the lower snorkel section of the North Fork River from Big Creek to Red Meadow Creek, the mountain whitefish was the most abundant species, followed by the cutthroat trout (Table 4). No juvenile or mature bull

Table 2. Estimates of numbers of cutthroat trout, bull trout, and mountain whitefish per mile of the Middle Fork Flathead River at Nyack and above Park Creek. Estimates are based on snorkel counts made in late summer, 1981.

	Number of fish per mile								
	Cutthroat trout			Bull trout				Mountain whitefish	
Area	Age I	Age II	Age III and older	Age I	Age II	Age III and older	Mature	<150mm	>150mm
At Nyack	0	0	19	0	0	0	0	137	774
Above Park Creek	0	0	14	3	0	7	3	108	698

Table 3. Estimates of number of cutthroat trout, bull trout and mountain whitefish per mile in sections of the Middle Fork of the Flathead River above and below Schafer Meadows. Estimates are based on snorkel runs made in late summer, 1980.

	Number of fish per mile								
	Cutthroat trout			Bull trout				Mountain whitefish	
Area	Age I	Age II	Age III and older	Age I	Age II	Age III and older	Mature	<150mm	>150mm
Above Schafer Meadows	1.0	4.1	66.9	6.1	2.9	0.6	4.1	72.4	588.1
Below Schafer Meadows	2.8	0.1	40.3	<0.1	5.6	<0.1	5.8	21.9	1068.1

trout were observed in this section; however, juvenile bull trout may have been present but undetected. In the upper section (Red Meadow Creek to the Canadian border), the mountain whitefish was still the most abundant species followed by cutthroat trout and juvenile bull trout (Table 5). It is likely that the juvenile bull trout population was, again, underestimated. The highest density of cutthroat trout within the North Fork was found in the upper section.

Although a small number of adult kokanee have been observed in the North Fork during the fall spawning season, no kokanee spawning has ever been documented in the North Fork. A total of 268 bull trout redds were counted in the North Fork drainage in 1980. Sixty-four percent of these were in tributaries located in the United States. In 1981, a total of 467 redds were counted in the North Fork drainage. Sixty-nine percent of these were in tributaries located in the U.S. Two important bull trout spawning tributaries, Big and Coal creeks, enter the North Fork below Bowman Creek. These two tributaries contained 83 redds in 1980 and 102 redds in 1981. Three other important spawning tributaries, Red Meadow, Whale and Trail creeks, enter the North Fork between Bowman Creek and the Canadian border. These three drainages contained 88 redds in 1980 and 219 in 1981.

South Fork River

In the downstream snorkel section of the South Fork River, the mountain whitefish was the most abundant species followed by age III and older cutthroat trout (Table 6). No juvenile bull trout were observed in this section although they may have been present. In the upstream section, the mountain whitefish was again the most abundant species followed by cutthroat trout and then bull trout. Three mature bull trout were observed in this section (Table 7).

No bull trout redd surveys have been completed on the upper South Fork drainage.

WILDLIFE

A wide array of game and nongame species of wildlife inhabit or utilize the diverse riparian habitat along the Flathead River and its forks. These birds and animals provide many recreational opportunities, not only for hunters and trappers, but also for wildlife viewers, photographers and other nonconsumptive users.

The upper forks of the Flathead flow through designated wilderness areas, along the edge of Glacier National Park and through Forest Service and sparsely populated private land. The river channels along these upper forks vary from steep-walled canyon sections to broad valley flats. The rivers braid frequently in these flats, forming islands. The riparian zone is well developed in these areas and is vegetated with alder, willow, cottonwood, aspen and conifers. The surrounding land consists of mixed coniferous forests. The riparian zone is small and poorly defined in most of the canyon areas.

Table 4. Observed densities (number of fish per acre) of cutthroat trout, bull trout and mountain whitefish in run habitats of the North Fork Flathead River snorkeled during the summer of 1980.

	Number fish per acre						
	Cutthroat trout			Bull trout		Mountain whitefish	
Feature	Age I	Age II	Age III and older	Age III and older	Mature	<150mm	>150mm
North Fork runs downstream from Red Meadow Creek	---	0.8	10.5	---	---	38.4	71.2

Table 5. Observed densities (number of fish per acre) of cutthroat trout, bull trout and mountain whitefish in run habitats of the North Fork Flathead River snorkeled during the summer of 1980.

	Number of fish per acre						
	Cutthroat trout			Bull trout		Mountain whitefish	
Feature	Age I	Age II	Age III and older	Age III and older	Mature	<150mm	>150mm
North Fork runs above Red Meadow Creek	0.4	20.2	20.2	0.4	0.2	20.2	44.1

Table 6. Estimates of numbers of cutthroat trout and mountain whitefish per mile in the South Fork of the Flathead River below the mouth of the White River. Estimates are based on expanded snorkel observations made in late summer, 1981.

Number per mile				
Cutthroat trout			Mountain whitefish	
Age I	Age II	Age III and older	<150mm	>150mm
0	0	130	175	1,062

Table 7. Estimates of numbers of cutthroat trout, bull trout and mountain whitefish per mile in the South Fork of the Flathead River below the mouth of Gordon Creek. Estimates are based on expanded snorkel observations made in August, 1981.

Number per mile								
Cutthroat trout			Bull trout				Mountain whitefish	
Age I	Age II	Age III and older	Age I	Age II	Age III	Mature	<150mm	>150mm
3	54	105	2	0	2	3	275	1,334

The mainstem Flathead River flows approximately 13 miles through Badrock Canyon then widens out along the floor of the Flathead valley flowing predominantly through agricultural land. The riparian zone is well developed and consists of cottonwood, willow, alder and birch. There are numerous islands, side channels and oxbow lakes along the lower river which provide additional riparian habitat for wildlife.

Waterfowl

Canada geese, mallards, pintails, lesser scaup, teal, wood ducks, widgeon, mergansers, goldeneyes, buffleheads and harlequin ducks are all seasonal users of the river. Most of these species also nest and rear young along the river.

Upland Game Birds

Ruffed grouse are present in wooded areas along the river throughout the drainage. Ring-necked pheasants and hungarian partridge are abundant in suitable habitat, particularly below Columbia Falls. Local populations of Merriam's turkeys are found along the lower river although no hunting season is presently held on them. Much of the upper drainage is bordered by forest habitat in which all three species of mountain grouse (ruffed, blue and Franklin's) can be found.

Bald Eagle and Osprey

Both bald eagles and osprey nest and rear young along the mainstem Flathead River and its forks. Osprey migrate out of the area during the winter, but some bald eagles are generally present along the river year-round. Resident bald eagles are joined by large numbers of migrating eagles that concentrate along the river in the fall to feed on dead and dying kokanee.

Big Game

The white-tailed deer inhabits the river bottoms year-round throughout the entire drainage, and is the major big game species found along the lower river. Other big game species that utilize the riparian zone of the drainage, at least on a seasonal basis, include elk, moose, mule deer, black bear, grizzly bear and mountain lion. Habitat along much of the drainage provides important winter range requirements for white-tailed and mule deer, moose and elk.

Furbearers

Beaver, otter, muskrat and mink are the primary furbearers associated with the river bottoms. They provide a considerable amount of recreation and income to valley residents during the trapping season.

RIVER SECTIONS AND FLOW RECOMMENDATIONS

MAINSTEM RIVER

Mainstem Flathead River from Flathead Lake upstream to the confluence of North and Middle Forks.

Description

Stream Length

Flathead River (inlet to Flathead Lake upstream to the confluence of North and Middle Forks): 55.3 miles

Inlet to Flathead Lake upstream to the mouth of the South Fork: 45.7 miles

Mouth of the South Fork upstream to the mouth of the Middle Fork: 9.6 miles

Drainage Area

Total Flathead River (above Flathead Lake): 5571 square miles.

Gradient

Total Flathead River (above Flathead Lake): 12.3 ft/mile (0.23%).

Flathead Lake inlet to South Fork: 2.8 ft/mile (0.05%).

South Fork to Middle Fork: 6.8 ft/mile (0.16%).

Origin

The Flathead River originates in the Rocky Mountains of British Columbia. The river is named the Flathead River in Canada until crossing the Canadian border. At this point, it is known as the North Fork of the Flathead River down to the confluence of the Middle Fork where it is again named the Flathead River. From the confluence of the Middle Fork, the river flows approximately 13 miles through Badrock Canyon before entering the Flathead Valley. The South Fork enters the main river in the canyon about 10 miles downstream from the confluence of the North and Middle Forks.

From the mouth of the Middle Fork downstream to the mouth of the South Fork the mainstem is somewhat entrenched. The riparian zone is not well defined with conifers being the primary vegetative type. There are scattered areas of cottonwood, willow and alder.

The lower mainstem Flathead River above Flathead Lake is a low gradient river flowing through agricultural land. There are numerous islands, side channels, and oxbow lakes. The riparian zone consists of cottonwood, willow, alder, and birch.

Water Quality

The Flathead River above Flathead Lake has an A-1 water quality classification from the State Water Quality Standards. Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. Water quality must be suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

The U.S.G.S. National Stream Quality Accounting Network has a site (12363000) at Columbia Falls (T30N, R20W, Sec. 17). During the water year October 1979 to September 1980 hardness as $CaCO_3$ (mg/l) ranged from 66 to 110, pH ranged from 7.4 to 8.3, D.O. ranged from 8.4 to 12.9, and total nitrogen ammonia (mg/l as N) ranged from .00 to .04. Many other water quality parameters are monitored. For a listing of results consult the U.S.G.S.'s "Water Resources Data for Montana" Volume 2. Upper Columbia River Basin" reports.

Recreation Usage

The Flathead River upstream from its confluence with the South Fork is classified a Recreational River under the National Wild and Scenic Rivers Act of 1976. This section is extremely popular with recreational floaters. The section of the Flathead River downstream from the mouth of the South Fork is also popular with recreational floating even though flows are partly regulated by release from Hungry Horse Dam (on the South Fork) and subject to extreme fluctuations. The mainstem Flathead River supports a high quality westslope cutthroat trout, trophy bull trout and seasonal kokanee salmon fishery. A creel census in 1981 estimated fishing pressure on the mainstem Flathead River at 35,940 man-days, or approximately 650 man-days per mile. The estimated harvest was 89,273 fish, of which 86 percent were kokanee. Other important species were westslope cutthroat trout (8,557-10%), mountain whitefish (1,582-2%) and bull trout (1,827-2%).

Waterfowl hunters frequently use the lower river and sloughs along the river.

Potential Environmental Problems

A potential dam site is located near Coram, Montana. Classification of the river under the National Wild and Scenic River Act and the proximity of Glacier National Park should preclude construction of the dam at this time. Some irrigation withdrawals are made in the Flathead Valley but there is no threat of dewatering. Minimum flows in the river below the South Fork have been much lower than historical averages since impoundment of the South Fork by Hungry Horse Dam (1951).

Reach I

Flathead Lake to the confluence of the South Fork.

Flows

A. U.S.G.S. gauge is located 5.7 miles downstream from the mouth of the South Fork. The South Fork contributes approximately one third of the river's flow and has been regulated by Hungry Horse Dam since September 21, 1951. The average discharge of the Flathead River for the 52 year period of record (1928-1980) is 9,724 cfs (7,045,000 acre-feet per year) with a maximum estimated discharge of 176,000 cfs and a minimum of 798 cfs. Flow records from this gauge were used in calculating the 80th percentile flows for this reach.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat in 12 high quality trout streams. For the 45.7 mile reach of the Flathead River from Flathead Lake upstream to the mouth of the South Fork, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1 - March 31	3,625
April 1 - September 30	8,125

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 3) occurs at a flow of about 3,500 cfs. For adjudication purposes a flow of 3,500 cfs is recommended for the low flow period. The Northwest Power Planning Council has adopted specific flow requirements for this reach of the mainstem Flathead River. These requirements as listed under Section 804(a)(1) of their Columbia River Basin Fish and Wildlife Program (1982) are as follows:

1) Spawning - Flow shall not be less than 3,500 cfs or more than 4,500 cfs from October 15 through December 15,

2) Incubation - A minimum flow of at least 3,500 cfs shall be provided 24 hours per day from December 15 through April 30,

3) Emergence - Flows shall be provided during the period from March 15 through initiation of spring runoff (usually mid-April) to flush emerging fry downstream to Flathead Lake; and

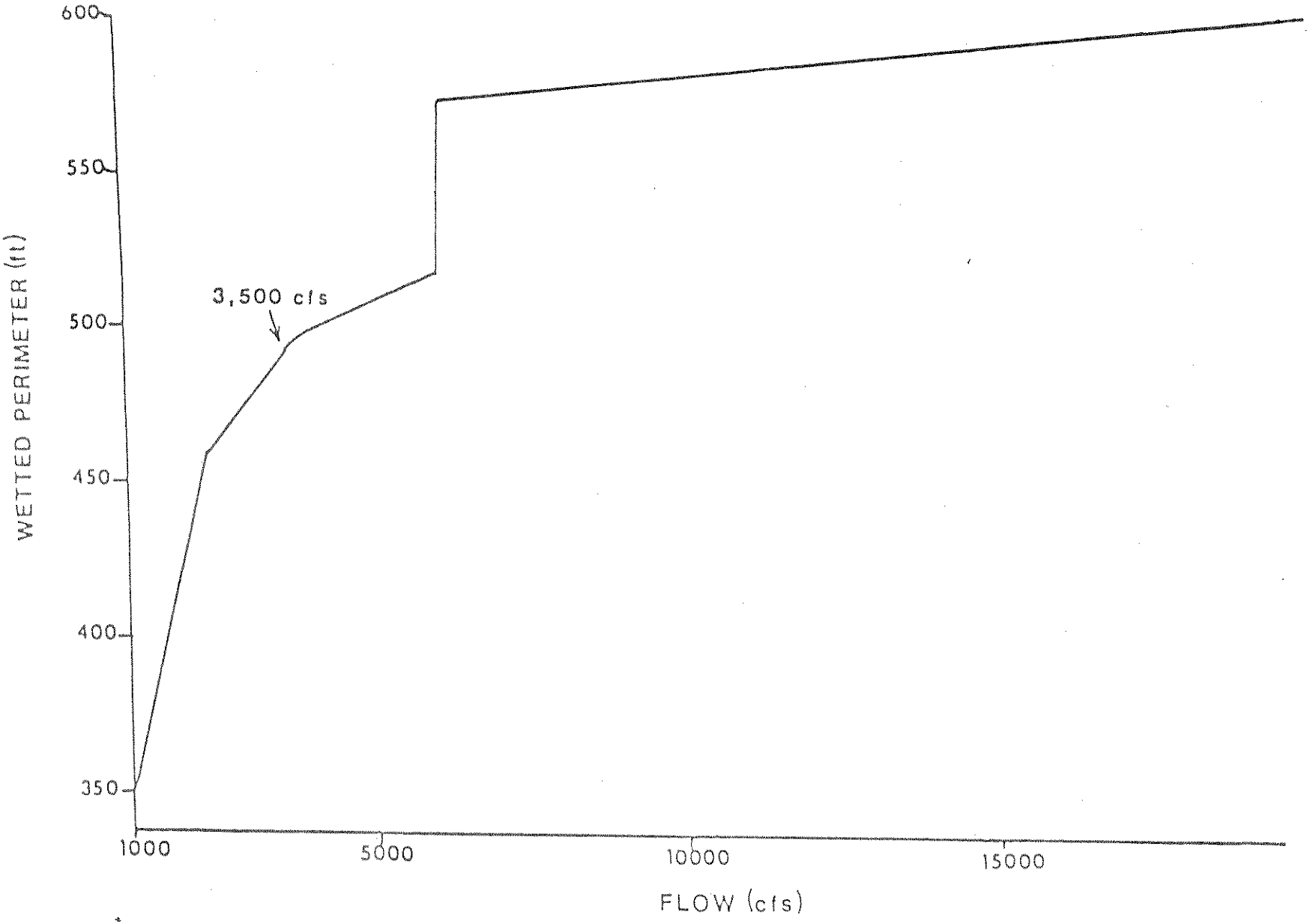

Figure 3. Relationship between wetted perimeter and flow for a riffle cross-section in the Flathead River.

4) Other - A minimum flow of at least 3,500 cfs in the Flathead River at Columbia Falls shall be provided 24 hours per day from July 1 through October 15.

The monthly flow recommendations derived from the combined kokanee spawning/incubation and wetted perimeter/inflection point method and the dominant discharge/channel morphology concept are listed in Table 8.

The flow recommendations, in addition to maintaining the resident cutthroat trout, rainbow trout, and mountain whitefish populations at the existing level, would also serve to:

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the summer and fall to their spawning areas as well as their return to Flathead Lake,

2) facilitate the upstream passage of kokanee salmon in September, October and November to their spawning areas,

3) maintain favorable spawning and incubation habitat for kokanee salmon,

4) maintain favorable habitat for the rearing of juvenile cutthroat and bull trout, and

5) facilitate the downstream passage of juvenile trout and kokanee fry to Flathead Lake.

For adjudication purposes, these recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The final claim is listed along with the original filing in Table 8. The final claim is less than the original filing for the period of July 16-April 30 and amounts to a net flow reduction of 872,408 acre-feet from the original filing, a reduction of 20.5 percent.

It is imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain the spawning and incubation habitat in this reach.

The final claim is compared to the median monthly flows of record, as derived from U.S.G.S. flow records for the gauge at Columbia Falls in Table 9. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of 10 years, or in other terms, in five years out of 10 there is more water than the median flowing in the river. The final claim is less than the median flows for the periods of April 1 - August 31 and October 1 - January 31 and slightly exceeds the medians for February 1 - March 31 and September 1 - 30.

The final claim, when adjusted to fall within the constraints of water availability for a median or normal year, equals 3,343,421 acre-feet of

Table 8. Monthly flow recommendations for the Flathead River (from Flathead Lake upstream to the South Fork) compared to the original filing of December 22, 1970 and the final claim.

Time period	Flow recommendations (cfs)[a/]	Original filing (cfs)[b/]	Final claim (cfs)[c/]
January	3,500	3,625	3,500
February	3,500	3,625	3,500
March	3,500	3,625	3,500
April 1-15	3,500	8,125	3,500
April 16-30	6,650	8,125	6,650
May 1-15	13,784	8,125	8,125
May 16-31	20,944[d/]	8,125	8,125
June 1-15	20,720	8,125	8,125
June 16-30	13,267	8,125	8,125
July 1-15	8,519	8,125	8,125
July 16-31	5,402	8,125	5,402
August	3,500	8,125	3,500
September	3,500	8,125	3,500
October	3,500[e/]	3,625	3,500
November	3,500[e/]	3,625	3,500
December	3,500[e/]	3,625	3,500

[a/] Derived from the wetted perimeter/inflection point method, the kokanee spawning and incubation requirements and the dominant discharge/channel morphology concept.

[b/] Flows as originally filed on December 22, 1970.

[c/] Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

[d/] The approximate bankful discharge (presently undefined) should be maintained for 24 hours during this period.

[e/] During the period of October 15-December 15, flows should not exceed 4,500 cfs to prevent kokanee from spawning in areas subject to later dewatering.

Table 9. Comparison of the final instream claim for the Flathead River (from Flathead Lake upstream to the South Fork) to the approximate median flows of record.

Time Period	Final claim (cfs)	Approximate median flows[a]	
		cfs	Acre-feet
January	3,500	4,270	262,490
February	3,500	3,360	186,561
March	3,500	3,280	201,631
April 1-15	3,500	6,790	201,969
April 16-30	6,650	14,587	433,890
May 1-15	8,125	21,347	634,967
May 16-31	8,125	30,412	964,912
June 1-15	8,125	29,300	871,529
June 16-30	8,125	23,067	686,128
July 1-15	8,125	13,980	415,835
July 16-31	5,402	7,537	239,134
August	3,500	4,490	276,014
September	3,500	3,170	188,583
October	3,500	4,850	298,144
November	3,500	4,420	262,946
December	3,500	5,500	338,102
			6,462,835[b]

[a] Derived from a 49 year period of record (between 1931-1979 water years) for the U.S.G.S. gauge station at Columbia Falls (5.7 miles downstream from the South Fork).

[b] Approximate volume of water normally available on an annual basis.

water per year, which is about 51.7 percent of the annual volume of water that is normally available at the U.S.G.S. gauging site on the Flathead River at Columbia Falls (5.7 miles downstream from the South Fork).

It should be recognized that the flow claimed by the MDFWP for fish and wildlife includes natural, unregulated flows from the North and Middle Forks that must be supplemented with regulated flows from the South Fork out of Hungry Horse Dam. Historically, the South Fork provided about one-third of the total flow of the main Flathead and while it still provides a similar volume of water annually, the pattern of flow has been significantly altered seasonally and daily. In order for the claim of the MDFWP to be met, a base flow from the South Fork must be provided.

Reach II

Confluence of the South Fork to the confluence of the Middle Fork.

Flows

There is no gauging station located between the mouth of the South Fork and the mouth of the Middle Fork. Gauging stations are located on the Middle Fork 3.8 miles above its mouth and on the North Fork 3.8 miles above the mouth of the Middle Fork. A reasonable estimate of flows on the mainstem between the Middle Fork and the South Fork can be made by adding the combined flows of the North and Middle Forks.

Flow	North Fork Flow(cfs)	Middle Fork Flow(cfs)	Mainstem Flow(cfs)
Average	2,981	2,938	5,919
Maximum	69,100	140,000	209,100
Minimum	198	173	371

The 80th percentile flows for this reach were estimated from U.S.G.S flow records for the gauges on the lower North and Middle Forks.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat in 12 high quality trout streams. For the 9.6 mile reach of the Flathead River from the mouth of the South Fork to the mouth of the Middle Fork, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1-March 31	1,950
April 1-September 30	5,000

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 4) occurs at a flow of about 2,100 cfs. For adjudication purposes a flow of 2,100 cfs is recommended for the low flow period.

The monthly flow recommendations derived from the wetted perimeter/-inflection point method and the dominant discharge/channel morphology concept are listed in Table 10. These flow recommendations, in addition to maintaining the resident cutthroat trout, rainbow trout and mountain whitefish populations at the existing level, would also serve to:

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the spring and bull trout in the summer and fall to their spawning areas as well as their return to Flathead Lake,

2) facilitate the upstream passage of kokanee salmon in September, October and November to their spawning areas,

3) maintain favorable spawning and incubation habitat for kokanee salmon,

4) maintain favorable habitat for the rearing of juvenile cutthroat and bull trout,

5) facilitate the downstream passage of juvenile trout and kokanee fry to Flathead Lake,

6) provide a flushing action which cleanses the bottom gravels, and

7) maintain the existing channel morphology.

For adjudication purposes, these recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The final claim is listed along with the original filing in Table 10. The final claim is less than the original filing for the periods of April 1-30 and July 16-September 30 and amounts to a net flow reduction of 512,259 acre-feet from the original filing, a reduction of 20 percent.

In order to achieve the fishery objective described above, it is imperative that the flows in this section of river be maintained at the recommended level rather than the claimed level during the low flow period. It is also imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain existing channel morphology.

The final claim is compared to the approximate median monthly flows of record, as derived from USGS flow records for the gauges on the lower North and Middle Forks, in Table 11. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of ten years or, in other terms, in five years out of ten there is more water than the median flowing in the river. Table 11

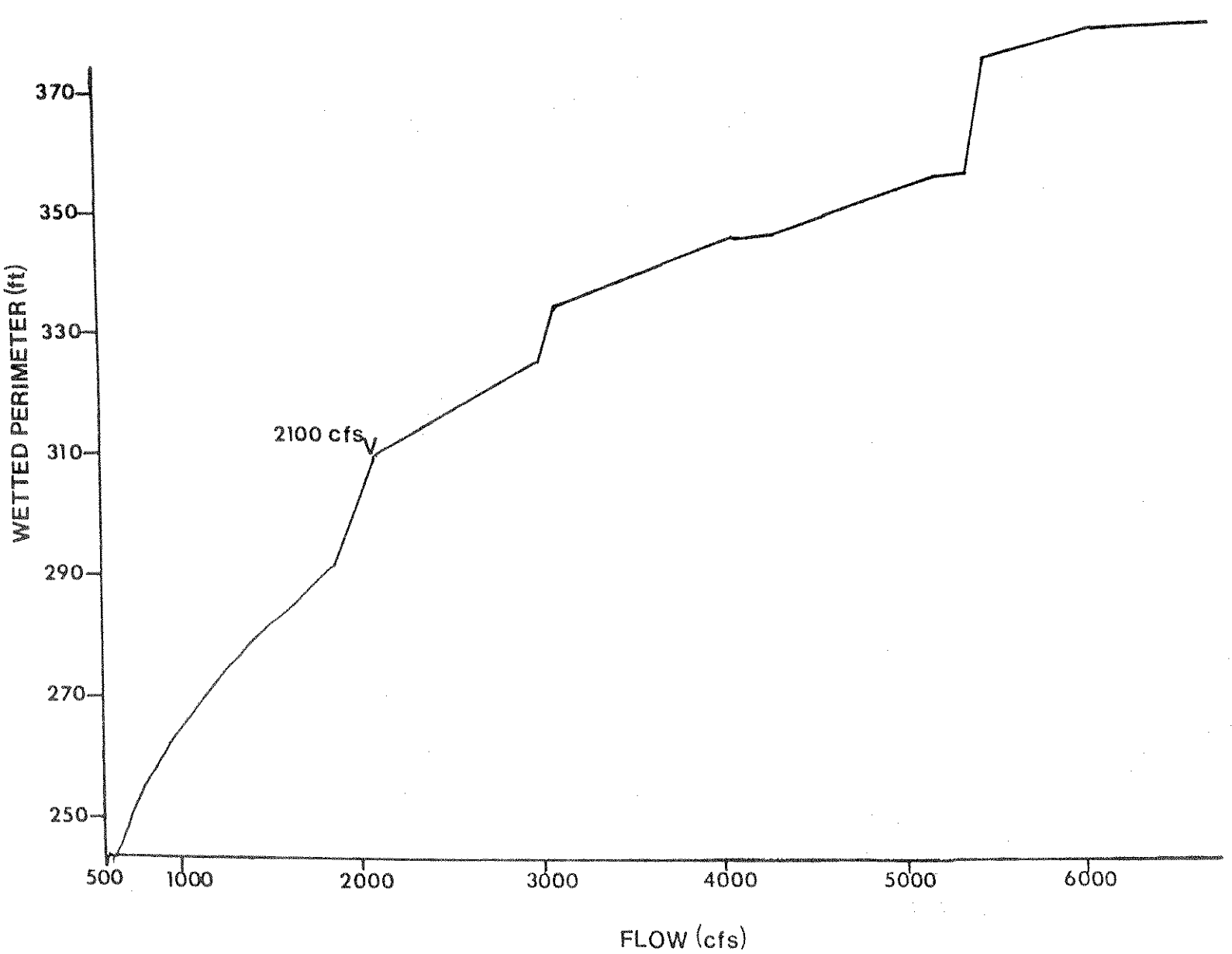

Figure 4. Relationship between wetted perimeter and flow for four riffle-run cross-sections located in the Flathead River.

Table 10. Monthly flow recommendations for the mainstem Flathead River (from the confluence of the South Fork to the confluence of the Middle Fork) compared to the original filing of December 22, 1970 and the final claim.

Time period	Flow recommendations (cfs)[a/]	Original filing (cfs)[b/]	Final claim (cfs)[c/]
January	2,100	1,950	1,950
February	2,100	1,950	1,950
March	2,100	1,950	1,950
April 1-15	2,100	5,000	2,100
April 16-30	3,597	5,000	3,597
May 1-15	9,312	5,000	5,000
May 16-31	15,613	5,000	5,000
June 1-15	15,971[d/]	5,000	5,000
June 16-30	10,943	5,000	5,000
July 1-15	6,915	5,000	5,000
July 16-31	3,945	5,000	3,945
August	2,100	5,000	2,100
September	2,100	5,000	2,100
October	2,100	1,950	1,950
November	2,100	1,950	1,950
December	2,100	1,950	1,950

[a/] Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

[b/] Flows as originally filed on December 22, 1970.

[c/] Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

[d/] A flow of 37,234 cfs (the approximate bankful discharge) should be maintained for 24 hours during this period.

shows that the final claim is less than the median flows for the period of April 1 - August 31 and exceeds the medians from September 1-March 31.

The final claim, when adjusted to fall within the constraints of water availability during a median or normal water year, equals 1,834,522 acre-feet of water per year, which is bout 46 percent of the annual volume of water that is normally available in the reach of the Flathead River between the mouths of the South and Middle Forks.

MIDDLE FORK RIVER

Middle Fork of the Flathead River (from the mouth of the Middle Fork upstream to the mouth of Cox Creek).

Description

Stream Length

Total Length of Middle Fork: 91.0 miles

Mouth to Bear Creek: 44.4 miles
Bear Creek to Cox Creek: 33.4 miles
Cox Creek to headwaters: 13.2 mile

Drainage Area

Total Middle Fork: 1,128 square miles

Mouth to Bear Creek: 639 square miles
Bear Creek to headwaters: 489 square miles

Gradient

Total Middle Fork: 23.2 ft/mile (0.4%)

Mouth to Bear Creek: 15.6 ft/mile (0.3%)

Bear Creek to headwaters: 33.6 ft/mile (0.6%)

Origin

The Middle Fork of the Flathead River originates at the confluence of Bowl and Strawberry creeks in the Bob Marshall Wilderness Area. The Lewis and Clark Range of the Rocky Mountains, which forms the Continental Divide along the east side of the upper Middle Fork, and the Flathead Range on the west are generally 6,982 to 7,979 feet high.

Water Quality

The Middle Fork has an A-1 classification under the State Water Quality Standards. Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. Water quality must be suitable

Table 11. Comparison of the final instream claim for the mainstem Flathead River (from the confluence of the South Fork to the confluence of the Middle Fork) to the approximate median flows of record.

Time period	Final claim (cfs)	Approximate median flows[a/]	
		cfs	Acre-feet
January	1,950	1,293	79,485
February	1,950	1,222	67,850
March	1,950	1,367	84,034
April 1-15	2,100	2,985	88,789
April 16-30	3,597	6,807	202,474
May 1-15	5,000	14,128	420,237
May 16-31	5,000	22,871	725,651
June 1-15	5,000	23,772	707,098
June 16-30	5,000	16,416	488,294
July 1-15	5,000	10,663	317,171
July 16-31	3,945	5,494	174,314
August	2,100	3,050	187,493
September	2,100	1,833	109,045
October	1,950	1,816	111,635
November	1,950	1,789	106,428
December	1,950	1,607	98,787
			3,968,785

[a/] Derived by adding the median monthly flows for the USGS gauge on the North Fork near Columbia Falls and the USGS gauge on the Middle Fork near West Glacier, both for a 39-year period of record (between 1941-1979 water years).

for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

Recreational Usage

The section of the Middle Fork from its mouth to the confluence of Bear Creek is classified as a Recreational River under the National Wild and Scenic Rivers Act of 1976. The section of the Middle Fork upstream from Bear Creek is classified as a Wild River under this same act. The Middle Fork River drains the Bob Marshall and Great Bear Wilderness areas. This whole river is popular for white water rafting. Floating in the upper section becomes marginal by late July as runoff subsides, but floating continues throughout the summer in the lower section. Forest Service estimates of floating use in 1979 were 125-150 floaters between Schafer Meadows and Bear Creek and 8,000 from Bear Creek downstream.

The Middle Fork supports a high quality westslope cutthroat trout and trophy bull trout fishery, and the lower Middle Fork also supports a good seasonal kokanee salmon fishery. A creel census in 1975 estimated total fishing pressure on the Middle Fork at 7,372 man-days, or about 81 man-days/river miles. The estimated harvest of fish during the summer period was 6,656. The two most important species were cutthroat (67% of the harvest) and bull trout (11% of the harvest). The bull trout provides a trophy fishery, as the minimum size limit is 18 inches. An estimated 751 bull trout were creeled by anglers in 1975. The harvest in 1975 also included 4,454 cutthroat trout and 649 mountain whitefish.

Potential Environmental Problems

There is a proposed high-head dam site at Spruce Park 5.6 miles upstream from Bear Creek. The classification of the river under the National Wild and Scenic River Act should preclude construction of the dam at this time. No known dewatering threats exist.

Reach I

Mouth of the Middle Fork of the confluence of Bear Creek.

Flows

A U.S.G.S. gauge located 3.8 miles upstream from the mouth of the Middle fork, near West Glacier, has been operating continuously since October, 1939. The average discharge for the 41 years of record is 2,938 cfs with the maximum estimated discharge of 140,000 cfs and a minimum of less than 173 cfs. The 80th percentile flows for this reach of the Middle Fork were estimated using flow records from this gauge.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat on 12 high quality trout streams. For

the 44.4-mile reach of the Middle Fork of the Flathead River between the mouth and the confluence of Bear Creek, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1-March 31	970
April 1-September 30	2,325

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 5) occurs at a flow of about 850 cfs. For adjudication purposes a flow of 850 cfs is recommended for the low flow period.

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the spring and bull trout in the summer and fall to their spawning areas as well as their return to Flathead Lake,

2) facilitate the upstream passage of kokanee salmon in September, October and November to their spawning areas,

3) maintain favorable spawning and incubation habitat for kokanee salmon,

4) maintain favorable habitat for the rearing of juvenile trout,

5) facilitate the downstream passage of juvenile cutthroat and bull trout and kokanee fry to Flathead Lake,

6) provide a flushing action which cleanses the bottom gravels, and

7) maintain the existing channel morphology.

For adjudication purposes, these recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed the original filing. This final claim is listed in Table 12 along with the original filing. The final claim is less than the original filing for the period of July 16 through April 30 and amounts to a net flow reduction of 293,654 acre-feet from the original filing, a reduction of 25 percent.

It is imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain the spawning and incubation habitat in this reach.

The final claim is compared to the median monthly flows of record, as derived from U.S.G.S. flow records for the gauge near West Glacier, in Table 13. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in

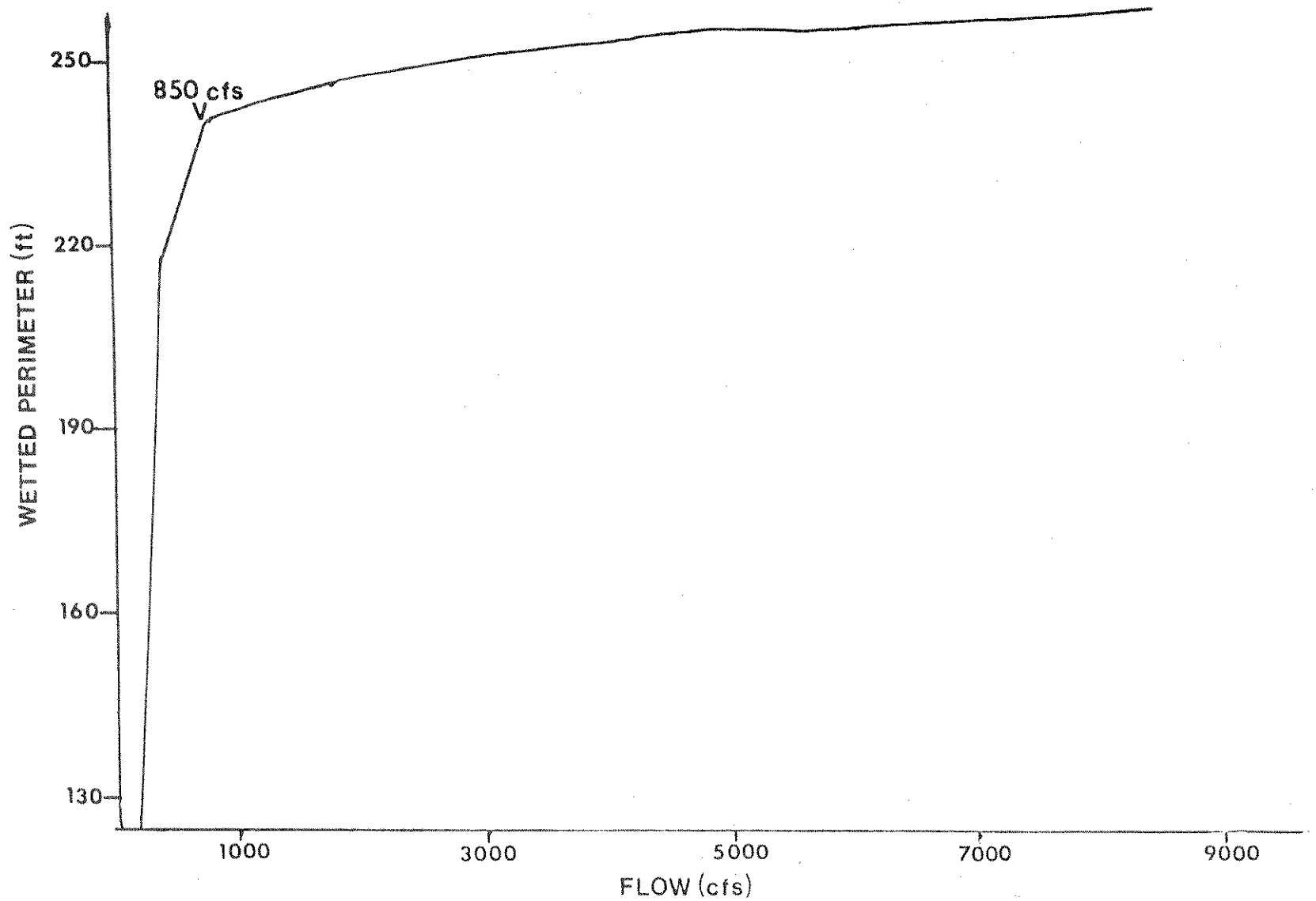

Figure 5. The relationship between wetted perimeter and flow for a riffle-run transect on the lower Middle Fork of the Flathead River.

Table 12. Monthly flow recommendations for the Middle Fork of the Flathead River (from its mouth upstream to Bear Creek) compared to the original filing of December 22, 1970 and the final instream claim.

Time period	Flow recommendations (cfs)[a/]	Original filing (cfs)[b/]	Final claim (cfs)[c/]
January	850	970	850
February	850	970	850
March	850	970	850
April 1-15	850	2,325	850
April 16-30	1,831	2,325	1,831
May 1-15	4,571	2,325	2,325
May 16-31	7,589	2,325	2,325
June 1-15	7,970[d/]	2,325	2,325
June 16-30	5,479	2,325	2,325
July 1-15	3,433	2,325	2,325
July 16-31	1,904	2,325	1,904
August	850	2,325	850
September	850	2,325	850
October	850	970	850
November	850	970	850
December	850	970	850

a/ Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

b/ Flows as originally filed on December 22, 1970.

c/ Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

d/ Includes a flow of 19,167 cfs (the approximate bankful discharge) for 24 hours.

Table 13. Comparison of the final instream claim for the Middle Fork of the Flathead River (from its mouth upstream to Bear Creek) to the approximate median flows of record.

Time Period	Final Claim (cfs)	Approximate Median Flows[a/]	
		Cfs	Acre-feet
January	850	646	39,712
February	850	557	30,927
March	850	650	39,957
April 1-15	850	1,488	44,261
April 16-30	1,831	3,378	100,479
May 1-15	2,325	6,843	203,545
May 16-31	2,325	11,249	356,908
June 1-15	2,325	11,700	348,017
June 16-30	2,325	8,227	244,712
July 1-15	2,325	5,144	153,008
July 16-31	1,904	2,560	81,224
August	850	1,360	83,603
September	850	793	47,176
October	850	820	50,408
November	850	845	50,269
December	850	840	51,637
			1,925,843[b/]

[a/] Derived for a 39-year period of record (between 1941-1979 water years) for the USGS gauge station near West Glacier (3.8 miles upstream from the mouth of the Middle Fork).

[b/] Approximate volume of water normally available on an annual basis.

five of 10 years or, in other terms, in five years out of 10 there is more water than the median flowing in the river. Table 13 shows that the final claim is less than the median flows for the period of April 1 - August 31 and slightly exceeds the medians for the period of September 1 - March 31.

The final claim, when adjusted to fall within the constraints of water availability for a median or normal water year, equals 852,890 acre-feet of water per year, which is about 44 percent of the annual volume of water that is normally available at the U.S.G.S. gauging site near West Glacier (3.8 miles upstream from the mouth of the Middle Fork).

Reach II

Confluence of Bear Creek upstream to the confluence of Cox Creek.

Flow

A U.S.G.S. gauge located at Essex, Montana, 4.4 miles downstream from Bear Creek, was operated from 1939 to 1953 and 1956 to 1960. The maximum discharge was 14,500 cfs (flood estimated at 18,000 cfs) and the minimum was 30 cfs. The mean flow for the period was 1,064 (770,300 acre-feet per year). The 80th percentile flow for this reach of the Middle Fork were estimated using flow records from this gauge.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat on 12 high quality trout streams. For the 33.4 mile reach of the Middle Fork of the Flathead River between the mouths of Bear and Cox Creeks, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1 - March 31	75
April 1 - September 30	180

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 6) occurs at a flow of about 350 cfs. For adjudication purposes a flow of 350 cfs is recommended for the low flow period.

The monthly flow recommendations derived from the wetted perimeter/-inflection point method and the dominant discharge/channel morphology concept are listed in Table 14. These flow recommendations, in addition to maintaining the resident cutthroat trout and mountain whitefish populations at the existing levels, would also:

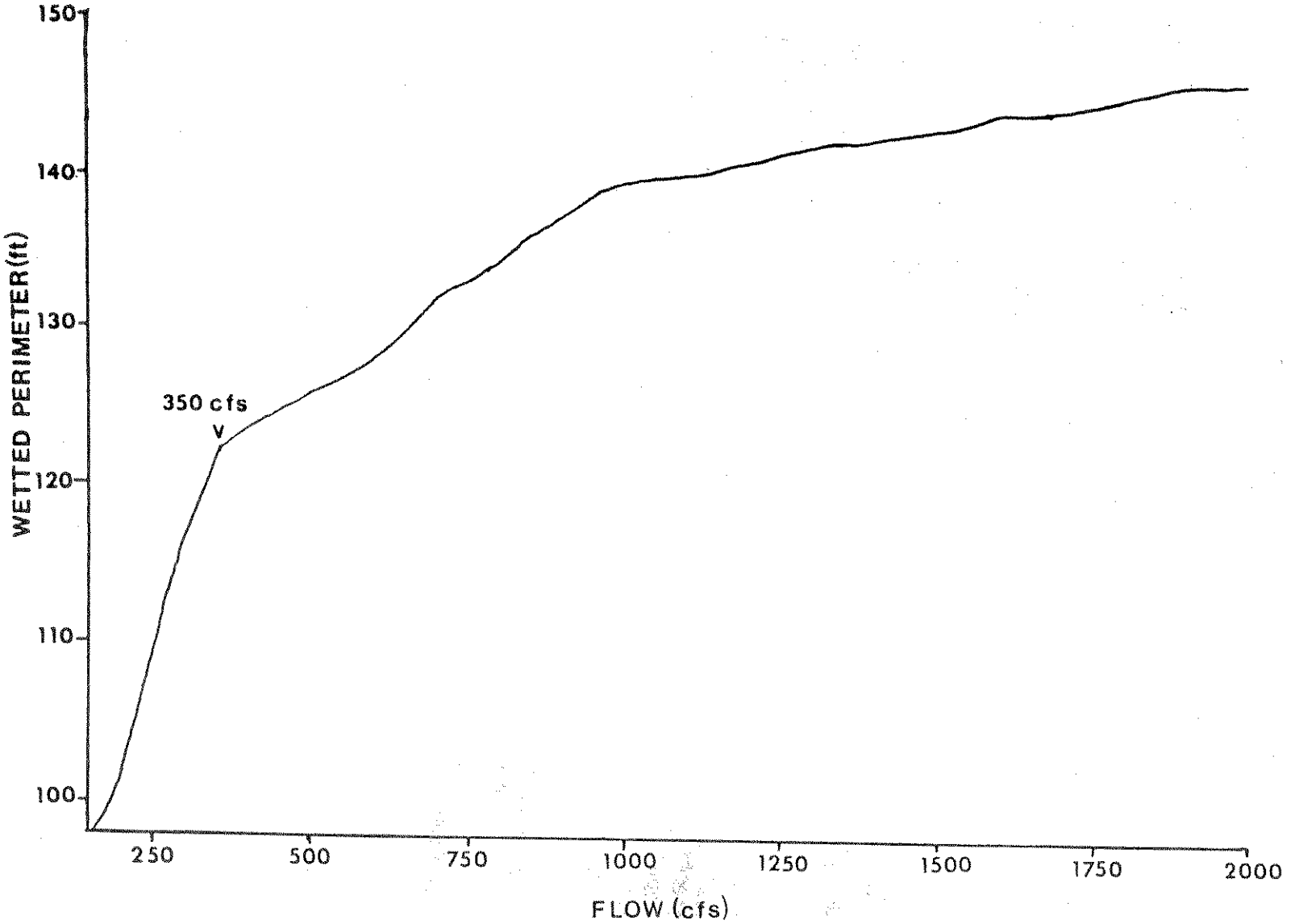

Figure 6. The relationship between wetted perimeter and flow for four riffle-run transects on the upper Middle Fork of the Flathead River.

Table 14. Monthly flow recommendations for the Middle Fork of the Flathead River (from Bear Creek upstream to Cox Creek) compared to the original filing of December 22, 1970 and the final claim.

Time period	Flow recommendations (cfs)[a/]	Original filing (cfs)[b/]	Final claim (cfs)[c/]
January	350	75	75
February	350	75	75
March	350	75	75
April 1-15	350	180	180
April 16-30	785	180	180
May 1-15	2,230	180	180
May 16-31	3,964[d/]	180	180
June 1-15	2,968	180	180
June 16-30	1,602	180	180
July 1-15	881	180	180
July 16-31	484	180	180
August	350	180	180
September	350	180	180
October	350	75	75
November	350	75	75
December	350	75	75

a/ Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

b/ Flows as originally filed on December 22, 1970.

c/ Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

d/ Includes a flow of 8,283 cfs (the approximate bankful discharge) for 24 hours.

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the spring and bull trout in the summer and fall to their spawning areas and their return to Flathead Lake,

2) maintain favorable habitat for the rearing of juvenile bull and cutthroat trout,

3) facilitate the downstream passage of juvenile trout to Flathead Lake,

4) provide a flushing action which cleanses the bottom gravels, and

5) maintain the existing channel morphology.

For adjudication purposes, these recommendations must be adjusted to the constraints imposed by the original instream filing on December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The recommended flows (Table 14) exceed the original filing for all months. Therefore, the final claim is the same as originally filed.

In order to achieve the fishery objectives described above, it is imperative that the flows in this section of river be maintained at the recommended levelrather than the claimed level during the low flow period. It is also imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain existing channel morphology.

The final claim is compared to the median monthly flows of record, as derived from U.S.G.S. flow records for the gauge at Essex, in Table 15. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of 10 years, or, in other terms, in five years out of 10 there is more water than the median flowing in the river. Table 15 shows that the final claim is considerably less than the median flows for all 12 months.

The final claim amounts to 92,385 acre-feet of water per year, which is about 12 percent of the annual volume of water that is normally available at the U.S.G.S. gauging site at Essex (Table 15).

NORTH FORK RIVER

North Fork of the Flathead River (from the mouth of the Middle Fork upstream to the Canadian border).

Description

Stream Length

Length of the North Fork (mouth of the Middle Fork up to Canadian border); 58.3 miles

Mouth of the Middle Fork up to the mouth of Bowman Creek: 33.5 miles

Table 15. Comparison of the final instream claim for the Middle Fork of the Flathead River (from Bear Creek upstream to Cox Creek) to the approximate median flows of record.

Time Period	Final Claim		Approximate Median Flows[a]	
	cfs	Acre-feet	cfs	Acre-feet
January	75	4,610	243	14,938
February	75	4,164	213	11,827
March	75	4,610	220	13,524
April 1-15	180	5,354	554	16,479
April 16-30	180	5,354	2,188	65,082
May 1-15	180	5,354	3,975	118,236
May 16-31	180	5,711	5,174	164,161
June 1-15	180	5,354	4,087	121,568
June 16-30	180	5,354	2,619	77,902
July 1-15	180	5,354	1,122	33,374
July 16-31	180	5,711	567	17,990
August	180	11,065	324	19,917
September	180	10,708	221	13,147
October	75	4,610	233	14,323
November	75	4,462	441	26,235
December	75	4,610	257	15,799
		92,385		744,502[b]

a Derived for a 9-year period of record (between 1945-1953 water years) for the USGS gage station at Essex (4.4 miles downstream from Bear Creek).

b Approximate volume of water normally available on an annual basis.

Mouth of Bowman Creek up to the Canadian border: 24.8 miles

Drainage Area

Total North Fork (above mouth of Middle Fork): 1,975 square miles

Mouth of the Middle Fork up to the Canadian border: 1,548 square miles

Upstream from the Canadian border: 427 square miles

Gradient

North Fork from the mouth of the Middle Fork up to headwaters: 17.4 ft/mile (0.33%)

Mouth of Middle Fork to Bowman Creek: 12.4 ft/mile (0.23%)

Bowman Creek to border: 15.7 ft/mile (0.29%)

Border to headwaters: 21.9 ft/mile (0.41%)

Origin

The North Fork originates in the Rocky Mountains of British Columbia. The river is named the Flathead River in Canada until crossing the Canadian border. At this point it is known as the North Fork of the Flathead River down to the confluence of the Middle Fork, where it is again named the Flathead River.

Twenty-eight percent of the drainage lies in Canada and contributes 32 percent of the mean annual discharge of the North Fork. The US portion of the river drains the Whitefish Range to the west and the Livingston Range in Glacier Park to the east.

The river between the Canadian border and Bowman Creek flows through a flat-bottomed valley. The river is braided throughout this segment, forming many islands. The riparian zone is vegetated with alder, willow, cottonwood, aspen and conifers. Subdivision of the surrounding forest lands has occurred and is on the increase, but is being controlled under the National Wild and Scenic Rivers Act. The river below Bowman Creek flows through steep-walled canyons alternating with broad flats. In these flats, the river braids frequently, forming islands. The riparian zone in the flat areas consists of willow, alder, cottonwood, aspen and mixed conifers.

Water Quality

The North Fork has an A-1 water quality classification from the state Water Quality Standards. Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. Water quality must be suitable for bathing, swimming and recreation; growth and propagation of salmonid

fishes and associated aquatic life, waterfowl and furbearers, and agricultural and industrial water supply.

Recreational Usage

The North Fork is classified as both Scenic and Recreational under the National Wild and Scenic Rivers Act. The river is classified Scenic from the US-Canadian border downstream to the Camas Creek bridge, and Recreational from the Camas Creek bridge to the mouth of the Middle Fork.

The North Fork is popular for rafting and canoeing because it is a relatively easy float with spectacular scenery. Glacier Park forms the east boundary of the river. Estimates of use by floaters in 1979 and 1980 were 2,000 and 3,000 people, respectively. Outfitters guided 220-270 people per year from 1978-1980.

The North Fork supports a good fishery for cutthroat and bull trout. A creel census conducted in 1981 on the North Fork River downstream from the Canadian border estimated fishing pressure at 9,485 man-days or approximately 163 man-days per mile. The estimated harvest was 17,996 fish, of which 91 percent (16,381) were cutthroat. Other important species were mountain whitefish (1,101-6%) and bull trout (404-2%).

Potential Environmental Problems

Two potential high-head hydroelectric sites are located in the lower North Fork. The Smoky Range site is eight miles upstream from the mouth of the river. Increased large-scale logging of pine beetle infested lodgepole timber in the US and Canada could increase the spring water yield, causing a widening of the stream channel and a reduced streamflow during the summer and fall. This could reduce the suitability of the river for floating and impact the fishery.

Reach I

Confluence of the Middle Fork to the confluence of Bowman Creek.

Flows

A U.S.G.S. gauge is located on the North Fork 3.8 miles upstream from the confluence of the Middle Fork. The average discharge for a 49-year period of record (1910-12, 1913-15, 1935-80) is 2,981 cfs with a maximum recorded flow of 69,100 cfs and a minimum of 198 cfs. The 80th percentile flow for this reach of the North Fork were estimated using flow records from this gauge.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat in 12 high quality trout streams. For the 33.5-mile reach of the North Fork of the Flathead River from the confluence of the Middle Fork to the confluence of Bowman Creek, the MDFWP

filed for the amounts listed below:

Time Period	Amount (cfs)
October 1-March 31	987.5
April 1-September 30	2,625.0

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 7) occurs at a flow of about 1,400 cfs. For adjudication purposes, a flow of 1,400 cfs is recommended for the low flow period.

The monthly flow recommendations derived from the wetted perimeter/-inflection point method and the dominant discharge/channel morphology concept are listed in Table 16. These flow recommendations, in addition to maintaining the resident cutthroat trout and mountain whitefish populations at the existing level, would also serve to:

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the spring and bull trout in the summer and fall to their spawning areas and their return to Flathead Lake,

2) maintain favorable habitat for the rearing of juvenile bull and cutthroat trout,

3) facilitate the downstream passage of juveniles to Flathead Lake,

4) provide a flushing action which cleanses bottom gravel, and

5) maintain the existing channel morphology.

For adjudication purposes, the recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The final claim is listed along with the original filing in Table 16. This final claim is less than the original filing for the periods of April 1-30 and July 16-September 30 and amounts to a net flow reduction of 228,697 acre-feet from the original filing; a reduction of 17 percent.

In order to achieve the fishery objectives described above, it is imperative that the flows in this section of river be maintained at the recommended level rather than the claimed level during the low flow period. It is also imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain existing channel morphology.

The final claim is compared to the median monthly flows of record, as derived from USGS flow records for the gauge on the North Fork near Columbia Falls, in Table 17. The median provides a measure of water availability during a normal or typical water year. The median is the flow

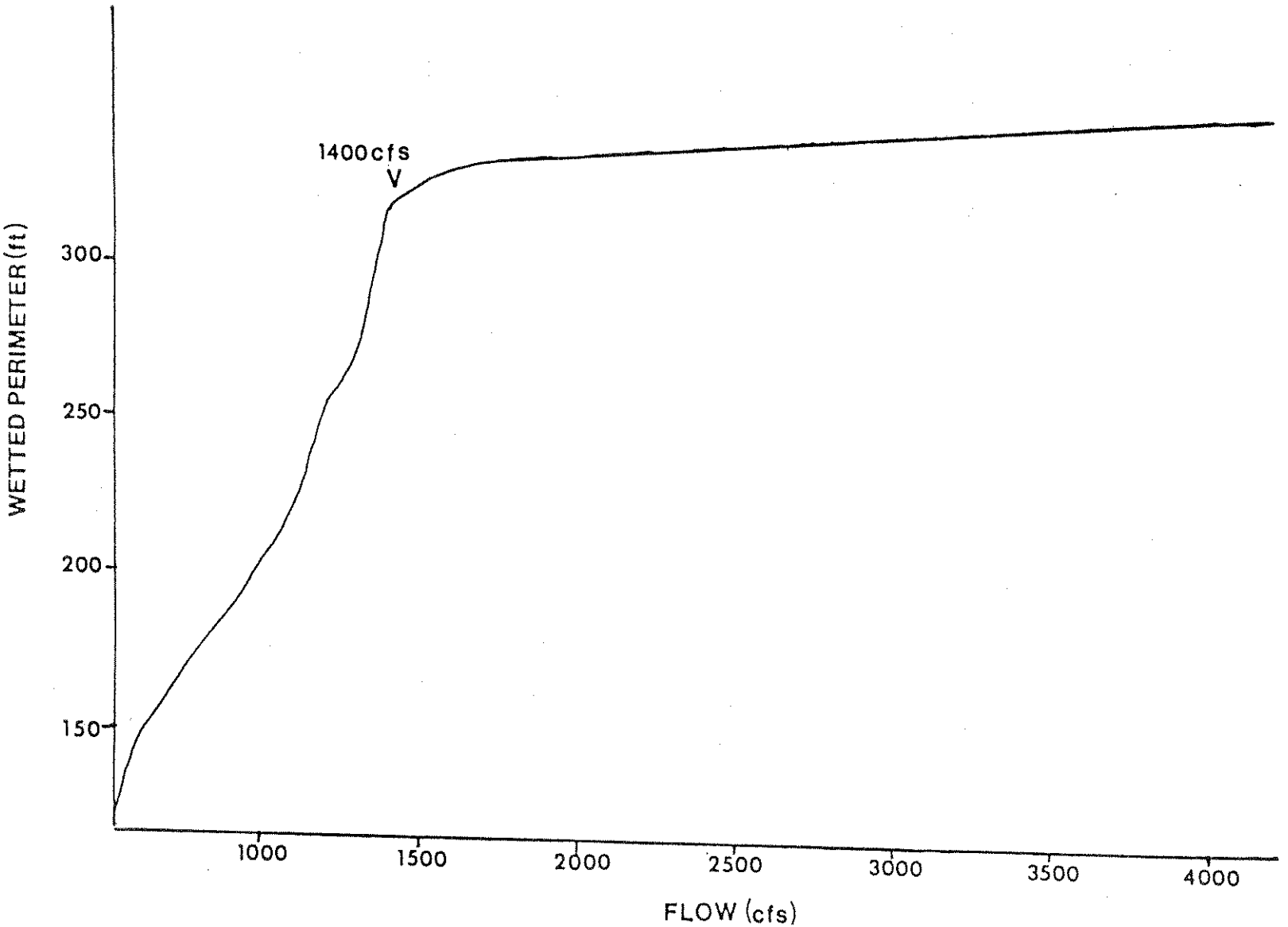

Figure 7. The relationship between wetted perimeter and flow for four riffle-run transects on the Flathead River upstream from the Middle Fork.

Table 16. Monthly flow recommendations for the North Fork of the Flathead River (from its confluence with the Middle Fork upstream to Bowman Creek) compared to the original filing of December 22, 1970 and the final claim.

Time Period	Flow Recommendations (cfs)[a/]	Original Filing (cfs)[b/]	Final Claim (cfs)[c/]
January	1,400	987.5	987.5
February	1,400	987.5	987.5
March	1,400	987.5	987.5
April 1-15	1,400	2,625	1,400
April 16-30	1,766	2,625	1,766
May 1-15	4,741	2,625	2,625
May 16-31	8,024[d/]	2,625	2,625
June 1-15	8,001	2,625	2,625
June 16-30	5,464	2,625	2,625
July 1-15	3,482	2,625	2,625
July 16-31	2,041	2,625	2,041
August	1,400	2,625	1,400
September	1,400	2,625	1,400
October	1,400	987.5	987.5
November	1,400	987.5	987.5
December	1,400	987.5	987.5

[a/] Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

[b/] Flows as originally filed on December 22, 1970.

[c/] Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

[d/] Includes a flow of 18,067 cfs (the approximate bankful discharge) for 24 hours.

Table 17. Comaprison of the final instream claim for the North Fork of the Flathead River (from its confluence with the Middle Fork upstream to Bowman Creek) to the approximate median flows of record.

Time Period	Final Claim (cfs)	Approximate Median Flows[a/]	
		cfs	Acre-feet
January	987.5	647	39,773
February	987.5	665	36,923
March	987.5	717	44,076
April 1-15	1,400	1,497	44,528
April 16-30	1,766	3,429	101,996
May 1-15	2,625	7,285	216,692
May 16-31	2,625	11,622	368,743
June 1-15	2,625	12,072	359,082
June 16-30	2,625	8,189	243,582
July 1-15	2,625	5,519	164,163
July 16-31	2,041	2,934	93,090
August	1,400	1,690	103,889
September	1,400	1,040	61,870
October	987.5	996	61,227
November	987.5	944	56,159
December	987.5	767	47,150
			2,042,943[b/]

[a/] Derived for a 39-year period of record (1941-1979) for the USGS gauge station on the North Fork near Columbia Falls (3.8 miles upstream from the Middle Fork).

[b/] Volume of water normally available on an annual basis.

that is exceeded in five of 10 years or, in other terms, in five years out of 10 there is more water than the median flowing in the river. Table 17 shows that the final claim is less than the median flows for the period of April 1-August 31 and exceeds the medians from September 1-March 31.

The final claim, when adjusted to fall within the constraints of water availability for a median or normal water year, equals 987,258 acre-feet of water per year, which is about 48 percent of the annual volume of water that is normally available at the USGS gauging station 3.8 miles upstream from the confluence of the Middle Fork.

Reach II

Confluence of Bowman Creek to the Canadian border.

Flows

No records are available for the North Fork of the Flathead River near the mouth of Bowman Creek. However, there is a USGS gauge at the upstream end of this section, 45 feet north of the international boundary at Flathead, British Columbia. Average discharge for a 29-year period of record (1951-1980) is 952 cfs, with a maximum discharge of 16,300 cfs and minimum of 62 cfs. This gauge is 24.8 miles upstream from the mouth of Bowman Creek. There is another USGS gauge 29.7 miles downstream from Bowman Creek, which is referred to as the North Fork Flathead River near Columbia Falls, Montana. The average discharge for a 49-year period of record is 2,981 cfs, with a maximum discharge of 69,100 cfs and a minimum of 198 cfs. The 80th percentile flows for this reach of the North Fork were estimated by averaging the 80th percentile flows obtained for each of these two gauges.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat in 12 high quality trout streams. For the 24.8-mile reach of the North Fork of the Flathead River from the confluence of Bowman Creek to the Canadian border, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1-March 31	625
April 1 - September 30	1,500

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 8) occurs at a flow of about 750 cfs. For adjudication purposes, a flow of 750 cfs is recommended for the low flow period.

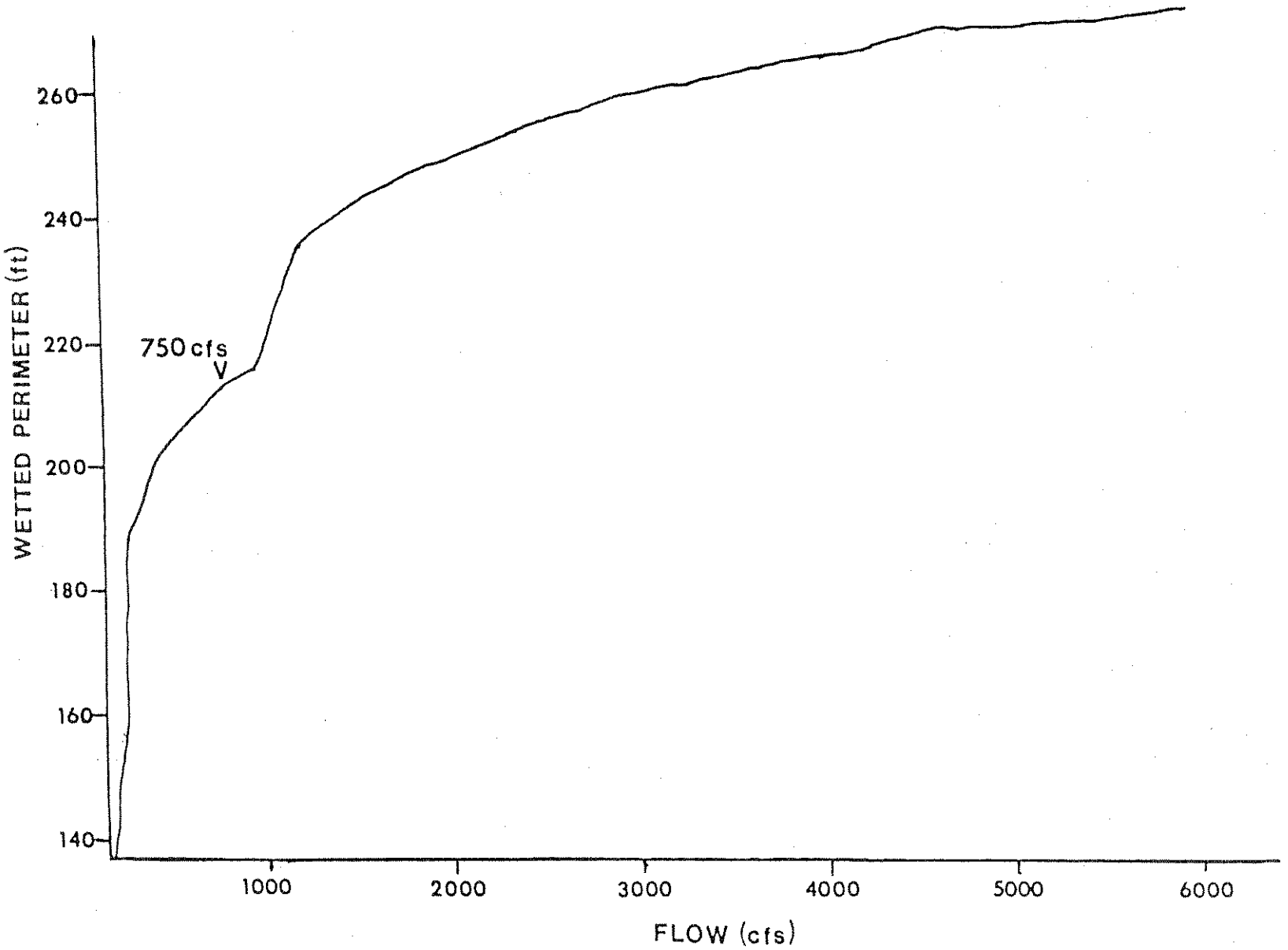

Figure 8. The relationship between wetted perimeter and flow for four riffle-run transects on the Flathead River near Bowman Creek.

The monthly flow recommendations derived from the wetted perimeter/-inflection point method and the dominant discharge/channel morphology concept are listed in Table 18. These flow recommendations, in addition to maintaining the resident cutthroat trout and mountain whitefish populations at the existing level, would also serve to:

1) facilitate the upstream passage of adult, adfluvial cutthroat trout in the spring and bull trout in the summer and fall to their spawning areas and their return to Flathead Lake,

2) maintain favorable habitat for the rearing of juvenile bull and cutthroat trout,

3) facilitate the downstream passage of juveniles to Flathead Lake,

4) provide a flushing action which cleanses the bottom gravels, and

5) maintain the existing channel morphology.

For adjudication purposes, the recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The final claim is listed along with the original filing in Table 18. The final claim is less than the original filing for the periods of April 1-30 and July 16-September 30 and amounts to a net flow reduction of 131,941 acre-feet, a reduction of 17 percent.

In order to achieve the fishery objectives described above, it is imperative that the flows in this section of river be maintained at the recommended level rather than the claimed level during the low flow period. It is also imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain existing channel morphology.

The final claim is compared to the median monthly flows of record, as derived from USGS flow records for the gauges at the Canadian border and near the confluence of the Middle Fork in Table 19. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of 10 years or, in other terms, in five years out of 10 there is more water than the median flowing in the river.

The final claim equals 637,959 acre-feet of water per year, which is about 31 percent of the annual volume of water that is normally available at the USGS gauging site near the confluence of the Middle Fork.

SOUTH FORK RIVER

South Fork of the Flathead River (from the head of Hungry Horse Reservoir upstream to the headwaters).

Table 18. Monthly flow recommendations for the North Fork of the Flathead River (from Bowman Creek upstream to the Canadian border) compared to the original filing of December 22, 1970 and the final claim.

Time period	Flow recommendations (cfs)[a/]	Original filing (cfs)[b/]	Final claim (cfs)[c/]
January	750	625	625
February	750	625	625
March	750	625	625
April 1-15	750	1,500	750
April 16-30	1,100	1,500	1,100
May 1-15	3,170	1,500	1,500
May 16-31	5,461[d/]	1,500	1,500
June 1-15	5,439	1,500	1,500
June 16-30	3,567	1,500	1,500
July 1-15	2,173	1,500	1,500
July 16-31	1,279	1,500	1,279
August	750	1,500	750
September	750	1,500	750
October	750	625	625
November	750	625	625
December	750	625	625

a/ Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

b/ Flows as originally filed on December 22, 1970.

c/ Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

d/ A flow of 18,067 cfs (the approximate bankful discharge) should be maintained for 24 hours during this period.

Table 19. Comparison of the final instream claim for the North Fork of the Flathead River (from Bowman Creek upstream to the Canadian border) to the approximate median flows of record.

Time period	Final claim (cfs)	Approximate median flows: Canadian border[a/] cfs	Canadian border[a/] Acre-ft	Near confluence with Middle Fork[b/] cfs	Near confluence with Middle Fork[b/] Acre-ft
January	625	158	9,713	647	39,773
February	625	156	8,662	665	36,923
March	625	176	10,819	716	44,076
April 1-15	750	324	9,637	1,497	44,528
April 16-30	1,100	776	23,082	3,429	101,996
May 1-15	1,500	2,345	69,752	7,285	216,692
May 16-31	1,500	4,266	135,352	11,622	368,743
June 1-15	1,500	4,204	125,048	12,072	359,082
June 16-30	1,500	2,451	72,905	8,189	243,582
July 1-15	1,500	1,393	41,435	5,519	164,163
July 16-31	1,279	797	25,287	2,934	93,090
August	750	408	25,081	1,690	103,889
September	750	273	16,241	1,040	61,870
October	625	267	16,413	996	61,227
November	625	259	15,408	944	56,159
December	625	215	13,217	767	47,150
			618,052[c/]		2,042,943[c/]

a/ Derived for a 19-year period of record (1961-79) for the USGS gauge station on the North Fork of the Canadian border (at Flathead, British Columbia).

b/ Derived for the 39-year period of record (1941-79) for the USGS gauge station on the North Fork near Columbia Falls (3.8 miles upstream from the Middle Fork).

c/ Volume of water normally available on an annual basis.

Description

Stream Length

Total length of South Fork: 104.6 miles

Mouth to the head of the reservoir: 45.5 miles
Head of reservoir to Powell-Flathead County line: 42.8 miles
Powell-Flathead County line to headwaters: 16.3 mile

Drainage Area

Total South Fork: 1,670 square miles

Head of Reservoir to headwaters: 1,160 square miles

Gradient

Hungry Horse Reservoir to Powell-Flathead County line: 19.1 ft/mile (0.4%)

Powell-Flathead County line to headwaters: 19.6 ft/mile (0.4%)

Origin

The South Fork of the Flathead River originates at the confluence of Danaher and Youngs creeks in the Bob Marshall Wilderness Area. The upper 41 miles is entirely within the wilderness boundary. The Continental Divide forms the east boundary and the Swan Range the west boundary.

Water Quality

The South Fork has an A-1 classification under the State Water Quality Standards. Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities. Water quality must be suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

Recreational Usage

The upper 51.9 miles of the South Fork from the headwaters to the Spotted Bear River is classified a Wild River under the National Wild and Scenic Rivers Act of 1976. From the Spotted Bear River downstream to Hungry Horse Reservoir (a distance of 7.2 miles) the river is classified a Recreational River. Floaters enjoy both sections of the South Fork. However, because of the inaccessibility of the area, floater use is somewhat limited.

The South Fork supports a high quality westslope cutthroat trout and trophy bull trout fishery. Fishing pressure on the river has not been accurately assessed because of the remoteness of the area. Anglers report

high catch rates and large fish from the South Fork, particularly for cutthroat trout.

Reach I

Hungry Horse Reservoir to Powell-Flathead County line.

Flows

A USGS gauge is located 1.2 miles upstream from the head of Hungry Horse Reservoir (above Twin Creek). The average discharge for the 16-year period of record (1964-1980) is 2,301 cfs, with a maximum discharge of 30,200 cfs and a minimum of 127 cfs. A flood of June 8, 1964, prior to the period of record, reached an estimated 50,900 cfs. The 80th percentile flows for this reach of the South Fork were estimated using flow records from this gauge.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of preserving fish and wildlife habitat in 12 high quality trout streams. For the 42.8-mile reach of the South Fork of the Flathead River from Hungry Horse Reservoir to the Powell-Flathead County line, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1 - March 31	600
April 1-September 30	1,750

The filing was recorded in Flathead County on December 22, 1970.

Flow Recommendations

The inflection point on the wetted perimeter-discharge relationship (see Figure 9) occurs at a flow of about 700 cfs. For adjudication purposes, a flow of 700 cfs is recommended for the low flow period.

The monthly flow recommendations derived from the wetted perimeter/-inflection point method and the dominant discharge/channel morphology concept are listed in Table 20. These flow recommendations, in addition to maintaining the resident cutthroat trout and mountian whitefish population at the existing level, would also:

1) facilitate the upstream passage of adult, adfluvial cutthroat and bull trout to their spawning areas and their return to Hungry Horse Reservoir,

2) maintain favorable habitat for the rearing of juvenile bull and cutthroat trout,

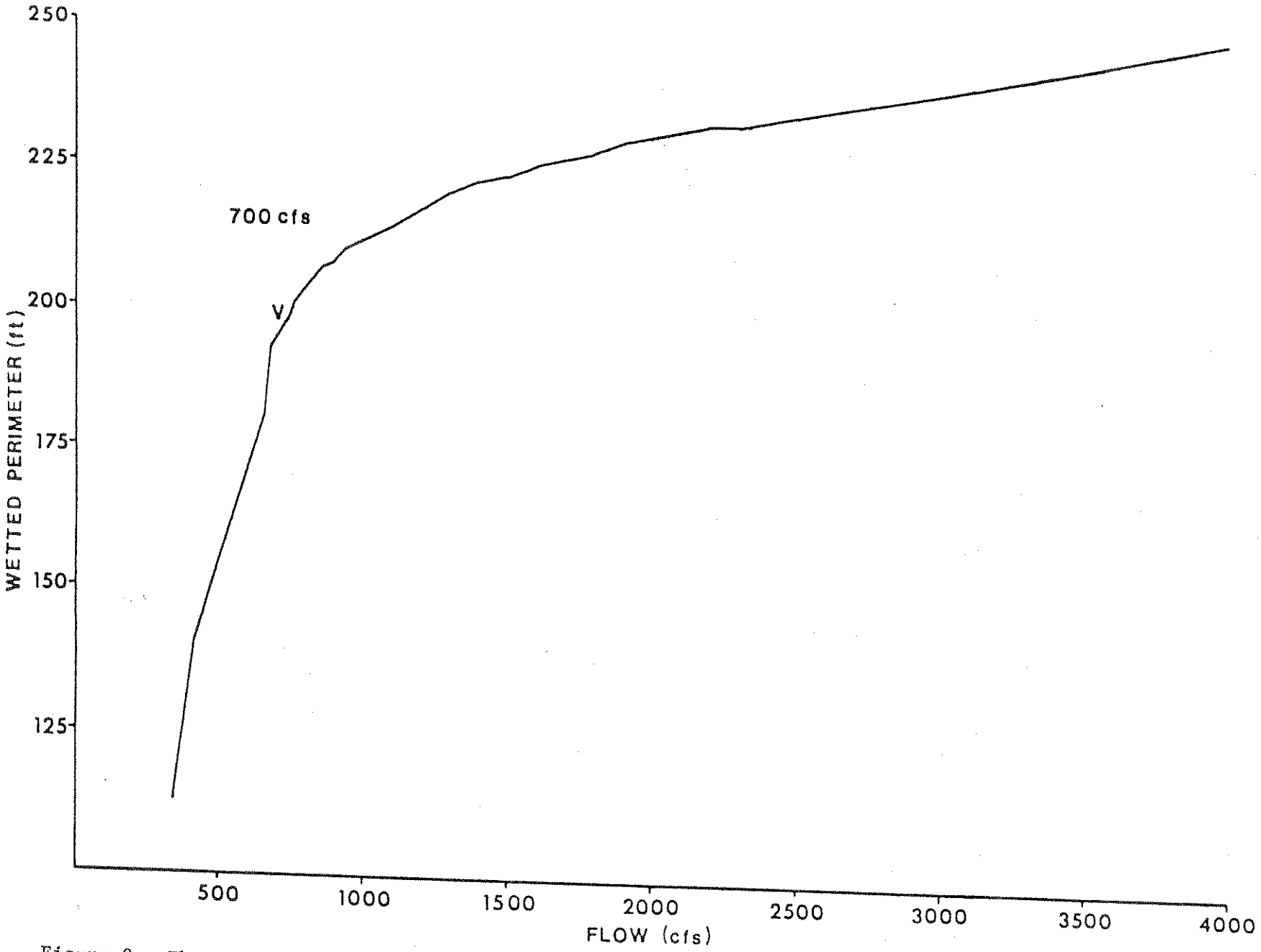

Figure 9. The relationship between wetted perimeter and flow for three riffle-run transects on the South Fork of the Flathead River upstream from Hungry Horse Reservoir.

Table 20. Monthly flow recommendations for the South Fork of the Flathead River (Hungry Horse Reservoir to the Powell-Flathead County line) compared to the original filing of December 22, 1970 and the final instream claim.

Time Period	Flow Recommendations (cfs)[a]	Original Filing (cfs)[b]	Final Claim (cfs)[c]
January	700	600	600
February	700	600	600
March	700	600	600
April 1-15	700	1,750	700
April 16-30	1,180	1,750	1,180
May 1-15	3,126	1,750	1,750
May 16-31	4,252	1,750	1,750
June 1-15	6,477[d]	1,750	1,750
June 16-30	4,471	1,750	1,750
July 1-15	1,957	1,750	1,750
July 16-31	943	1,750	943
August	700	1,750	700
September	700	1,750	700
October	700	600	600
November	700	600	600
December	700	600	600

[a] Derived from the wetted perimeter/inflection point method and the dominant discharge/channel morphology concept.

[b] Flows as originally filed on December 22, 1970.

[c] Derived by adjusting the flow recommendations to the constraints imposed by the original instream filing of December 22, 1970.

[d] Includes a flow of 16,100 cfs (the approximate bankful discharge) for 24 hours.

3) facilitate the downstream passage of juvenile trout to Hungry Horse Reservoir,

4) provide a flushing action which cleanses the bottom gravels, and

5) maintain the existing channel morphology.

For adjudication purposes, the recommendations must be adjusted to the constraints imposed by the original instream filing of December 22, 1970. This adjustment is necessary because the final claim can be less than, but not exceed, the original filing. The final claim is also listed along with the original filing in Table 20. The final claim is less than the original filing for the periods July 16-September 30 and April 1-30. This amounts to a net flow reduction of 200,803 acre-feet from the original filing; a reduction of 24 percent.

In order to achieve the fishery objectives described above, it is imperative that the flows in this section of river be maintained at the recommended level rather than the claimed level during the low flow period. It is also imperative that a bankful flushing flow be provided each spring to cleanse the bottom gravel and maintain existing channel morphology.

In Table 21, the final claim is compared to the median monthly flows of record, as derived from USGS flow records for the gauge above Twin Creek (1.2 miles upstream from Hungry Horse Reservoir). The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of 10 years or, in other terms, in five years out of 10 there is more water than the median flowing in the river. Table 21 shows that the final claim is less than the median flows from April through August and exceeds the median from September through March.

The final claim, when adjusted to fall within the constraints of water availability for a median or normal water year, equals 567,782 acre-feet of water per year, which is about 37 percent of the annual volume of water that is normally available at the USGS gauge site above Twin Creek.

Reach II

Powell-Flathead County line upstream to the headwaters.

Flows

A USGS gauge is located 1.2 miles upstream from the head of Hungry Horse Reservoir (above Twin Creek). The average discharge for the 16 year period of record (1964-1980) is 2,301 cfs, with a maximum discharge of 30,200 cfs and a minimum of 127 cfs. A flood of June 8, 1964, prior to the period of record, reached an estimated 50,900 cfs.

Previous Instream Claim

An act passed by the 1969 Montana Legislature (Chapter 345, Laws of 1969) enabled the MDFWP to file for instream water rights for purposes of

Table 21. Comparison of the final instream claim for the South Fork of the Flathead River (Hungry Horse Reservoir to the Powell-Flathead County line) to the approximate median flows of record.

Time Period	Final Claim (cfs)	Approximate Median Flows[a/]	
		cfs	Acre-feet
January	600	353	21,700
February	600	296	16,435
March	600	510	31,351
April 1-15	700	1,037	30,846
April 16-30	1,180	2,167	64,457
May 1-15	1,750	5,257	156,369
May 16-31	1,750	9,027	286,409
June 1-15	1,750	10,605	315,446
June 16-30	1,750	7,595	225,913
July 1-15	1,750	5,156	153,365
July 16-31	943	2,497	79,225
August	700	1,030	63,317
September	700	543	32,303
October	600	406	24,958
November	600	412	24,510
December	600	389	23,913
			1,550,517

[a/] Derived from a 9-year period of record (between 1971 and 1979 water years) for the USGS gauge station above Twin Creek.

preserving fish and wildlife habitat in 12 high quality trout streams. For the 16.3 mile reach of the South Fork of the Flathead River from the Flathead-Powell County line to the headwaters at the confluence of Youngs and Danaher creeks, the MDFWP filed for the amounts listed below:

Time Period	Amount (cfs)
October 1 - March 31	100
April 1 - September 30	270

The filing was recorded in Powell County on January 7, 1971.

Flow Recommendations

The MDFWP was unable to quantify the instream flow needs for this reach of the South Fork due to the inaccessibility of the area. This reach of river, which is entirely within the boundaries of the Bob Marshall Wilderness Area, is roughly 25 miles by foot and horse trails from the nearest access point.

For adjudication purposes, the MDFWP is claiming the flows that were originally filed on January 7, 1971. The claim, which is listed in Table 22, equals 134,071 acre-feet of water per year.

The claim is also compared to the median monthly flows of record, as derived from USGS flow records for the gauge above Twin Creek, in Table 22. The median provides a measure of water availability during a normal or typical water year. The median is the flow that is exceeded in five of 10 years or, in other terms, in five years out of 10 there is more water than the median flowing in the river.

The claim is considerably less than the medians for all 12 months. However, the gauge above Twin Creek is located 42 miles downstream from the Powell-Flathead County line and therefore does not reflect the flows in the reach of river being discussed. It is likely that the 100 cfs claim for the October-March period is in the neighborhood of what is normally available in this reach while the 270 cfs claim from April-September is obviously far less than what is available for much of this period. The flow of the South Fork near the headwaters in late August of 1981 was measured at 96 cfs by personnel of the MDFWP.

Table 22. Comparison of the instream claim for the South Fork of the Flathead River (Powell-Flathead County line to the Headwaters) to the approximate median flows of record.

Time Period	Claim		Approximate Median Flows[a/]	
	cfs	Acre-Feet	cfs	Acre-Feet
January	100	6,147	353	21,700
February	100	5,552	296	16,435
March	100	6,147	510	31,351
April	270	16,062	2,070	123,144
May	270	16,598	6,740	414,328
June	270	16,062	10,100	600,849
July	270	16,598	3,880	238,515
August	270	16,598	1,030	63,317
September	270	16,062	543	32,303
October	100	6,147	406	24,958
November	100	5,949	412	24,510
December	100	6,147	389	23,913
		134,071		1,615,323

a/ Derived for a 9-year period of record (between 1971 and 1979 water years) for the USGS gauge station above Twin Creek (1.2 miles upstream from Hungry Horse Reservoir).

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