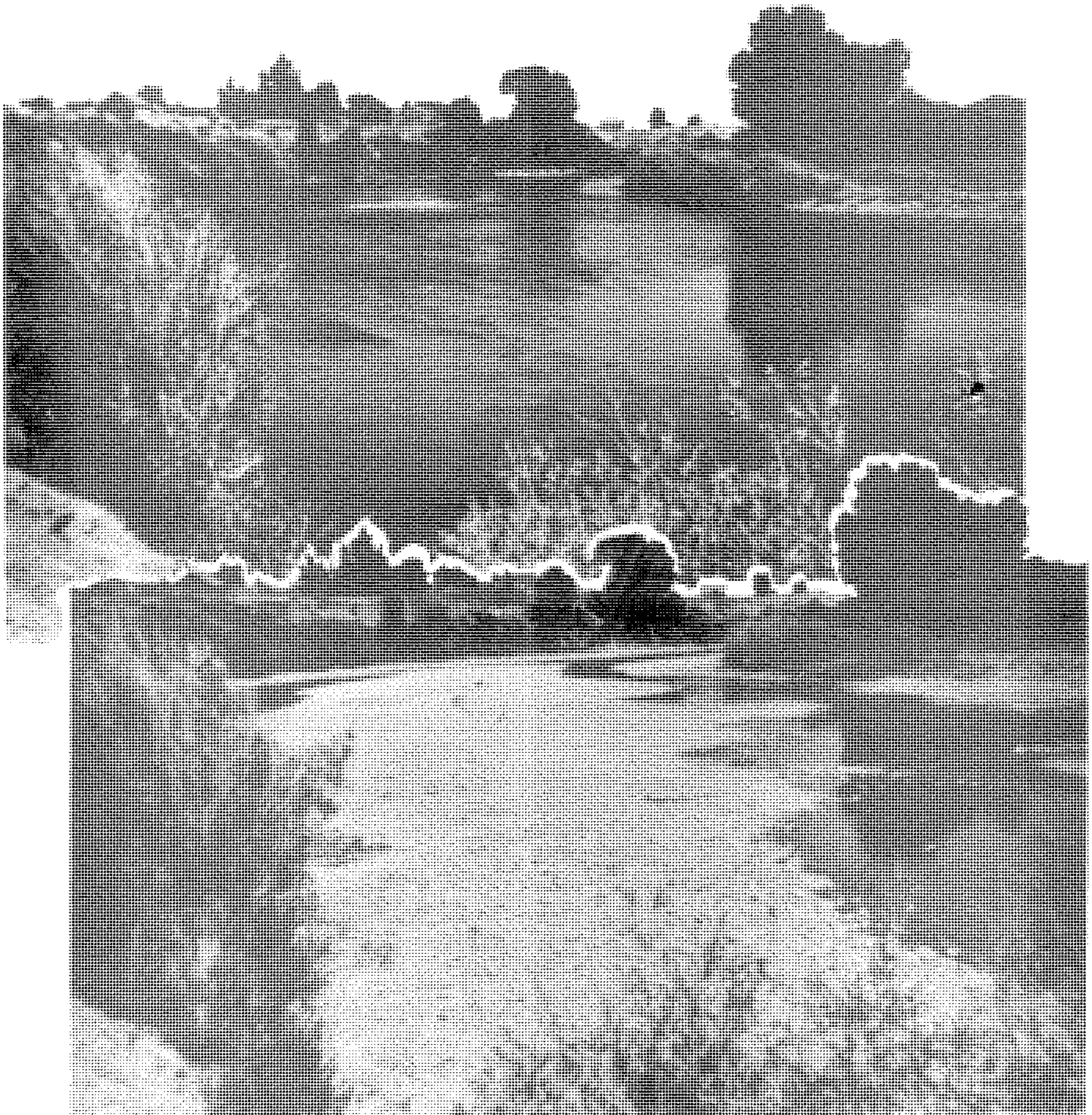
# APPLICATION FOR RESERVATION OF WATER
# in
# THE YELLOWSTONE RIVER BASIN

Montana Fish and Game Commission



Helena, Montana
November 1, 1976

Form No. 610
(New 9/74)

APPLICATION No. 1781
(3/15/74; 3:30 P.M.)

STATE OF MONTANA
DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

## APPLICATION FOR RESERVATION OF WATER

NOTE: Pursuant to Section 89-890, R.C.M. 1947, only the state or any political subdivision or agency thereof, or the United States or any agency thereof, may apply to the board to reserve waters for existing or future beneficial uses, or to maintain a minimum flow, level, or quality of water throughout the year or at such periods or for such length of time as the board designates. Pursuant to Section 89-8-107, R.C.M. 1947, the United States or any agency thereof may not apply for a reservation of water in the Yellowstone River Basin until the requirements of Section 89-8-105, R.C.M., are met.

(Please type or print in ink)

1. Name of applicant Montana Fish and Game Commission

   Mailing address 1420 East Sixth

   City or town Helena State Montana Zip Code 59601

   Home phone ______ Other phone 449-3186

2. Source of water supply Yellowstone River Basin

   a tributary of Missouri River

3. Use(s) to which reserved waters will be applied fish and wildlife

4. Amount of water necessary for the reservation as per attached statement
   (cubic feet per second and acre-feet per year)

5. Type of reservation:

   A. Waters will be reserved in stream for beneficial use without any diversion.
      Yes X No ____

   B. Reservation requires construction of a storage or diversion facility to exercise the beneficial use. Yes ____ No. X 1/

6. If a storate or diversion facility is necessary, the date by which reserved waters will be applied to a beneficial use unknown at this date
   (month and year)

7. THE APPLICANT CERTIFIES THAT THE STATEMENTS APPEARING HEREIN ARE TO THE BEST OF HIS KNOWLEDGE TRUE AND CORRECT.

Wes Woodgerd Secretary
Signature of applicant

November 1, 1976
Date

1/ Fox Lake reservation only might require diking to fully utilize reserved water.

(continued)

TABLE OF CONTENTS

Page

Application for Reservation of Water - Continuation and Amendment

I

## INTRODUCTION

Pursuant to Section 89-890, R.C.M. 1947, and Article II of the Constitution of the state of Montana which establishes that a clean and healthful environment is an inalienable right of Montana citizens, the Montana Fish and Game Commission hereby respectfully makes amended application for reservation of water and flows thereof in the Yellowstone River basin.

This is an amendment to an application for reservation of water in the Yellowstone River submitted to the Department of Natural Resources and Conservation by this applicant on March 15, 1974. The original application requested a reservation of water and flows thereof only in the Yellowstone River from the mouth of the Clarks Fork River to the North Dakota state line. This amended application is made necessary by the broadening of the object of legislative interest indicated by enactment of Section 89-8-103 to 89-8-111, R.C.M. 1947, since the date of the original application and by the promulgation of rules to implement these statutes. It requests reservation of water in the Yellowstone River and within certain of its tributaries located within the river basin from Gardiner near Yellowstone National Park, to the Montana-North Dakota state boundary.

Streamflows requested for the lower reaches of the river, in the original application, have been adjusted from the original request and application due to increased knowledge of the fish and wildlife resources and their requirements. Further, this continuation and amendment is necessary to meet requirements of Montana Administrative Code Rule 36-2.14R(1)-S1430 Application Content. There is no provision for meeting these requirements on the Department of Natural Resources and Conservation's application form number #610.

II

## AMOUNT OF WATER NECESSARY FOR THE PURPOSE OF THE RESERVATION

The Montana State Fish and Game Commission, Department of Fish and Game, an agency of the state of Montana, requests, and applies for, instream reservation of water and flows thereof, during each year hereafter in the Yellowstone River basin, including the Yellowstone River and certain tributaries of the river, in amounts as indicated by stream or stream reach, and for the periods indicated for each of the respective streams set forth in the "Statement on Amount of Water Necessary for the Purpose of the Reservation" attached hereto and hereby made a part of this application.

## III

## THE PURPOSE OF THE RESERVATION

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

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

The attainment and service of such uses are to:

(1) provide fish and wildlife habitat sufficient to perpetuate the diverse species comprising this natural resource at levels comparable to current existing levels;
(2) contribute to, and maintain a clean, healthful and desirable environment;
(3) to sustain high levels of water quality; and
(4) honor and support all existing water use rights.

## IV

## THE NEED FOR THE RESERVATION

A water right for instream beneficial use for fish and wildlife, and recreational uses may be obtained, under applicable statutes and rules, only by application for reservation and not by petition or application for permit. Without this reservation, beneficial uses provided by the Montana Constitution, and by law, cannot be met or maintained.

Existing water rights in the river basin will at all times be honored. If the reservations here requested are not granted and approved, any waters available over and above such existing rights will be vulnerable to future appropriations by permit. If these future appropriations are allowed to be executed in advance of, or without, the reservations here requested being established, the fish and wildlife resources will be permanently deprived of the waters so necessary for their healthy survival. It is readily apparent when realistically considered, that under our current laws and regulations, waters once allowed to be appropriated might well never again be available to reservation for fish and wildlife purposes. The need for an adequate reservation now is thus dictated.

Further, this reservation is needed for the continued preservation of fish and wildlife habitat sufficient to perpetuate the diverse species comprising this natural resource at levels comparable to current existing levels, for recreational uses which those resources provide, and for the attainment and service of those other purposes of this reservation.

The documentation for this need is found in the "Statement of the Need for the Reservation" and other statements attached to this application.

V

## THE RESERVATION IS IN THE PUBLIC INTEREST

This reservation of water is in the public interest. The public benefits which will occur from the reservation are:

(1) continued perpetuation of the fish and wildlife resources whose very existence is in the public interest;
(2) prevention of the gradual depletion of streamflows currently enjoyed by the public for recreational uses;
(3) continued perpetuation of the fish and wildlife resources for current and future utilization by the public;
(4) maintenance of water quality which contributes to a clean, healthful environment for the citizens of the state and the nation; and
(5) contribution to the protection of and continued utilization of existing water rights.

The explanation of these public benefits, by economic and environmental beneficial and adverse effects is provided in the "Statement that the Reservation is in the Public Interest." Included therein is reference to state and federal legislation or policies which support fish and wildlife and recreational uses.

VI

## SUPPORTING STATEMENTS

There are attached hereto, and made a part hereof, statements on the need for, amount of, and public interest of this requested reservation of water, including a concluding statement. These statements and attached appendices are presented in support of this application for reservation and to meet the requirements of the Montana Water Use Act and applicable rules thereunder in establishment of a reservation of water and flows thereof for fish and wildlife and recreational uses.

## STATEMENT OF THE NEED FOR THE RESERVATION

A water right for instream beneficial use for fish and wildlife, and recreational uses may be obtained, under applicable statutes and regulations, only by application for reservation and not by petition or application for permit.

The need for a reservation of water in the Yellowstone River basin is brought about by the basic habitat requirements of all fish, wildlife and other living organisms that have through the long evolutionary process come to be totally dependent upon the natural flow of the Yellowstone River and its tributary streams.

The respiratory dependence of a fish population upon the presence of an adequate water body is obvious. But, of course, this is not the sum total of the matter. Not so obvious, perhaps, is the fishery's dependence upon an adequate material streamflow for:

1. maintenance of spawning and rearing areas
2. shelter
3. food sources which, in turn, depend on good and sufficient stream flow.

In all of these, not only is water quantity critical, but also good water quality.

The stream discharge, as influenced by channel configuration must necessarily meet the hydrologic requirements necessary to provide these factors. Stream discharge in conjunction with channel configuration comprises the only living space available to aquatic organisms in streams. Over the centuries, fish populations in the Yellowstone River basin have survived and become attuned to both flood and drought, and today within that same framework they sustain themselves at levels allowed by the natural limiting factors found within the extremes of their environment.

The requested water is needed to maintain fish habitat, aquatic insect and lower plant and animal life which sustain fish. The Yellowstone River and its tributaries are important fishing and recreation areas used by the people of Montana and the nation. The recreational use of these waters is an important outlet from day-to-day pressures and is important in the human experience on this planet and is recognized as worthy of protection by our water use statutes. The fish species which would be protected by this flow request contribute to the well being of the people of Montana and those visitors who come to enjoy the splendors Montana has to offer.

Need for the reservations herein requested is outlined above. It is contended that if the requested reservations from future use are not provided for, the deterioration of these interests is inevitable. The degree or rate of deterioration depends on the degree that these needs for reservations are ignored.

Realizing that other uses of water are necessary, application is not made for all the water which has historically sustained these organisms. This request is for that amount of water strenuously urged as being absolutely necessary to sustain the organisms without significant long-term reduction in quantity and quality thereof. Increased water withdrawals over existing levels will, in the long run, reduce availability of habitat and consequently reduce the number of organisms which can healthily occupy that habitat. There is a limit to the amount of water which can be removed from any stream channel without severely changing the quantity and quality of the aquatic species present.

All aquatic animals depend for their existence on lower forms of plants or other animals. These lower forms also have specific water requirements needed to grow and reproduce. Reduction in availability of lower aquatic forms ultimately reduce the number, health and well being of those organisms at higher trophic levels.

Reduced streamflows also affect the quality of water which is necessary to sustain these organisms. Possible consequences of reduced streamflow are higher water temperatures and increased amounts of dissolved solids. Thus, there are several ways reduced streamflow can adversely affect aquatic organisms: (1) reduction in the physical size or character of living space, (2) altering the food chain or reducing availability of food organisms, and (3) changing water quality which alters living conditions for plant and animal life. Thus streamflows must be protected from depletion to prevent loss of these habitat conditions which allow aquatic organisms to survive.

The Yellowstone River is a Class 1 or "blue ribbon" trout stream from Gardiner to Big Timber and was classified as such in 1959 and again in 1965 by the stream classification committee composed of representatives of the Montana Department of Fish and Game, Montana State University and U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife. A blue ribbon stream is classified as a stream which has national as well as statewide value as a fishery. A total of 452 miles of streams was classified as "blue ribbon" in 1965. Of this total, the blue ribbon stream reach between Gardiner and the Boulder River at Big Timber represents the largest single reach (103 miles) of blue ribbon trout stream in Montana, and contains 23 percent of the state's blue ribbon waters. As stated in the introduction to the classification map, "A serious problem in the preservation of fishing streams is the measurement of the total worth of a fishery - economic as well as social. Recreational fishing does not readily lend itself to conventional means of measurement and as a result is often sold short in comprehensive planning that involves water resources."

The classification was an attempt to provide a base for calculating the material worth of the fishery resource and a guide to long-range policy, administration and management of the fishery resource. The classification shows rather clearly that Montana fishing streams are limited both in quantity and quality.

The Yellowstone River is unique in this nation in that it is one of the few remaining major "free-flowing" streams left in the continental

United States. The upper Yellowstone (upstream from the Boulder River) is characterized by its clean, cold, highly productive water. Its trout fishery in these upper reaches is renowned nationwide. It provides high quality fishing for rainbow, brown and Yellowstone cutthroat trout. The Yellowstone cutthroat is a unique species found only in the upper Yellowstone basin. Mountain whitefish are also abundant and provide an important winter fishery.

The Yellowstone River derives much of its water and bedload material from the mountain tributary streams. These creeks originating in high mountain areas contribute cold, high quality water to the Yellowstone. They also, themselves, support self-sustaining rainbow-cutthroat hybrid, brown and brook trout and mountain whitefish, which provide an important recreational fishery. The tributary streams are generally high gradient with cobble and boulder channels. Fish cover is provided primarily by water surface roughness, streambank vegetation and instream boulders.

Tributaries arising in the Absaroka Mountains include Bear, Cedar, Sixmile, Emigrant, Mill, Pine, Deep, Suce and Mission Creeks. Tributaries arising in the Gallatin Range and flowing east to join the Yellowstone include Mol Heron, Tom Miner, Rock, Big, Fridley, Eightmile, Trail and Billman Creeks. Fleshman Creek originates in the southern end of the Bangtail Ridge and joins the Yellowstone at the city of Livingston.

In addition to the mountain tributary streams, McDonald, Emigrant, Armstrong and Nelson Creeks are outstanding among several important spring-fed streams located in this area. The spring creeks are characterized by fairly constant flows and temperature, and are rich in aquatic vegetation and insect life. They derive their richness from the rich bottomlands of Paradise valley, through which they flow. The high productivity of the spring creeks is reflected in the excellent trout populations which they support (Elser and Marcoux 1971, Workman 1972 and 1973). Brown trout and rainbow trout are the dominant species. Fish cover consists primarily of streambank vegetation, undercut banks, debris and instream vegetation. In addition to resident trout populations, substantial numbers of rainbow and brown trout from the Yellowstone River use the spring creeks for spawning purposes (Berg 1975).

Waters in the Shields River drainage offer sport fishing for cutthroat, rainbow, brown and brook trout and mountain whitefish. Cutthroat and brown trout and mountain whitefish form the backbone of the fishery. Brown trout and mountain whitefish are most abundant in the Shields River mainstem below the headwaters basin, while cutthroat trout are mainly found in the headwaters basin and in the tributary streams.

Rainbow and brown trout are the most sought-after species in the upper Yellowstone and provide excellent angling opportunities. Although not native to the study area, they now provide the bulk of the trout fishery and harvest. The Yellowstone cutthroat is a highly prized native species, but it is by far the least numerous of the three trout species present today.

Yellowstone cutthroat trout spawning runs have been documented in 9 of 16 tributaries inventoried during a 3-year period (Berg 1975).

Streams with confirmed cutthroat runs include Cedar, Mol Heron, Tom Miner, Rock, Big, Mill, Emigrant Spring, McDonald Spring and Nelson Spring Creeks. No migratory cutthroat were found in Billman, Mission, Dry, Eightmile, Pine, Sixmile or Deep Creeks; however, limited sampling conducted on the latter tributaries does not allow the determination of the presence or absence of a cutthroat spawning run at this time.

Brown and rainbow trout spawning runs were found in 4 of the 13 tributaries in 1974 and 1975. Migratory brown trout were taken in the tributaries from early November through early December 1974, and rainbow were found from early April through early May 1975. Migratory brown and rainbow trout utilize only Armstrong Spring, Nelson Spring, McDonald Spring and Emigrant Spring Creeks for spawning. Some fish migrate several miles in an upstream or downstream direction in the Yellowstone River to reach a spring creek, then ascend it to spawn. The two native salmonid fish species, Yellowstone cutthroat trout and mountain whitefish, appear to be particularly dependent on the tributary streams for spawning (Berg 1975).

Mountain whitefish spawning runs were documented and monitored in 6 of the 13 tributaries. These included Mol Heron, Tom Miner, Big, Eightmile, Fridley and Mission Creeks. No migratory whitefish were found during limited sampling conducted on Rock, Cedar, Billman, McDonald Spring, Nelson Spring, Emigrant Spring and Armstrong Spring Creeks. In most streams where migratory whitefish were found, a large number of fish was involved in the run (Berg 1975).

Thus it is evident that the upper Yellowstone River and its tributaries are intimately related due to streamflow contribution and biological interchange between the tributaries and mainstem. The tributaries of the upper Yellowstone cannot be separated from the blue ribbon mainstem, and flow recommendations have been made accordingly.

The middle Yellowstone River (between the Boulder River and the Bighorn River) is a transition zone between the primarily cold water environment of the upper river and the warm water environment of the lower river. It contains fish species common to both the upper and lower river (below the Bighorn River). This stretch of the Yellowstone is classified as a class 2 ("red ribbon") stream from the Boulder River to the Sweet Grass-Carbon County line, a class 3 stream from the county line to Laurel and a class 4 stream from Laurel to the Bighorn. Only small amounts of aquatic resource data have been obtained on this stretch of the Yellowstone River and its importance may not yet be fully realized.

The upper portion of this stream reach of the Yellowstone is primarily salmonid habitat - the principal game species being rainbow and brown trout and mountain whitefish. Species change to channel catfish and sauger below the Clarks Fork of the Yellowstone.

The Boulder and Stillwater rivers are major tributaries within the reach. Both of these streams and their tributaries are important trout fisheries and are extensively used by Billings area residents.

The Clarks Fork of the Yellowstone River contains a trout fishery from its headwaters downstream to Belfry. Brown and rainbow trout, mountain whitefish and an occasional cutthroat trout are found in this reach. Below this reach water quality is lowered by a high sediment content. This sediment affects trout habitat requirements; however, warm water species such as catfish and sauger are present. The Clarks Fork also contributes its flow quantity to the mainstem Yellowstone River and is therefore important in its effects on aquatic habitat downstream from their confluence. In addition, Rock Creek (near Red Lodge) and its tributaries and Bluewater Creek are important tributaries to the Clarks Fork and are important in their own right as trout streams and recreation areas. Their waters should be protected from depletion.

The lower Yellowstone River (below the mouth of the Bighorn River) contains a variety of fish commonly called warm water species. Little was known about this system until studies were initiated in 1973. Additional data have been obtained since then which indicate a unique and significant fishery exists for paddlefish, shovelnose sturgeon, sauger, walleye and channel catfish. Certain ecological relationships have been established for some of these fish which show that two of the Yellowstone's major tributaries - the Tongue and Powder rivers, are important components of their life cycles.

The Bighorn River has been regulated by Yellowtail Dam for about 10 years. During this period a significant, high quality, trophy trout fishery has developed from the Yellowtail afterbay dam downstream to approximately 10 miles below St. Xavier. Brown and rainbow trout are the principal species sought by anglers. The comparatively large size of these fish stimulates a great interest by Billings residents as well as fishermen from other areas. Little is known about the Bighorn below the salmonid reach. Channel catfish and sauger are known residents of this stream reach and it is possible that burbot and paddlefish may use the stream for spawning.

The Yellowstone River, under predevelopment conditions, had an estimated mean annual flow of between 11 to 12 million acre feet (MAF) (J. Dooley pers. comm.). The average annual discharge at Sidney for a 62-year period of record (1912-1974) was 9.47 MAF (USGS Surface Water Records for Montana 1974). Adjusted to the 1970 level of water depletion, the mean annual discharge at Sidney was calculated to be 8.8 MAF (NGPRP 1974).

It can be seen from the above figures that the Yellowstone is significantly depleted (20 to 27 percent) from its average virgin flow conditions. Aquatic organisms are limited primarily by the extremes in their environment. The prospect of additional water depletions, in view of the historic low flows experienced in the lower river during the period of record, is particularly disturbing. While the current level of water usage does not produce significant impacts during better than average water years, the effects of further depletions will be severe during natural extremely low water years or during prolonged drought periods.

In addition to waterfowl, riparian wildlife and furbearers, the lower Yellowstone supports a diverse and unique fish fauna. Fish species present range from the primitive paddlefish and sturgeons to the popular walleye, sauger, channel catfish and ling. In addition there are a host of nongame species. To help assure their continued existence in their present abundance, it is necessary for the reservation to reflect flows which maintain their habitat as well as satisfy the requirements of various stages of their life history.

Paddlefish migrate up the Yellowstone River each spring to spawn. Observations in Missouri indicate that paddlefish migrate in response to water temperature, photoperiod and an increase in flow level (Purkett 1961). The Yellowstone paddlefish migration also occurs coincident with spring runoff (Robinson 1966, Rehwinkel 1975). Strength of the spawning run is associated with the duration of the seasonal rise, as well as the height of the rise. The increase in flow is necessary to trigger the run, allow passage of the migrant fish to the spawning areas and provide adequate spawning habitat (Vasetskiy 1971). The spring rise must be maintained in the Yellowstone to meet the reproductive needs of this paddlefish population and is thus included in the requested flow quantity.

Two populations of sturgeon, the shovelnose and pallid, currently inhabit the Yellowstone River. Life history information on these two species is extremely limited, however they also migrate and spawn during the spring high water period. Flows which assure paddlefish reproduction will also satisfy the sturgeon's requirements. Significant reductions in existing water levels may threaten the abundance of the shovelnose populations and possibly the very existence of the pallid, which is considered rare over most of its entire range.

In addition to satisfying the reproductive requirements of certain species of fish, the spring high water period also provides flows necessary for the major channel forming processes to occur. With insufficient high flows, the bedload movement necessary for formation of channel structures (islands, bars, pools, etc) would diminish and result in altered habitat conditions, both for aquatic and riparian populations. Deposition of silt in streams carrying a high sediment load greatly changes the environment for certain species of fish by blanketing portions of the streambottom, eliminating potential spawning areas and reducing the available food producing areas. Increased discharge associated with spring runoff results in flushing action which removes the deposited sediments. A discharge which results in an annual cleansing of the streambottom is an important aspect of the stream ecology, particularly for streams which transport large amounts of sediment like the lower Yellowstone.

The abundance of food in a river varies, depending on the production area. Riffles generally have the greatest food production (Hynes 1970) but also are the areas most severely affected by lowered water levels (Bovee 1974). Minimum flow recommendations should reflect physical conditions which would maintain quality aquatic food production. By ensuring that most of the stream substrate is wetted, maximum benthic production is maintained. By assuring good food production, rearing flows for sub-adult fishes are maintained as well as suitable growth rates for adult fishes.

Observations on anchor ice by Benson (1955) indicated that ice formed most commonly in stream sections possessing fast-flowing water, with a gradually decreasing volume of flow. Anchor ice serves as a method of dislodging and scouring of bottom insects, and could result in a loss of invertebrate production. Adequate flow must be maintained during the winter months to retard the formation of excess anchor ice and the subsequent total freezeup of the channel. Fish habitat conditions and needs during the critical low flow period of December through February are totally unknown. However, Chapman (1966) states that winter-regulated density of fish populations is probably related to space necessary to escape displacement or damage by current.

To protect the present water quality of the lower river, not only for aquatic life but also for municipalities and agriculture, adequate flows must be maintained. The flows recommended in this reservation will help assure maintenance of suitable water quality of the lower Yellowstone River (J. Thomas, 1976 - personal communication).

Water temperatures in the lower reaches of the river are approaching critical levels, with summer temperatures in the 80's common. Withdrawal of water during this season could alter the heat budget of the river, and may result in lethal temperatures for fish like sauger, northern pike, sturgeon and burbot, or for aquatic invertebrates or forage fish that support them. A study by the USGS is being conducted on flow/temperature relationships in an effort to define flow levels which will not raise water temperatures beyond limits stated in Montana Water Quality Standards.

In addition to species which live within the aquatic environment, a number of important terrestrial wildlife species are dependent upon the streams in the Yellowstone basin for life-sustaining needs.

Among the major migratory bird species that may be affected by reduced river flows are bald eagles, Canada geese, great blue herons, and several species of ducks. All of these birds use the river during at least a portion of the year for a variety of reasons, including resting, nesting, and/or feeding.

Spring migrant Canada geese arrive on the river sometime in March, depending on weather conditions. Up to 16,000 have been counted at one time on the river between Billings and the North Dakota border. Most of these geese stay along the river for only a short time before continuing their northerly migration, but a substantial number remain along the Yellowstone to breed. Nesting activities begin sometime in March. In 1975, there were an estimated 450 to 500 pairs of breeding Canada geese along the Yellowstone River in Montana.

As has been reported for Canada geese nesting along other rivers (Childress 1971; Dimmick 1968; and Ballou 1954), geese breeding along the Yellowstone prefer islands. Approximately 96 percent of 140 nests surveyed in 1975 and 1976 were on islands (Hinz 1976). They appear to prefer vegetation or other cover that allows them good visibility along with concealment. This type of site occurs on the upstream ends and sides of islands where ice scouring and high flows have reduced vegetation density.

There are several possible effects of reduced river flows on Canada goose nesting. An immediate effect of abnormally low spring water levels would be an increase in predation on goose nests as happened in the spring of 1976. Low flows decreased the width and depth of side channels which more readily permitted access of predators to nesting islands. Reduced winter flows might alter or eliminate ice scouring on islands, with the result that vegetation densities might increase to unacceptable levels for nesting. Also, a reduction in peak spring flows might alter the sediment and bedload material transport system to the point that no new islands are formed and vegetation encroachment takes place on older islands.

Fall goose concentrations on the Yellowstone River have been increasing since the mid-1960's. Recent surveys (1973-1975) indicate that up to 10,000 migrant geese stop along the river below Billings usually in November for varying periods of time. Reasons for this apparent increase in geese stopping along the lower river may be an increase in the amount of grain grown near the river and possibly an increase in the continental goose population.

Many geese remain on the river until it freezes over, usually between late November and the middle of December. Reduced river flows and lower velocities would probably hasten the onset of freeze up, which would shorten the duration of goose occupation of the river. This in turn would decrease the enjoyment derived from the presence of the geese by people who live in the region and by waterfowl hunters.

In 1974, 17.9 percent of the statewide goose harvest (all species) occurred in counties bordering the Yellowstone River.

Large numbers of migrant ducks, primarily mallards, stop along the Yellowstone during spring and fall. Estimates of 30,000 to 50,000 ducks using the river below Billings have been made in 1974 and 1975. Species known to nest along the river include mallards, blue and green-winged teal, wood ducks, and mergansers. The potential effects of reduced river flows on these breeding birds are unknown.

Fall waterfowl use of the river is quite variable and apparently dependent upon weather. In the portion of the river below Billings, peak counts have ranged up to 60,000 ducks, primarily mallards. One possible effect of low water flows would be a hastening in the date of freeze up, which in turn would shorten the duration of fall mallard use along the river.

Species known to winter on open portions of the river include common goldeneye, Barrow's goldeneye, and common merganser. Reduced flows would probably affect these species, because there would be less available open water. Similarly Canada geese and mallards use open portions of the upper river during winter.

Bald eagles congregate along the Yellowstone during spring and fall, with some eagles remaining over winter. The peak numbers of eagles present during both spring and fall along the river below Billings have ranged from 90 to 120. When compared to other reported eagle concentrations (McClelland 1973; Martinka 1974), these counts rank as fairly impressive for any state except Alaska.

Large concentrations of eagles during spring and fall may be in response to waterfowl concentrations during those time periods. Ducks are probably a supplement to the main diet of eagles, which appears to be fish and carrion. Thus, any decrease in waterfowl concentrations or fish populations due to reduced water levels in the river might be detrimental to bald eagles.

Great blue herons usually arrive on the Yellowstone in March, depending on weather and ice conditions. They nest in colonies (rookeries) high in cottonwood trees along the river. There are 19 known rookeries along the Yellowstone. Peak counts of up to 350 herons have been made on the river below Billings. The potential effects of reduced river flows on this species are unknown, but any decrease in fish populations or mature cottonwood groves might affect them.

White pelicans are present along the lower river from spring through fall. During spring, 300-450 pelicans have been observed below Miles City. Summer populations usually number between 100 and 200, mainly in the Powder River and Intake areas. These birds are probably a nonbreeding segment of the populations that breed in northern Montana. Any reduction in fish populations might be detrimental to these birds.

A more detailed discussion of migratory bird use along the lower Yellowstone will appear in the migratory bird section of the Old West Regional Commission Yellowstone River Study to be completed by the Montana Department of Natural Resources and Conservation in early 1977.

Environmental detriments of maintaining a minimum flow must relate to a comparison between not maintaining the flow and maintaining the full amount requested. We believe there would be some environmental detriments with our reservation in those portions of the Yellowstone basin where we have requested specific "numbers" for streamflows needed. These detriments hinge on the assumption that all water over and above our requests would be allocated and eventually withdrawn from the streams for other uses.

Where we have requested specific flow "numbers" in our water reservation, we have ourselves ultimately altered the natural flow regime of many streams in the basin if other water users are annually allowed to remove the water in excess of this request. By setting "numbers" in streams which currently do not appreciably suffer from low water, we have given up for possible future diversionary use a portion of the historical streamflow the aquatic organisms have been associated with. This will likely result in future populations becoming established at lower levels if future diversionary uses of the remaining water evolve. What this will accomplish is an increase in the frequency of low flow periods over those which have historically occurred and through which aquatic and riparian populations have adapted. More frequent low flow periods will reduce habitat size, change water quality, alter riparian vegetation and habitat used by terrestrial animals and ultimately alter the entire ecosystem associated with the stream course. Due to the importance of these resources to the people of Montana, it becomes obvious that significant reduction in their availability for enjoyment will be a future environmental detriment to the resource as well as to those people who utilize this resource for recreation. Conversely, to maintain at least some semblance of the natural flow regime through approval of this reservation request will be an environmental benefit to current and future human generations and to the affected organisms themselves.

However, this will not be true for the Yellowstone River basin upstream from Big Timber. Our requests for this portion of the basin will produce only small environmental detriments since no change in natural streamflow conditions will be evident except during the spring runoff period. Thus those aquatic and riparian populations which now depend on the Yellowstone and its tributaries will likely remain the same if streamflow is the only variable considered. Other changes in habitat due to land use changes and channel modification might alter these populations in the future regardless of streamflow conditions.

During Spring high flow periods we have requested streamflow "numbers" in this portion of the basin, because it is not practical to request instantaneous high flows which include floods. Assuming these flows would be approved and all flows above those would be withdrawn in the future, there could be some environmental detriments to the river system. These detriments are difficult to predict, but will be related to changes in stream channel morphology and sediment transport. Changes in these parameters could produce changes in habitat for aquatic and riparian wildlife species.

Environmental benefits associated with our request in the upper Yellowstone basin are a continuation of the existing trout fisheries in these streams and a continuation of the physical, chemical and biological relationships the tributaries have enjoyed with the mainstem Yellowstone River. These relationships contribute to the high quality trout fishery which exists in this "blue ribbon" stretch of the river and which is now enjoyed by many people of Montana and the nation. To not maintain the requested flows will contribute to the degradation of these important resources.

STATEMENT OF THE AMOUNT OF WATER
NECESSARY FOR THE PURPOSE OF THE RESERVATION

In specifying the quantities of water being requested for flow reservation, it must be acknowledged that during the present, and perhaps now normal, fluctuations in discharge in the Yellowstone River basin, there will be times when the streams will not be capable of supplying the quantities of water requested. It is our intent in requesting these quantities that under all natural hydrologic conditions, future water use permits be conditioned to cease when river discharges reach the levels requested in this application. When river levels drop below the quantities requested due to existing uses or natural phenomena, we fully anticipate that our requests will not be met. Under no circumstances should these figures be construed to imply that augmenting the natural flow through impoundment of flood waters for later discharge will in any way improve upon the existing natural conditions as we now find them in and along the Yellowstone River.

Certain considerations must be recognized if the flow reservation figures for the Yellowstone are to be meaningful. The recommended flows must approximate the seasonal variations which occur naturally if existing aquatic conditions are to be maintained. It is also important that the requested flows will occur with a reasonable degree of frequency.

The flow quantities in our reservation requests take two forms in this application. The first form encompasses the Yellowstone River and its tributaries from Gardiner to the Boulder River at Big Timber. This stretch of the Yellowstone has been previously described as an important and unique blue ribbon stream of state and national importance. We have also tried to show that it is not possible to separate the tributary streams to this reach from the mainstem itself, due to the physical and biological relationships which are inherent between the two, i.e., the fishery in the mainstem is dependent upon tributary streams for water quantity and quality, as well as for sources of new fish to supply the system.

Thus, in view of the importance of this famous river, it is felt that establishment of a single set of "numbers" as recommendations for instream flow needs would be a first step in degrading the high quality of the "blue ribbon" portion of the river and its fishery. Simply assigning flow "numbers" to this part of the river would eventually place limitations on the fishery which do not exist today. Because the Yellowstone is unregulated by man, aquatic resources have evolved to existing relative numbers and status due to a multitude of historical streamflow conditions; i.e., the extreme highs and lows as well as all other flows inbetween. Thus to eventually limit flows to a monthly "number" could effectively alter the status of those existing aquatic resources. It was therefore felt that the low flow period between August and April were most critical to maintain, and that flows should not be established at a "number" during that period or portions thereof.

Outline

1. project purpose as stated

2. examine sites –
systematically evaluate each site
1. degree of erosion
2. what is being protected
3. what may be lost

3. you have [illegible] in level B [illegible]
economically justifiable
1. something of this magnitude [illegible]
be justifiable – 1. precedent [illegible]
[illegible]
2. do [illegible]
[illegible]

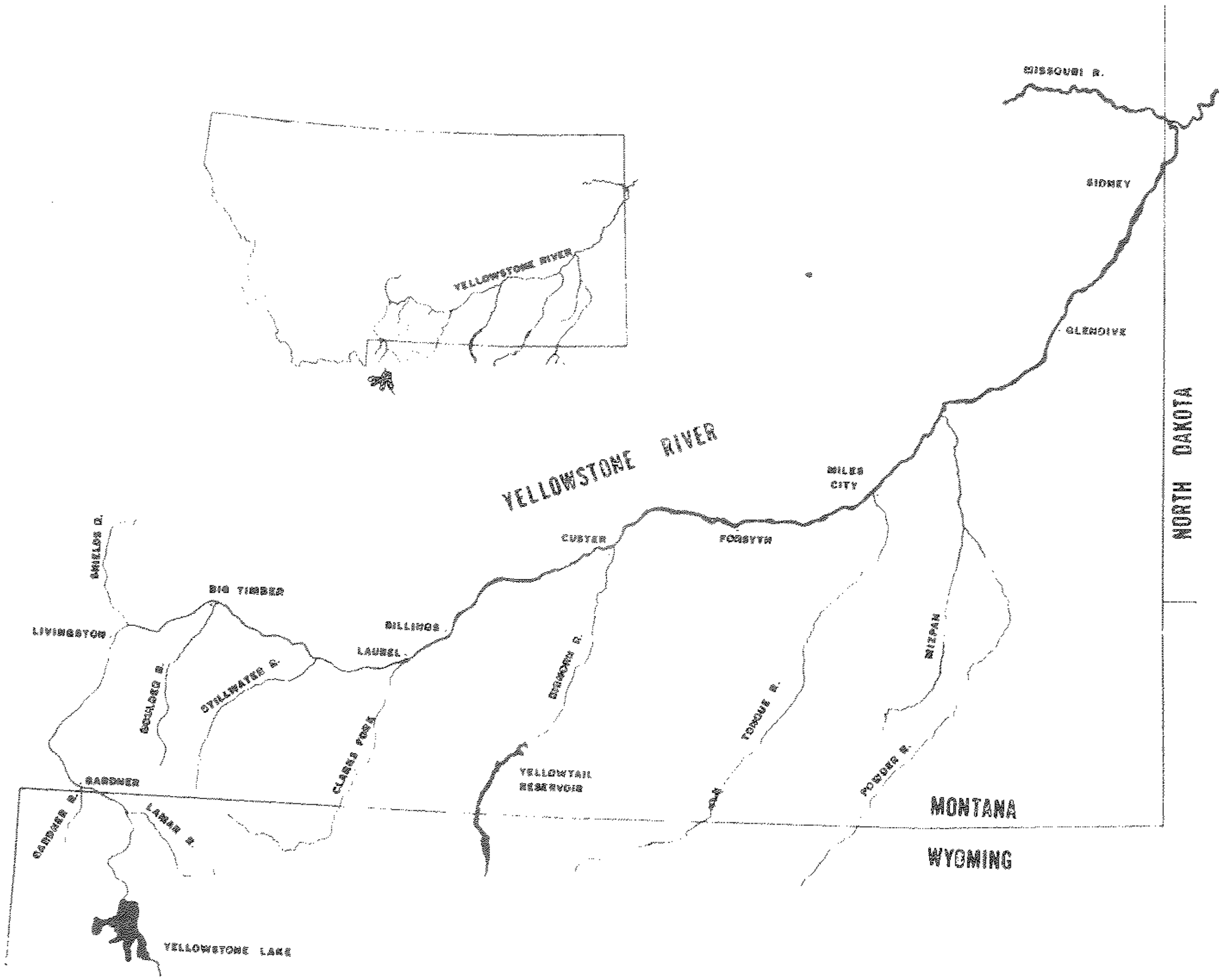
note [illegible] [illegible]
comments
many new proposals
[illegible]

[illegible] justification
[illegible] it [illegible] the project

Only during the spring runoff periods did it seem infeasible to request the instantaneous flow, since this would include floods (some of which could be of great magnitude), and other high water conditions. High flows are responsible for maintaining channel form processes by transporting sediment and allowing bedload movement to occur. These processes build the physical habitat which aquatic and riparian species require (in addition to suitable streamflows) in a stream and are, therefore, necessary functions of the ecosystem. It was, therefore, believed some portion of the high spring flows should be reserved.

Therefore, in the upper Yellowstone basin we have elected to provide flow "numbers" where possible during the high flow period. During the remaining months we have requested "the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach." During May or June we have requested a peak flow preceded by a rise in April and/or May and followed by a recession in July and August. The peak flow requested is the "dominant discharge" for the stream. The dominant discharge is the discharge which occurs with a frequency of about 1.5 years and is sometimes called the "bankful" discharge (Leopold and Wolman 1964). The dominant discharge is the discharge which is primarily responsible for maintaining the shape and other features of the stream channel, which in turn is what determines the amount and type of physical habitat for fish and other aquatic organisms. This discharge is equaled or exceeded about 67% of the time. Flow is less than the dominant discharge 33% of the time, so there will be times when the discharge will be less than requested. The implications of this lesser natural discharge from our viewpoint were addressed in the first paragraph of this section.

The second form of our request encompasses the remainder of the Yellowstone basin downstream from the Boulder River at Big Timber. Flow "numbers" were recommended in all cases for the mainstem and its tributaries. These numbers were derived by various methods.




Yellowstone River drainage.

ATTACHMENTS TO THE STATEMENT OF
THE AMOUNT OF WATER NECESSARY FOR THE PURPOSE OF THE RESERVATION

Flow (or level) recommendations are given for individual streams and/or stream reaches. A standard outline has been followed for continuity between streams. Only principal and important fish and wildlife species which depend upon streamflow are listed; a complete list would be quite extensive, and impractical for each stream or stream reach.

Life history periodicity charts show the periods of the year when important fish species migrate, spawn and perform other necessary life cycle activities. Important waterfowl species are shown on the same charts when applicable. The charts are intended to show why flows (or levels) are necessary throughout the year in a given stream reach. Where more intensive life history data were available, the charts reflect that data. For example, brook trout will show different spawning times in the same drainage when those data were available. In some drainages more specific data were not available and a single chart represents all streams. For example, only one chart is shown for all species in the upper Yellowstone basin since charts for individual streams would be the same anyway, given the limited data available on each stream.

Methods used to request streamflows are simply listed in Item 7 of each attachment when a standard method or concept was used (for example, the Water Surface Profile Program). A more complete description is given for these standard methods and concepts in Appendix A. Where other methods were used the methods are described in greater detail in Item 7.

Streams are alphabetical in order within each portion of the basin as follows:

(1) Upper basin - Gardiner to Boulder River at Big Timber

(2) Middle basin - Boulder River to Bighorn River

(3) Lower basin - Bighorn River to North Dalota state line

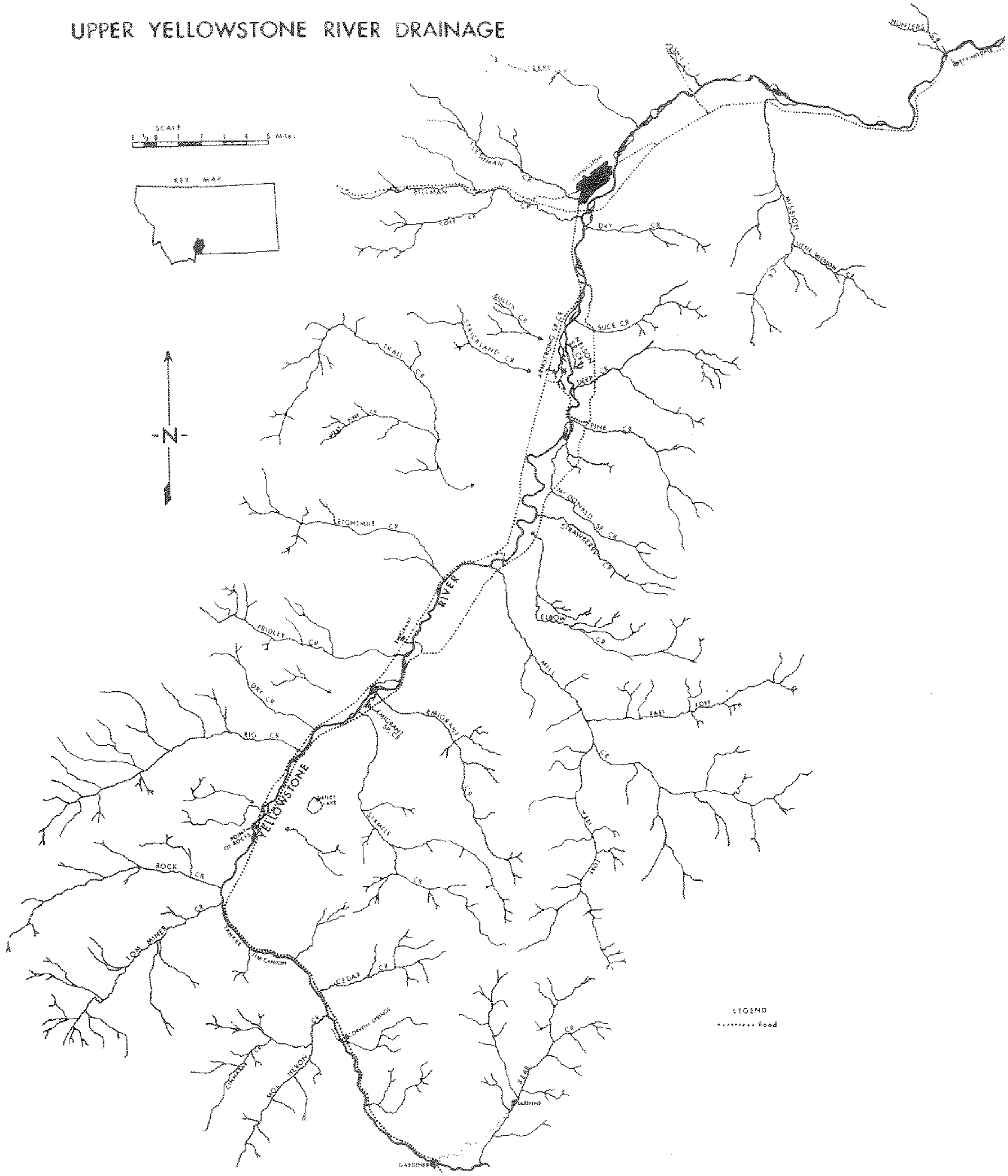
The page upon which a particular stream is located can be found in the Table of Contents at the beginning of this application.

In some cases abbreviations for the names of fish species present are given for the stream reach. The common names that go with these abbreviations are given in Appendix B.

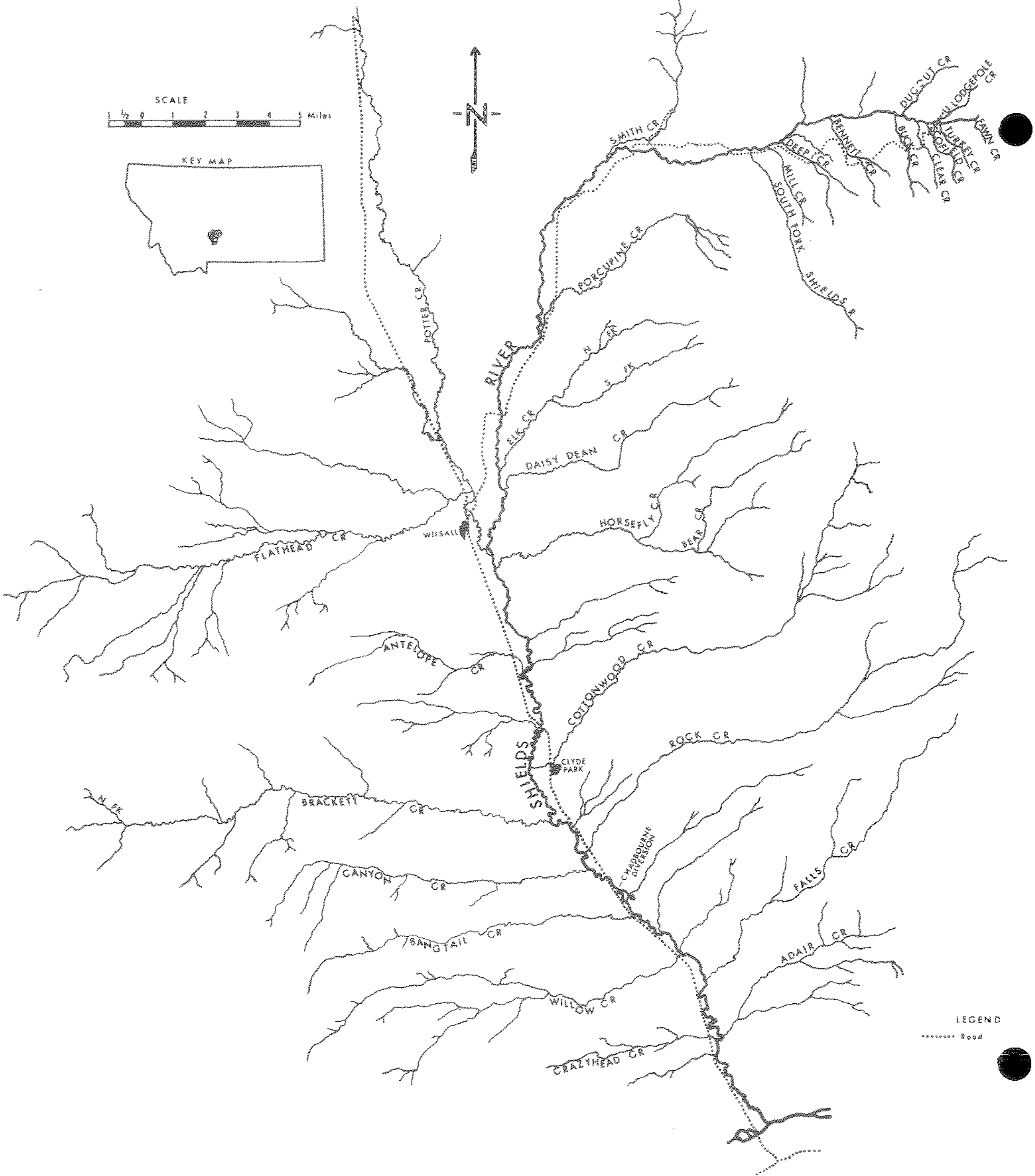
# UPPER YELLOWSTONE BASIN

## Gardiner to mouth of Boulder River

UPPER YELLOWSTONE RIVER DRAINAGE



# SHIELDS RIVER DRAINAGE



1. Name: Armstrong Spring Creek

2. Stream reach: Mouth to origin

3. Location: T3S, R9E, Sec. 23 to T3S, R9E, Sec. 26

4. Fish species present:

   Resident: Rb, LL (Workman 1972, 1973); Ct, Wf[1/]

   Migratory transient: Rb, LL (Berg 1975); Ct, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory: Ducks, geese, swans, great blue heron, shorebirds, bald eagle (Hook 1975)

6. Life history periodicity chart: (See attached). This chart also includes other species in the upper Yellowstone and tributaries, not just those found in Armstrong Spring Creek.

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; precipitation-runoff method.

8. Why flow is necessary:

   Requested flows are necessary to maintain this highly productive spring creek and the excellent trout population it supports. The request is also needed to maintain documented spawning runs of rainbow and brown trout from the Yellowstone River and potential spawning runs of cutthroat and whitefish. Armstrong Spring Creek is nationally known for its challenge to fly fishermen. Flows requested are also needed to maintain natural channel form and processes.

9. Flow request:

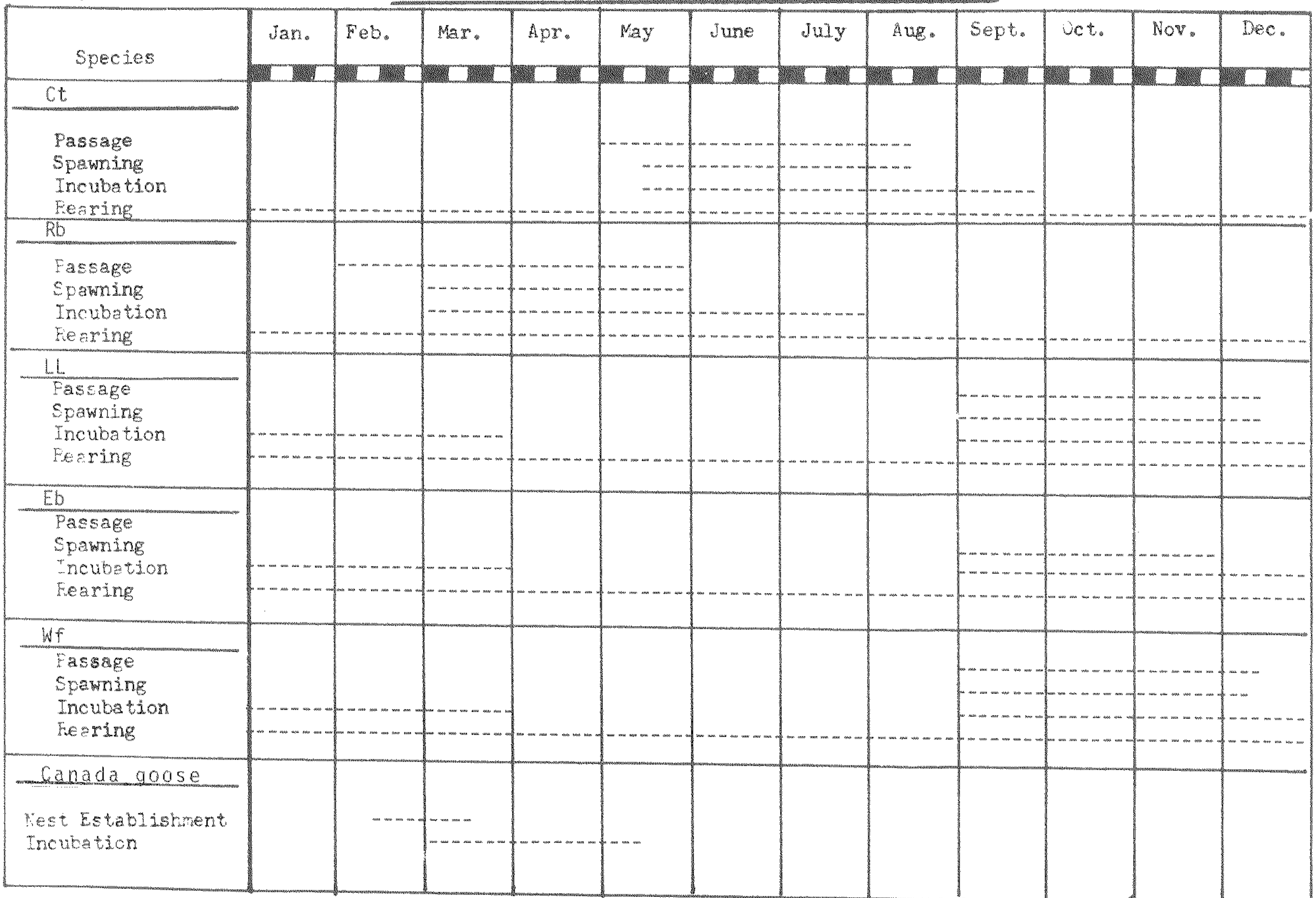
   The instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach.

---

1/ Potential fish species present: although extensive sampling has been done in the Yellowstone and Shields River drainages, more intensive sampling is needed to determine life cycle requirements of fish species present in individual tributary systems. This category represents species that potentially inhabit the stream based on documentation of their presence in similar streams of the drainage and the life history requirements of the species.

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Yellowstone River and Tributaries



LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Yellowstone River and Tributaries

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RbxCt<br>Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Nest Establishment<br>Incubation | | | | | | | | | | | | |

1. Name: Bear Creek

2. Stream reach: Mouth to mouth of North Fork of Bear Creek

3. Location: T9S, R9E, Sec. 19 to T9S, R9E, Sec. 4

4. Fish species present:

   Resident: Rb, Rb x Ct (Berg 1975); Ct1/

   Migratory transient: Ct, Rb, Rb x Ct1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population. These flows are also needed to maintain potential spawning runs of cutthroat, rainbow, brown trout and whitefish from the Yellowstone River. Bear Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Bear Creek

2. Stream reach: North Fork Bear Creek to Fish Lake

3. Location: T9S, R9E, Sec. 4 to T8S, R9E, Sec. 9

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct1/

   Migratory transient: Ct, Rb1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain resident trout populations in Bear Creek and to protect potential spawning runs of trout at Knox and Fish Lakes and the lower reaches of Bear Creek. Further, flows are requested to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Big Creek

2. Stream reach: Mouth to Millfork Creek

3. Location: T6S, R7E, Sec. 23 to T6S, R7E, Sec. 17

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, LL, Wf (Workman, Pers. Comm.)

   Migratory transient: Ct, Wf (Berg 1975); Rb, LL, Rb x Ct[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept, dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population (Workman 1976). This stream also supports cutthroat trout and mountain whitefish spawning runs from the Yellowstone River. Further, it has potential as a rainbow and brown trout spawning and rearing tributary. Big Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Creek.

1. Name: Big Creek

2. Stream reach: Millfork Creek to Bark Cabin Creek

3. Location: T6S, R7E, Sec. 17 to T6S, R6E, Sec. 32

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, LL, Wf1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow potential passage, spawning, and recruitment of trout which may migrate from the lower reaches of Big Creek. Big Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Billman Creek

2. Stream reach: Mouth to mouth Coke Creek

3. Location: T2S, R9E, Sec. 25 to T2S, R9E, Sec. 17

4. Fish species present:

   Resident: Ct, Rb, LL (Berg 1975); Rb x Ct, Eb, Wf[1/]

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept, dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population (Berg 1975) and to maintain potential spawning migrations of cutthroat, rainbow and brown trout, and whitefish from the Yellowstone River. Billman Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Billman Creek

2. Stream reach: Coke Creek to Fork south of NE Corner Sec. 20

3. Location: T2S, R9E, Sec. 17 to T2S, R8E, Sec. 20 NE Corner

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, EB (Berg 1975); LL, Wf1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Eb, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population and potential spawning migrations of trout and whitefish from the lower reaches of Billman Creek and from the Yellowstone River. Billman Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain natural channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Brackett Creek

2. Stream reach: Mouth to Sheep Creek

3. Location: T1N, R9E, Sec. 3 to T1N, R8E, Sec. 2

4. Fish species present:

   Resident: Ct, Rb, LL, Wf (Berg 1975); Rb x Ct1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Eb, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout, and whitefish from the Shields River. Brackett Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - April 15; July 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

| | cfs | ac. ft. | | cfs | ac. ft. |
|---|---|---|---|---|---|
| April 16 - 30 | 35 | 1,041 | June 1 - 10 | 69 | 1,369 |
| May 1 - 10 | 66 | 1,309 | June 11 - 20 | 56 | 1,111 |
| May 11 - 20 | 72 | 1,428 | June 21 - 30 | 43 | 853 |
| May 21 - 31 | 77 | 1,680 | July 1 - 10 | 33 | 655 |

   Flow to equal or exceed 151 cfs for at least one continuous 24-hour period between April 16 - July 31.

   Total Ac. Ft. = 9,676 (includes 151 cfs for 1 day)

1/See Armstrong Spring Creek.

1. Name: Brackett Creek

2. Stream reach: Sheep Creek to Skunk Creek

3. Location: T1N, R8E, Sec 2 to T1N, R7E, Sec. 2

4. Fish species present:

   Resident: Ct, LL, Wf (Berg 1975); Rb[1/]

   Migratory transient: Ct, Rb, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout, and whitefish from the lower reaches of Brackett Creek and from the Shields River. Brackett Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Brackett Creek

2. Stream reach: Skunk Creek to one mile up North, Middle and South Forks

3. Location: T1N, R7E, Sec 2 to T1N, R7E, Sec's. 6, 7, 18

4. Fish species present:

   Resident: Ct, Eb, LL, Wf (Berg 1975)

   Migratory transient: Ct, Rb, LL Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout, and whitefish from the lower reaches of Brackett Creek. Brackett Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cedar Creek

2. Stream reach: Mouth to Second Fork Cedar Creek

3. Location: T8S, R7E, Sec. 13 to T8S, R8E, Sec. 8

4. Fish species present:

   Resident: Ct, Rb, LL, Eb, Wf (Berg 1975); Rb x Ct[1/]

   Migratory transient: Ct (Berg 1975); Rb, Rb x Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow passage, spawning, and recruitment of cutthroat trout which migrate from the Yellowstone River to spawn. Further, it has potential as a whitefish, rainbow and brown trout spawning and rearing tributary. Cedar Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow Request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cedar Creek

2. Stream reach: Second fork to North Fork of Cedar Creek

3. Location: T8S, R8E, Sec. 8 to T8S, R8E, Sec. 9

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, LL, Eb, Wf1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept, dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and potential spawning migration from the lower reaches of Cedar Creek and from the Yellowstone River. Cedar Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cinnabar Creek

2. Stream reach: Mouth to Cottonwood Creek

3. Location: T8S, R7E, Sec. 25 to T8S, R7E, Sec. 27

4. Fish species present:

   Resident: Rb, Rb x Ct (Berg 1975); Ct, LL, Eb, Wf[1/]

   Migratory transient: Ct, Wf, Rb, Rb x Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident trout population. Also, these flows are necessary to allow potential passage, spawning and successful recruitment of Yellowstone cutthroat, rainbow and brown trout, and whitefish which may migrate from the Yellowstone River[1/]. Cinnabar Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cinnabar Creek

2. Stream reach: Cottonwood Creek to FS boundary at T8S, R7E, Sec. 32

3. Location: T8S, R7E, Sec. 27 to T8S, R7E, Sec. 32

4. Fish species present:

   Resident: Rb, Eb (Berg 1975); Ct, Rb x Ct, LL, Wf1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and potential spawning migrations from the lower reach of Cinnabar Creek, Mol Heron Creek and the Yellowstone River. Cinnabar Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Creek.

1. Name: Coke Creek

2. Stream reach: Mouth to Minor Creek

3. Location: T2S, R9E, Sec. 17 to T2S, R8E, Sec. 26

4. Fish species present:

   Resident: Ct (Berg 1975); Rb, Rb x Ct, LL, Eb[1/]

   Migratory transient: Ct, Rb, Rb x Ct, LL, Eb[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident trout fishery. Also, these flows are necessary to allow potential passage, spawning and successful recruitment of cutthroat, rainbow, brown trout, and whitefish from Billman Creek and the Yellowstone River. Further, the requested flows are necessary to maintain flows in Billman Creek. Coke Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cottonwood Creek

2. Stream reach: Mouth to Little Cottonwood

3. Location: T2N, R9E, Sec. 33 to T3N, R10E, Sec. 35

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, LL, Eb (Berg 1975)

   Migratory transient: Ct, Rb, Rb x Ct, LL, Eb[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout, and whitefish from the Shields River. Cottonwood Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Cottonwood Creek

2. Stream reach: Little Cottonwood Creek to Trespass Creek

3. Location: T3N, R10E, Sec. 35 to T3N, R11E, Sec. 7

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL, Eb (Berg 1975); Wf1/

   Migratory transient: Ct, Rb, RbxCt, LL, Eb1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow, brown and brook trout and whitefish from the lower reach of Cottonwood Creek. Cottonwood Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Eight Mile Creek

2. Stream reach: Mouth to Big Draw

3. Location: T5S, R8E, Sec. 14 to T4S, R8E, Sec. 31

4. Fish species present:

   Resident: Ct, Rb, Eb (Berg 1975); Rb x Ct, LL, Wf1/

   Migratory transient: Wf (Berg 1975); Ct, Rb, Rb x Ct, LL1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout fishery (Berg 1975). Also, these flows are necessary to allow passage, spawning and successful recruitment of whitefish which migrate from the Yellowstone River and for potential spawning runs of cutthroat, rainbow and brown trout from the Yellowstone River. Eight Mile Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Eight Mile Creek

2. Stream reach: Big Draw to North Fork of Eightmile Creek

3. Location: T4S, R8E, Sec. 31 to T4S, R7E, Sec. 34

4. Fish species present:

   Resident: Ct, Rb, Eb (Berg 1975); Rb x Ct, LL, Wf 1/

   Migratory transient: Wf (Berg 1975); Ct, Rb, Rb x Ct, LL 1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to allow potential passage, spawning, and recruitment of trout from the lower reaches of Eight Mile Creek and from the Yellowstone River. Eight Mile Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). Requested flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Emigrant Spring Creek

2. Stream reach: Mouth to origin

3. Location: T6S, R8E, Sec. 8 to T6S, R8E, Sec. 8

4. Fish species present:

   Resident: LL, Eb, Wf (Berg 1975); Ct, Rb, Rb x Ct[1/]

   Migratory transient: Ct, Rb, LL (Berg 1975); Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; precipitation-run-off method.

8. Why flow is necessary:

   Requested flows are necessary to maintain this highly productive spring creek and the excellent trout population it supports. The flows are also needed to maintain documented spawning runs of cut-throat, rainbow and brown trout from the Yellowstone River and for potential spawning runs of whitefish. The creek is well known for its challenge to fly fishermen (Berg 1975). Flows requested are needed to maintain channel form and processes.

9. Flow request:

   The instantaneous streamflow, subject to existing, lawfully appro-priated water rights in the stream reach.

1/See Armstrong Spring Creek.

1. Name: Flathead Creek

2. Stream reach: Mouth to Muddy Creek

3. Location: T3N, R9E, Sec. 29 to T3N, R8E, Sec. 13

4. Fish species present:

   Resident: Ct, LL, Wf (Berg 1975)

   Migratory transient: Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout and whitefish from the Shields River. Cottonwood Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Flathead Creek

2. Stream reach: Muddy Creek to Cache Creek

3. Location: T3N, R8E, Sec. 13 to T3N, R7E, Sec. 26

4. Fish species present:

   Resident: Ct, LL, Eb, Wf (Berg 1975)

   Migratory transient: Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout and whitefish from the lower reaches of Flathead Creek and from the Shields River (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Flathead Creek

2. Stream reach: Cache Creek to South Fork Flathead Creek

3. Location: T3N, R7E, Sec. 26 to T3N, R6E, Sec. 36

4. Fish species present:

   Resident: Ct, Eb (Berg 1975)

   Migratory transient: Ct, Eb, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, brown and brook trout and whitefish from the lower reaches of Flathead Creek. Flathead Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Fleshman Creek

2. Stream reach: Mouth to Perkins Creek

3. Location: T2S, R10E, Sec. 18 to T2S, R9E, Sec. 6

4. Fish species present:

   Resident: Ct, Rb, LL, Eb (Berg 1975); Rb x Ct1/

   Migratory transient: Ct, Rb, Rb x Ct, LL1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population. Also, these flows are necessary to allow potential passage, spawning, and successful recruitment of cutthroat, rainbow, and brown trout, and whitefish which may migrate from the Yellowstone River. Fleshman Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek.

1. Name: Fridley Creek

2. Stream reach: Mouth to Miller Creek

3. Location: T5S, R8E, Sec. 33 to T5S, R7E, Sec. 36

4. Fish species present:

   Resident: Ct, Rb, Eb (Berg 1975); Rb x Ct[1/]

   Migratory transient: Wf (Berg 1975); Ct, Rb, Rb x Ct, LL[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident trout fishery (Berg 1975). Also, these flows are necessary to allow passage, spawning, and successful recruitment of whitefish which migrate from the Yellowstone River, and potential cutthroat, rainbow and brown trout spawning runs from the Yellowstone River. Fridley Creek lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). Requested flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Fridley Creek

2. Stream reach: Miller Creek to Needle Creek

3. Location: T5S, R7E, Sec. 36 to T5S, R7E, Sec. 20

4. Fish species present:

   Resident: Ct, Rb, Eb (Berg 1975);
   RbxCt1/

   Migratory transient: Ct, Rb, RbxCt, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. They are also needed for potential passage, spawning and recruitment of trout and whitefish which may migrate from the lower reaches of Fridley Creek and from the Yellowstone River. Fridley Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Little Mission Creek

2. Stream reach: Mouth to Little Mission Forks

3. Location: T2S, R11E, Sec. 33 to T3S, R11E, Sec. 2

4. Fish species present:

   Resident: Ct (Berg 1975)

   Migratory transient: Ct, Rb[1/]

5. Wildlife Species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow potential passage, spawning, and recruitment of trout which may migrate from the lower reaches of Mission Creek. Mission Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: McDonald Spring Creek

2. Stream reach: Mouth to northern boundary of Section 22

3. Location: T4S, R9E, Sec. 11 to T4S, R9E, Sec. 22 northern boundary

4. Fish species present:

   Resident: Rb, LL, Wf (Berg 1975); Ct, Rb x Ct[1/]

   Migratory transient: Rb, LL, Ct (Berg 1975); Rb x Ct, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek).

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; precipitation-runoff method.

8. Why flow is necessary:

   Requested flows are necessary to maintain this highly productive spring creek and the excellent resident trout population it supports. These flows are also requested to maintain documented spawning runs of Yellowstone cutthroat, rainbow and brown trout from the Yellowstone River and potential spawning runs of whitefish. McDonald Spring Creek is well known for its challenge to fly fishermen (Berg 1975). Requested flows are needed to maintain channel form and processes.

9. Flow request:

   The instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach.

1/See Armstrong Spring Creek.

1. Name: Mill Creek

2. Stream reach: Mouth to East Fork Mill Creek

3. Location: T5S, R9E, Sec. 7 to T6S, R9E, Sec. 13

4. Fish species present:

   Resident: Ct, RbxCt (Berg 1975);
   Rb, LL, Wf1/

   Migratory transient: Ct (Berg 1975);
   Rb, RbxCt, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, they are needed to allow passage, spawning and recruitment of cutthroat trout which migrate from the Yellowstone River. Further, Mill Creek has potential as a whitefish, rainbow and brown trout spawning and rearing tributary. Mill Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mill Creek

2. Stream reach: East Fork Mill Creek to Passage Creek

3. Location: T6S, R9E, Sec. 13 to T6S, R10E, Sec. 29

4. Fish species present:

   Resident - Ct, Wf (Berg 1975)

   Migratory transient - Rb1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, they are needed to allow potential passage, spawning and recruitment of trout which may migrate from the lower reach of Mill Creek and from the Yellowstone River. Mill Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mill Creek

2. Stream reach: Passage Creek to Lambert Creek

3. Location: T6S, R10E, Sec. 29 to T6S, R10E, Sec. 36

4. Fish species present:

   Resident: Ct (Berg 1975);
   Rb, Wf1/

   Migratory transient: Ct, Rb, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Fish populations were surveyed (Berg 1975). Dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, they are needed to allow potential passage, spawning and recruitment of trout which may migrate from the lower reaches of Mill Creek. Mill Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mission Creek

2. Stream reach: Mouth to Spring Creek

3. Location: T1S, R11E, Sec. 29 to T2S, R11E, Sec. 17

4. Fish species present:

   Resident: Rb, LL, Wf (Berg 1975); Ct, RbxCt[1/]

   Migratory transient: Wf (Berg 1975); Ct, Rb, RbxCt, LL[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population. Also, these flows are necessary to allow passage, spawning and recruitment of whitefish which migrate from the Yellowstone River, and potential cutthroat, rainbow and brown trout spawning runs from the Yellowstone River. Mission Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mission Creek

2. Stream reach: Spring Creek to Little Bear Draw

3. Location: T2S, R11E, Sec. 17 to T2S, R11E, Sec. 33

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL (Berg 1975); Wf1/

   Migratory transient: Ct, Rb, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population. Also, these flows are necessary to allow potential passage, spawning and recruitment of fish which may migrate from the lower reach of Mission Creek and the Yellowstone River. Mission Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mol Heron Creek

2. Stream reach: Mouth to Cinnabar Creek

3. Location: T8S, R7E, Sec. 24 to T8S, R7E, Sec. 25

4. Fish species present:

   Resident: Ct, Rb, LL, Wf, RbxCt (Berg 1975)

   Migratory transient - Ct, Wf (Berg 1975);
   Rb, LL, RbxCt 1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident fish population (Berg 1975). Also, these flows are necessary to allow passage, spawning and successful recruitment of cutthroat trout and whitefish which migrate from the Yellowstone River and potential spawning runs of rainbow and brown trout from the Yellowstone River. Mol Heron Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Mol Heron Creek

2. Stream reach: Cinnabar Creek to Yellowstone Park Boundary

3. Location: T8S, R7E, Sec. 25 to T9S, R7E, Sec. 20

4. Fish species present:

   Resident: Ct, Rb (Berg 1975);
   RbxCt, LL, Wf[1/]

   Migratory transient: Ct, Rb, RbxCt, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow potential passage, spawning and recruitment of trout which may migrate from the lower reaches of Mol Heron Creek. Mol Heron Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Nelson Spring Creek

2. Stream Reach - Mouth to origin

3. Location: T3S, R9E, Sec. 23 to T3S, R9E, Sec. 26

4. Fish species present:

   Resident: Rb, LL (Berg 1975); Ct, Wf[1/]

   Migratory transient: Ct, Rb, LL (Berg 1975); Rb x Ct, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept, dominant discharge concept; precipitation-runoff method.

8. Why flow is necessary:

   Requested flows are necessary to maintain this highly productive spring creek and the excellent resident trout population it supports. The flows are also needed to maintain documented spawning runs of cutthroat, rainbow and brown trout from the Yellowstone River and for potential spawning runs of whitefish. Nelson Spring Creek is nationally known for its challenge to fly fishermen (Berg 1975). Flows requested are also needed to maintain natural channel form and processes.

9. Flow request:

   The instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach.

1/See Armstrong Creek.

1. Name: Rock Creek (Shields Drainage)

2. Stream reach: Mouth to Forest Service west boundary Sec. 8

3. Location: T1N, R9E, Sec. 11 to T2N, R11E, Sec. 8

4. Fish species present:

   Resident: Ct, LL, Eb (Berg 1975); Rb, RbxCt, Wf[1/]

   Migratory transient: Ct, Rb, RbxCt, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, brown and rainbow trout and whitefish from the Shields River. Rock Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Rock Creek (Shields Drainage)

2. Stream reach: Forest Service west boundary Sec. 8 to Smeller Creek

3. Location: T2N, R11E, Sec. 8 to T3N, R11E, Sec. 22

4. Fish species present:

   Resident: Ct, LL, Eb, Rb, Wf1/

   Migratory: Ct, LL, Eb, Rb, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, brown and brook trout from the Shields River. Rock Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Rock Creek (of the Yellowstone)

2. Stream reach: Mouth to Steele Creek

3. Location: T7S, R7E, Sec. 19 to T7S, R6E, Sec. 20

4. Fish species present:

   Resident: Ct (Workman 1976);
   Rb, RbxCt, Wf[1/]

   Migratory transient: Ct (Berg 1975);
   Rb, RbxCt, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident trout population. Also, these flows are necessary to allow passage, spawning, and successful recruitment of cutthroat trout which migrate from the Yellowstone River, and potential spawning runs of rainbow and brown trout and whitefish from the Yellowstone River. Rock Creek lies in a heavy recreational use area and is utilized by fishermen. Requested flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Shields River

2. Stream reach: Mouth to Cottonwood Creek

3. Location: T1S, R10E, Sec. 26 to T2N, R9E, Sec. 33

4. Fish species present:

   Resident: Ct, Rb, Rb x Ct, LL, Wf (Berg 1975)

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle, great blue heron (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident trout population and to maintain potential spawning runs of cutthroat, rainbow and brown trout, and whitefish from the Yellowstone River. The Shields River lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain natural channel form and processes.

9. Flow request:

   January 1 - March 31; July 11 - December 31 - the instantaneous streamfow subject to existing lawfully appropriated water rights in the stream reach.

| | cfs | ac. ft. | | cfs | ac. ft. |
|---|---|---|---|---|---|
| April 1 - 15 | 99 | 2,945 | June 1 - 10 | 325 | 6,446 |
| April 16 - 30 | 156 | 4,641 | June 11 - 20 | 278 | 5,514 |
| May 1 - 10 | 240 | 3,094 | June 21 - 30 | 151 | 2,995 |
| May 11 - 20 | 319 | 6,327 | July 1 - 10 | 80 | 1,587 |
| May 21 - 31 | 287 | 6,262 | | | |

   Flow to equal or exceed 774 cfs for at least one continuous 24-hour period between April 1 - July 10.

   Total Ac. Ft. = 41,346 (includes 774 cfs for 1 day)

1/See Armstrong Spring Creek.

1. Name: Shields River

2. Stream reach: Cottonwood Creek to Elk Creek

3. Location: T2N, R9E, Sec. 33 to T3N, R9E, Sec. 8

4. Fish species present:

   Resident: Ct, Rb, LL, Wf (Berg 1975); Rb x Ct[1/]

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle, great blue heron (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout and whitefish from the lower reach of the Shields River and from the Yellowstone River. The Shields River lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - April 15; July 21 - December 31 - the instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach.

| | cfs | ac. ft. | | cfs | ac. ft. |
|---|---|---|---|---|---|
| April 16 - 30 | 39 | 1,160 | June 11 - 20 | 157 | 3,114 |
| May 1 - 10 | 83 | 1,646 | June 21 - 30 | 105 | 2,083 |
| May 11 - 20 | 137 | 2,717 | July 1 - 10 | 56 | 1,111 |
| May 21 - 31 | 184 | 4,014 | July 11 - 20 | 36 | 714 |
| June 1 - 10 | 189 | 3,749 | | | |

   Discharge to equal or exceed 457 cfs for at least one continuous 24-hour period between April 15 and July 31.

   Total Ac. Ft. = 21,214 (includes 457 cfs for 1 day)

1/See Armstrong Spring Creek.

1. Name: Shields River

2. Stream reach: Elk Creek to Lodgepole Creek

3. Location: T3N, R9E, Sec. 8 to T5N, R11E, Sec. 16

4. Fish species present:

   Resident: Ct, Rb, LL, Eb, Wf (Berg 1975); Rb x Ct1/

   Migratory transient: Ct, Rb, Rb x Ct, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle, great blue heron (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, rainbow and brown trout, and whitefish from the lower reaches of the Shields River and the Yellowstone River. The Shields River lies in an area of increasing recreation use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/See Armstrong Spring Creek.

1. Name: Sixmile Creek

2. Stream reach: Mouth to North Fork Sixmile Creek

3. Location: T6S, R8E, Sec. 8 to T7S, R8E, Sec. 9

4. Fish species present:

   Resident: Ct, LL (Berg 1975);
   Rb, RbxCt1/

   Migratory transient: Ct, Rb, RbxCt, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. These flows are also necessary to allow potential passage, spawning and successful recruitment of cutthroat, rainbow and brown trout, and whitefish which may migrate from the Yellowstone River. Sixmile Creek lies in a heavy recreational use area and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Smith Creek

2. Stream reach: Mouth to Bitter Creek

3. Location: T5N, R9E, Sec. 26 to T6N, R10E, Sec. 31

4. Fish species present:

   Resident: Ct, LL, Eb (Berg 1975); Wf1/

   Migratory transient: Ct, Rb, LL, Eb, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why the flow is necessary:

   Requested flows are necessary to maintain a resident fish population and to maintain potential spawning of cutthroat, brown and brook trout, and whitefish from the Shields River. Smith Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - March 31; July 21 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   April 1 - July 20 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Suce Creek

2. Stream reach: Mouth to Lost Creek

3. Location: T3S, R9E, Sec. 14 to T35, R10E, Sec. 16

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL (Berg 1975); Wf[1/]

   Migratory transient: Ct, Rb, RbxCt, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident trout population. Also, these flows are necessary to allow potential passage, spawning and successful recruitment of Yellowstone cutthroat, rainbow and brown trout and whitefish which may migrate from the Yellowstone River. Suce Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Tom Miner Creek

2. Stream reach: Mouth to Canyon Creek

3. Location: T7S, R7E, Sec. 30 to T7S, R6E, Sec. 36

4. Fish species present:

   Resident: Ct, LL (Berg 1975);
   Rb, Wf1/

   Migratory transient: Ct, Wf (Berg 1975);
   Rb, LL, RbxCt1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to sustain a resident fish population. Also, these flows are necessary to allow passage, spawning and successful recruitment of cutthroat trout and whitefish which migrate from the Yellowstone River and potential rainbow and brown trout spawning runs. Tom Miner Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Tom Miner Creek

2. Stream reach: Canyon Creek to Trail Creek

3. Location: T7S, R6E, Sec. 36 to T8S, R6E, Sec. 19

4. Fish species present:

   Resident: Ct (Berg 1975);
   Rb, RbxCt, LL, Wf[1/]

   Migratory transient: Ct, Rb, RbxCt, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow potential passage, spawning and recruitment of trout which may migrate from the lower reaches of Tom Miner Creek. Tom Miner Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Trail Creek

2. Stream reach: Mouth to West Pine Creek

3. Location: T3S, R9E, Sec. 14 to T4S, R8E, Sec. 11

4. Fish species present:

   Resident: RbxCt, LL (Berg 1975);
   Ct, Rb1/

   Migratory transient: Ct, Rb, RbxCt, LL, Wf1/

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, these flows are necessary to allow potential passage, spawning, and successful recruitment of cutthroat, rainbow and brown trout, and whitefish which may migrate from the Yellowstone River. Trail Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong Spring Creek

1. Name: Trail Creek

2. Stream reach: West Pine Creek to South Boundary Sec. 35

3. Location: T4S, R8E, Sec. 11 to T3S, R7E, Sec. 35

4. Fish species present:

   Resident: RbxCt, LL (Berg 1975)

   Migratory transient: Ct, Rb, LL, Wf[1/]

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, marten, river otter (Constan 1975)

   Migratory transient: Ducks, bald eagle (Hook 1975)

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue-ribbon concept; dominant discharge concept.

8. Why flow is necessary:

   Requested flows are necessary to maintain a resident fish population. Also, they are needed to allow potential passage, spawning and recruitment of trout which may migrate from the lower reaches of Trail Creek. Trail Creek lies in an area of increasing recreational use and is utilized by fishermen (Berg 1975). These flows are also needed to maintain channel form and processes.

9. Flow request:

   January 1 - May 10; August 11 - December 31 - the instantaneous streamflow subject to existing lawfully appropriated water rights in the stream reach.

   May 11 - August 10 - 24-hour dominant discharge, to be determined.

1/ See Armstrong spring Creek

1. Name: Yellowstone River

2. Stream reach: Gardiner to Tom Miner Creek

3. Location: T9S, R8E, Sec. 23 to T7S, R7E, Sec. 30

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL, Wf (Berg 1975)

   Migratory transient: Eb (Berg 1975)

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, marten, river otter, raccoon, white-tailed deer (Constan 1975); pheasants

   Migratory transient: Waterfowl - pintails, shovelers, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-wing teal, green-wing teal, cinnamon teal, coot, ring-necked duck, and Canada goose. Nongame - bald eagle, great blue heron (Hook 1975).

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; streamflow frequency data and current biological data. Flow requests are based on streamflow frequency data at the USGS gaging station "Yellowstone River at Corwin Springs," existing water rights held by the Department of Fish and Game, and flow recommendations for the lower Yellowstone River.

   Biological-streamflow data obtained on the lower Yellowstone River below the Big Horn River are the basis for the flow requests from May 11-August 10. Requested flows in the lower river for this period were based on biological data but approached those flows equaled or exceeded 70% of the time (based on USGS data from 1942-1971). Thus to be consistent with those recommendations, the 70 percent exceedance flows for the Yellowstone River at Corwin Springs (1926-1974) were used as the base flow for the May-August period. However, the Department of Fish and Game has an existing right (see below) in this reach which was subtracted from the base flow to obtain the requested flows. The dominant discharge at the Corwin Springs gage was requested for a 24-hour period.

   Existing Rights of the Department of Fish and Game[1/]

   From Yellowstone Park boundary to Tom Miner Creek: January 1 - December 31 800 cfs

1/Section 89-801 R.C.M. 1947 - Chapter 345, Laws of 1969. Constitution of the state of Montana; Montana Water Use Act.

8. Why flow is necessary:

Flows are necessary to preserve and maintain fish and wildlife population at current levels in this blue ribbon stream as stated in Section IV "Statement on the Need for the Reservation," and to maintain the physical characteristics of the stream channel through adequate sediment transport and bedload movement.

9. Flow request:

January 1 - May 10, August 11 - December 31: The instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach.

| | CFS | AC. FT. | | CFS | AC. FT. |
|---|---|---|---|---|---|
| May 11-20 | 2900 | 57,521 | July 1-10 | 5700 | 113,058 |
| May 21-31 | 5500 | 120,000 | July 11-20 | 4000 | 79,339 |
| June 1-10 | 7800 | 154,710 | July 21-31 | 2900 | 63,273 |
| June 11-20 | 8700 | 172,562 | Aug. 1-10 | 2200 | 43,636 |
| June 21-30 | 7700 | 152,727 | | Total | 956,826 |

Discharge to equal or exceed 15,000 cfs for one continuous 24 hour period between May 11 and Aug. 10 (= 29,752 Ac. Ft.).

Total Ac. Ft. = 986,578 (includes 15,000 cfs for one day).

1. Name: Yellowstone River

2. Stream reach: Tom Miner Creek to Big Creek

3. Location: T7S, R7E, Sec. 30 to T6S, R7E, Sec. 23

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL, Wf (Berg 1975)

   Migratory transient: Eb (Berg 1975)

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, marten, river otter, raccoon, white-tailed deer (Constan 1975); pheasants

   Migratory transient: Waterfowl - pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-wing teal, green-wing teal, cinnamon teal, coot, ring-neck duck, and Canada goose. Nongame - bald eagle, great blue heron (Hook 1975).

6. Life history periodicity chart : (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; streamflow frequency and hydrograph data. Flow requests are based on streamflow frequency data at the USGS gaging station "Yellowstone River at Corwin Springs," existing water rights held by the Department of Fish and Game, and flow recommendations for the lower Yellowstone River.

   Biological-streamflow data obtained on the lower Yellowstone River below the Big Horn River are the basis for the flow requests from May 11-August 10. Requested flows in the lower river for this period were based on biological data but approached those flows equaled or exceeded 70% of the time (based on USGS data from 1942-1971). Thus to be consistent with those recommendations, the 70% exceedance flows for the Yellowstone River at Corwin Springs (1926-1974) were used as the base flow for the May-August period. However, the Department of Fish and Game has an existing right (see below) in this reach which was subtracted from the base flow to obtain the requested flows. The dominant discharge at the Corwin Springs gage was requested for a 24-hour period.

Existing Rights of the Department of Fish and Game[1/]

| | | |
|---|---|---|
| From Tom Miner Creek to Shields River: | April 16-October 31 | 2000 cfs |
| | November 1-April 15 | 1200 cfs |

1/Section 89-801 R.C.M. 1947; Chapter 345, Laws of 1969; Constitution of the state of Montana; Montana Water Use Act.

8. Why flow is necessary:

Flows are necessary to preserve and maintain fish and wildlife populations at current levels in this blue ribbon stream as stated in Section IV "Statement on the Need for the Reservation," and to maintain the physical characteristics of the stream channel through adequate sediment transport and bedload movement.

9. Flow request:

January 1-May 10, August 11-December 31: The instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach.

| | CFS | AC. FT. | | CFS | AC. FT. |
|---|---|---|---|---|---|
| May 11-20 | 1700 | 33,719 | July 1-10 | 4500 | 89,256 |
| May 21-31 | 4300 | 93,818 | July 11-20 | 2800 | 55,537 |
| June 1-10 | 6600 | 130,909 | July 21-31 | 2000 | 43,636 |
| June 11-20 | 7500 | 148,760 | Aug. 1-10 | 1000 | 19,835 |
| June 21-30 | 6500 | 128,926 | | | |
| | | | | Total | 744,396 |

Discharge to equal or exceed 15,000 cfs for one continuous 24-hour period between May 11 and August 10 (= 29,752 Ac. Ft.).

Total Ac. Ft. = 774,148 (includes 15,000 cfs for one day).

1. Name: Yellowstone River

2. Stream reach: Big Creek to Shields River

3. Location: T6S, R7E, Sec. 23 to T1S, R10E, Sec. 26

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL, Wf (Berg 1975)

   Migratory transient: Eb (Berg 1975)

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, marten, river otter, raccoon, white-tailed deer (Constan 1975); pheasants

   Migratory transient: Waterfowl - pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red-breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-wing teal, green-wing teal, cinnamon teal, coot, ring-neck duck, and Canada goose. Nongame - bald eagle, great blue heron (Hook 1975).

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; streamflow frequency data; and current biological data. Flow requests are based on streamflow frequency data at the USGS gaging station "Yellowstone River near Livingston," existing water rights held by the Department of Fish and Game, and flow recommendations for the lower Yellowstone River.

   Biological-streamflow data obtained on the lower Yellowstone River below the Big Horn River are the basis for the flow requests from May 11-August 10. Requested flows in the lower river for this period were based on biological data but approached those flows equaled or exceeded 70% of the time (based on USGS data from 1942-1971). Thus to be consistent with those recommendations, the 70% exceedance flows for the Yellowstone River near Livingston (1901-1967) were used as the base flows for the May-August period. However, the Department of Fish and Game has an existing right (see below) in this reach which was substracted from the base flow to obtain the requested flows. The dominant discharge at the Livingston gage was requested for a 24-hour period.

<u>Existing Rights of the Department of Fish and Game[1/]</u>

| | | |
|---|---|---|
| From Tom Miner Creek to Shields River: | April 16-October 31 | 2000 cfs |
| | November 1-April 15 | 1200 cfs |

1/Section 89-801 R.C.M. 1947; Chapter 345, Laws of 1969; Constitution of the state of Montana; Montana Water Use Act.

8. Why flow is necessary:

Flows are necessary to preserve and maintain fish and wildlife populations at current levels in this blue-ribbon stream as stated in Section IV "Statement on the Need for the Reservation," and to maintain the physical characteristics of the stream channel through adequate sediment transport and bedload movement.

9. Flow request:

January 1-May 10, August 11-December 31: The instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach.

| | CFS | AC. FT. | | CFS | AC. FT. |
|---|---|---|---|---|---|
| May 11-20 | 1900 | 37,686 | July 1-10 | 5400 | 107,107 |
| May 21-31 | 4700 | 102,545 | July 11-20 | 3800 | 75,372 |
| June 1-10 | 7700 | 152,727 | July 21-31 | 2500 | 54,545 |
| June 11-20 | 9000 | 178,512 | Aug. 1-10 | 1600 | 31,736 |
| June 21-30 | 8000 | 158,678 | | | |
| | | | | Total | 898,908 |

Discharge to equal or exceed 18,200 cfs for one continuous 24-hour period between May 11 and August 10 (= 36,099 Ac. Ft.).

Total Ac. Ft. = 935,007 (includes 15,000 cfs for one day).

1. Name: Yellowstone River

2. Stream reach: Shields River to Boulder River

3. Location: T1S, R10E, Sec. 26 to T1N, R14E, Sec. 12

4. Fish species present:

   Resident: Ct, Rb, RbxCt, LL, Wf (Berg 1975)

   Migratory transient: Eb (Berg 1975)

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, marten, river otter, raccoon, white-tailed deer (Constan 1975); pheasant

   Migratory transient: Waterfowl - pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red-breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-wing teal, green-wing teal, cinnamon teal, coot, ring-neck duck, and Canada goose. Nongame - bald eagle, great blue heron (Hook 1975).

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Blue ribbon concept; dominant discharge concept; streamflow frequency data and current biological data. Flow requests are based on streamflow frequency data at the USGS gaging stations (1) "Yellowstone River near Livingston" and (2) "Shields River at Clyde Park," existing water rights held by the Department of Fish and Game, and flow recommendations for the lower Yellowstone River.

   Biological-streamflow data obtained on the lower Yellowstone River below the Big Horn River are the basis for the flow requests from May 11-August 10. Requested flows in the lower river for this period were based on biological data but approached those flows equaled or exceeded 70% of the time (based on USGS data from 1942-1971). Thus to be consistent with those recommendations, the 70% exceedance flows for the Yellowstone River, near Livingston plus the 70% exceedance flows for the Shields River at Clyde Park were used as the base flow for the May-August period. However, the Department of Fish and Game has an existing right (see below) in this reach which was subtracted from the base flow to obtain the requested flows. The dominant discharge at the Livingston gage was requested for a 24-hour period.

Existing Rights of the Department of Fish and Game[1/]

| | | |
|---|---|---|
| From Shields River to Boulder River: | April 16-October 31 | 2000 cfs |
| | November 1-April 15 | 1200 cfs |

1/Section 89-801 R.C.M. 1947, Chapter 345; Laws of 1969; Constitution of the state of Montana; Montana Water Use Act.

8. Why flow is necessary:

Flows are necessary to preserve and maintain fish and wildlife populations at current levels in this blue ribbon stream as stated in Section IV "Statement on the Need for the Reservation," and to maintain the physical characteristics of the stream channel through adequate sediment transport and bedload movement.

9. Flow request:

January 1-May 10, August 11-December 31: The instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach.

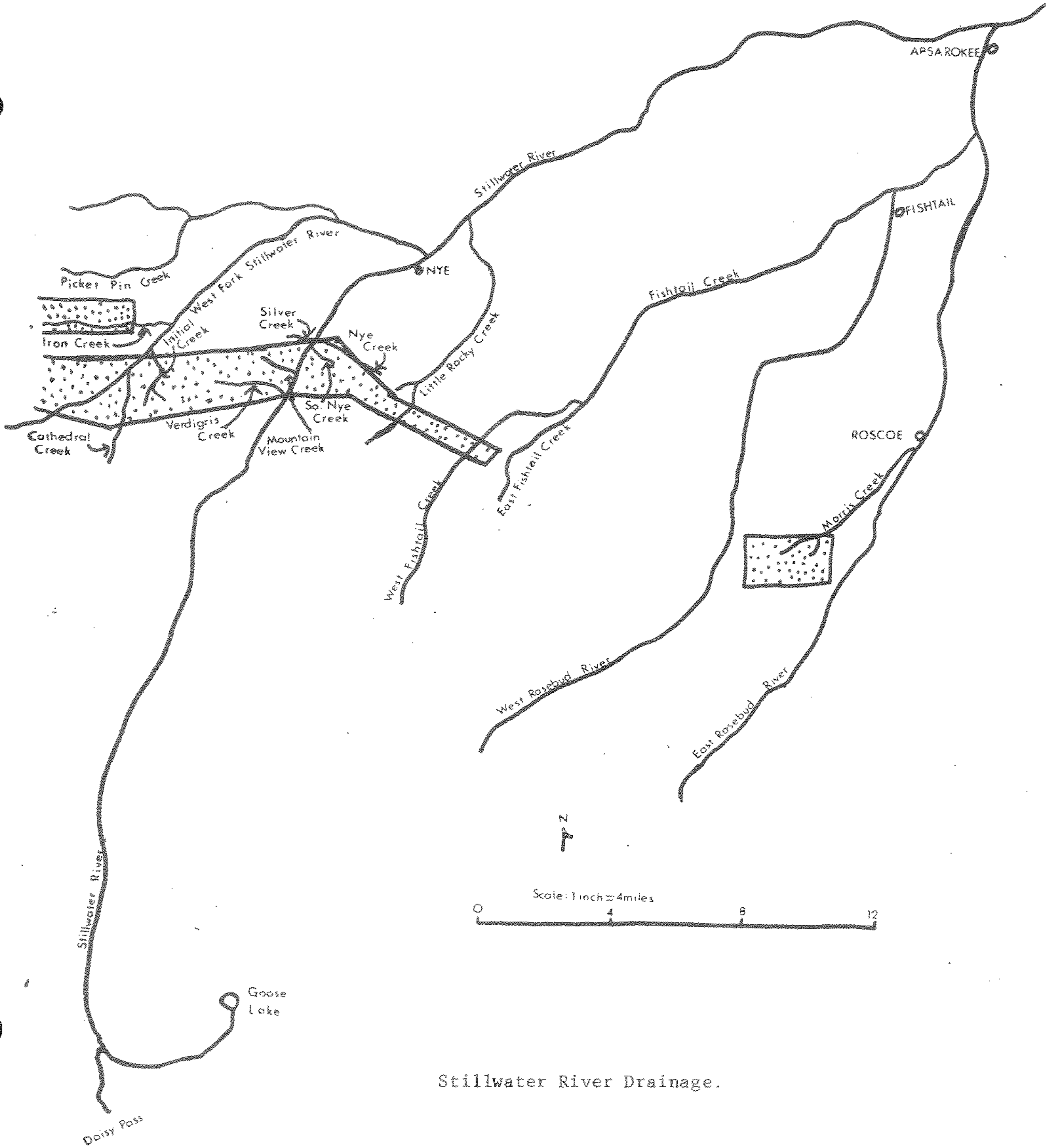
| | CFS | AC. FT. | | CFS | AC. FT. |
|---|---|---|---|---|---|
| May 11-20 | 2200 | 43,636 | July 1-10 | 5500 | 109,091 |
| May 21-31 | 4900 | 106,909 | July 11-20 | 3800 | 75,372 |
| June 1-10 | 8000 | 158,678 | July 21-31 | 2500 | 54,545 |
| June 11-20 | 9300 | 184,463 | Aug. 1-10 | 1600 | 31,736 |
| June 21-30 | 7200 | 142,810 | | | |
| | | | | Total | 907,240 |

Discharge to equal or exceed 18,200 cfs for one continuous 24-hour period between May 11 and August 10 (= 36,099 Ac. Ft.).

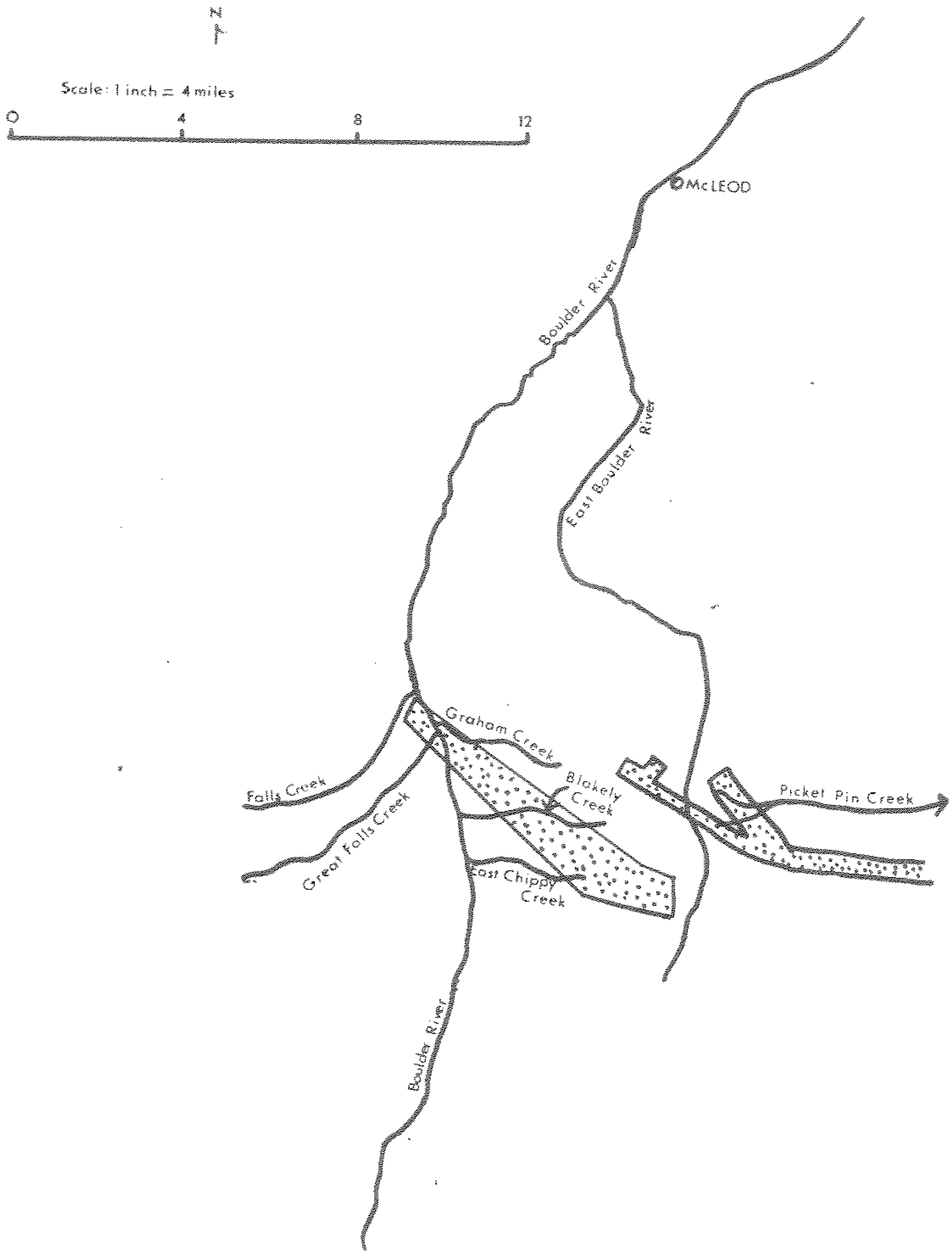
Total Ac. Ft. = 943,339 (includes 15,000 cfs for one day).

# MIDDLE YELLOWSTONE BASIN

## Boulder River to Big Horn River




Stillwater River Drainage.




Boulder River Drainage.

Mid-Big Timber Creek

Gallatin National Forest boundary to confluence with Swamp Creek

T3N, R13E, Sec. 6, 7, 18, 19, 30 to T2N, R14E, Sec. 27A
T2N, R12E, Sec. 36

Game fish species present:
- Rainbow trout (Salmo gairdneri)
- Brown trout (Salmo trutta)
- Brook trout (Salvenlinus fontinalis)
- Mountain whitefish (Prosopium williamsoni)

Riparian wildlife species present:
- Beaver (Castor canadensis)
- Muskrat (Ondatra zibethicus)
- Mink (Mustela vison)
- Racoon (Procyon lotor)

Methods:
- Water discharge measurements and photographs
- Professional judgment
- Fisheries data collections
- Historic flow data - U. S. Geological Survey

Flow request:

| | Jan | Feb | Mar | April | May | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 10 | 10 | 10 | 20 | 85 | 180 | 100 | 30 | 30 | 20 | 15 | 10 | 10 |
| AF | 615 | 555 | 615 | 1,190 | 5,226 | 10,711 | 3,967 | 655 | 1,845 | 1,190 | 922 | 595 | 615 |

Total AF 28,701

This reservation of flow request is necessary to maintain a portion of the existing fish and aquatic life. Without at least this request for minimum flows, the system will not have sufficient water exchange to maintain water quality necessary to sustain trout populations. These flows are below optimum fishing levels and considerably below other water-based recreational opportunities. Photographs at various discharge values and 10 years of occasional observations suggest that esthetics are best at flows of 50 to 75 cfs. Fishermen interviews revealed that they feel optimum fishing during August and September occurs at flows around 40 to 50 cfs.

A small amount of electrofishing in a 300-foot section reemphasized the importance of undercut banks and overhanging vegetation. At 13 cfs only the outside of each meander contained these critical habitat types. An occasional debris pile of logs and brush resulting from high flows constituted the remaining trout habitat. Whitefish occupied only pool areas. Juvenile trout used shoal areas over 1½ inches in depth; as flows are reduced this nursery habitat diminishes rapidly because of the substrate character. Due to unstable flows and associated stream channel disturbance, the substrate is mostly cobbles which do not allow continuity of shoal water adjacent to main channel flows. Juveniles were observed in isolated shallow pools within the shoal cobbles. These fish are assumed to be consumed by predators and/or die due to lack of adequate dissolved oxygen and high temperatures.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Mid-Big Timber Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (First ½) | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower Big Timber Creek

Swamp Creek to Yellowstone River

T2N, R14E, Sec. 27 to T1N, R14E, Sec. 12

Game fish species present:
- Brown trout (*Salmo trutta*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water Surface Profile
- Water discharge and photographs
- U.S.G.S. discharge measurements upstream

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 10 | 10 | 10 | 20 | 85 | 180 | 100 | 30 | 30 | 20 | 13 | 10 | 10 |
| AF | 615 | 555 | 615 | 1,190 | 5,226 | 10,711 | 3,967 | 655 | 655 | 1,190 | 922 | 595 | 615 |

Total AF 28,701

Lower Big Timber Creek is an extremely erratic environment. Extreme flows occur during freshet and occasionally during heavy rains falling on the east edge of the Crazy Mountains. During the irrigating season flows sometimes approach zero. Thus its difficult to request flows for trout regardless of the methodology in arriving at flow values. Flow measurements, occasional observations of this stretch and specific data collections on nearby Sweet Grass Creek prompted the above request.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Big Timber Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Upper Bluewater Creek

Headwaters to Bluewater Springs Trout Hatchery

T7S, R24E, Sec. 2B to T6S, R24E, Sec. 9B

Game fish species present:
- Brown trout (*Salmo trutta*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Mink (*Mustela vison*)
- Muskrat (*Ondatra zibethicus*)
- Racoon (*Procyon lotor*)

Methods:
- Water discharge measurements and photographs
- Fisheries data collections, production study, known age study
- Sediment investigations
- Professional judgment
- Aquatic insect study
- Flow duration curves

Flow request:

| | Jan | Feb | Mar | Apr | May | June | June | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 | 9.5 |
| AF | 584 | 528 | 584 | 565 | 584 | 565 | 584 | 584 | 565 | 584 | 565 | 584 |

Total AF 6,878

The entire Bluewater Creek has been studied intensively for 15 years. Studies were both biological and physical investigations. It was demonstrated in several cases the detrimental effects of sediment, relationship of both high and low flows with sediment transport and deposition. The requested flows for this reach are essential to maintain trout embryo survival. They are below the amount of water presently in the system and that utilized by agriculture. Lesser flows in this reach would have considerable impact downstream. Less flows would lessen flows downstream, cause fines to settle out and ultimately force downstream brown trout to occupy only the upper 5 miles of Bluewater Creek. At present, brown trout exist in 10 miles of the 13-mile stream. Lower limits are due to low flows, silt deposition, and increased temperature.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Bluewater Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (1st week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Middle Bluewater Creek

Bluewater Springs Trout Hatchery effluent to McDowell Coulee

T6S, R24E, Sec. 9B to T6S, R24E, Sec. 6C

Game fish species present:
- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water discharge measurements and photographs
- Fisheries data collections (numerous studies)
- Sediment investigations
- Professional judgement
- Flow duration curves
- Aquatic insect studies

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 |
| AF | 1,599 | 1,444 | 1,599 | 1,547 | 1,599 | 1,547 | 1,599 | 1,599 | 1,547 | 1,599 | 1,547 | 1,599 |

Total AF 18,823

Flow data for ten years (1960-1970) reveal the great stability (28 cfs) in stream discharge in this reach. Later measurements show increased volumes 35+ cfs due to additional water from Bluewater Springs Trout Hatchery. The requested flows above are well below the lowest measured flows and are necessary to maintain existing trout egg survival, nursery areas, bank cover, feeding stations and adequate temperature regimes. The request flows are adequate to intra-gravel oxygen supplies, apparent velocity and cleasing of intra-gravel sediments. Lesser flows would cause more sediment deposition and indirectly reduce the fishery. It has also been demonstrated that increased sediment deposition increases the opportunity for rough fish species with greater tolerances. Thus more suckers and less brown trout. A discharge of 26 cfs allows for existing water needs and still provides for trout needs.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Middle Bluewater Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st | week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (2nd week) | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower Bluewater Creek

McDowell Coulee to mouth at Yellowstone River

T6S, R24E, Sec. 6C to T5S, R23E, Sec. 21B

Game fish species present:
Brown trout (Salmo trutta)

Riparian wildlife species present:
Beaver (Castor canadensis)
Muskrat (Ondatra zibethicus)
Racoon (Procyon lotor)
Mink (Mustela vison)

Methods:
Water discharge measurements and photographs
Fishing data collection
Sediment studies
Professional judgment
Flow duration curves

Flow request:

| | Jan | Feb | Mar | Apr | May | June | June | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| AF | 1,230 | 1,111 | 1,230 | 1,190 | 1,230 | 1,190 | 1,230 | 1,230 | 1,190 | 1,230 | 1,190 | 1,230 |

Total AF 14,479

Lower Bluewater Creek is subject to less stability due to irrigation removal and waste water returns. Brown trout comprise the entire trout fishery. Recent efforts to increase this fish species distribution are keyed to maintaining adequate flows (see upper and lower Bluewater Creek requests). The largest trout found in Bluewater Creek occupy this mid-lower reach, but these fish must shift upstream when flows become low, water temperatures warm and rough fish densities become large enough to create serious competition for food. The above request is necessary to maintain brown trout and still allow water uses above present levels.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Bluewater Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (1st week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Bridger Creek

Headwaters to Krone Ditch headgate

T3S, R15E, Sec. 9B to T1S, R16E, Sec. 36C

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water discharge measurements and photograph
- Professional judgment
- Fisheries data collections and creel census

Flow request:

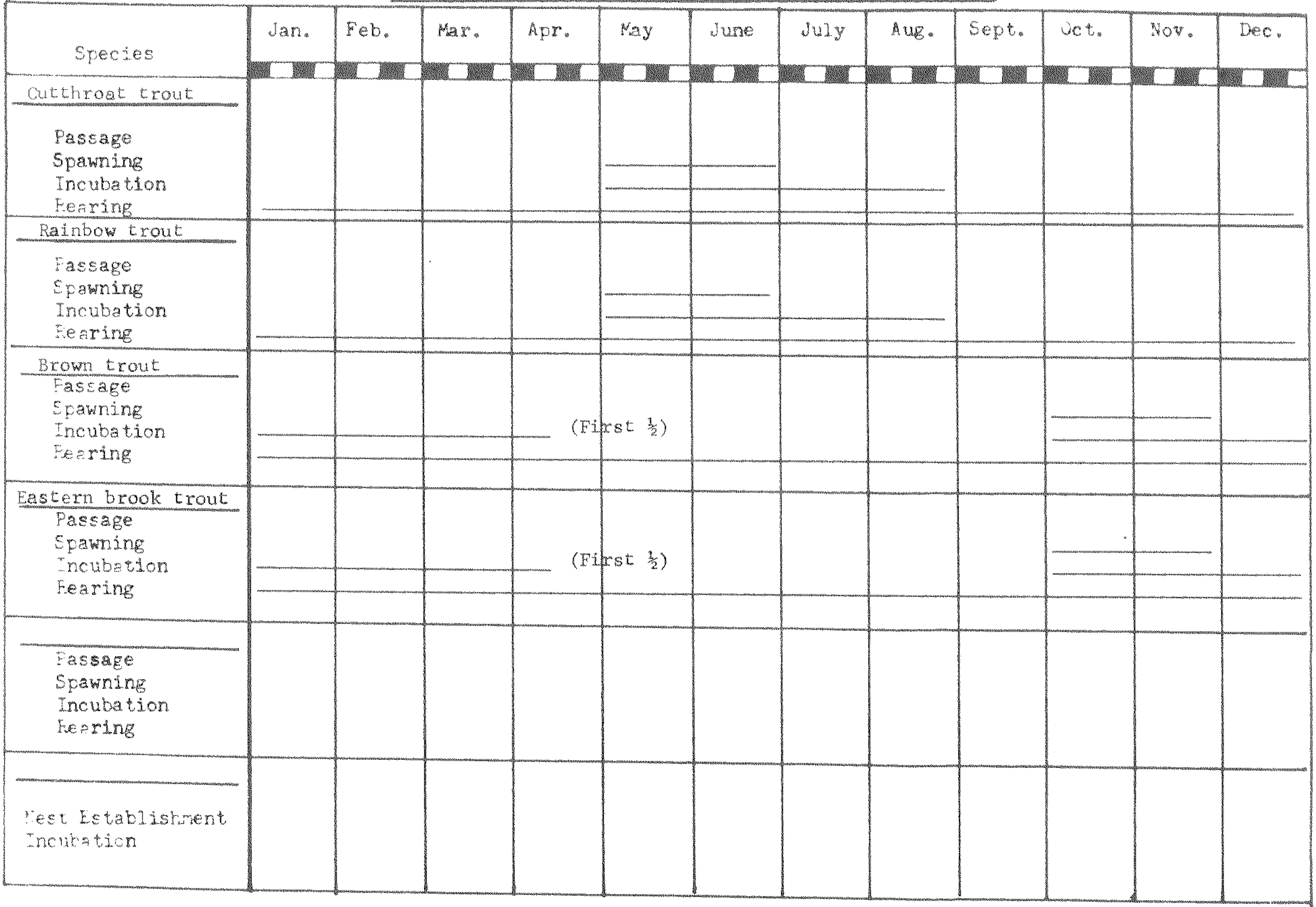
| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 3 | 3 | 3 | 3 | 3 | 15 | 15 | 4 | 4 | 3 | 3 | 3 | 3 |
| AF | 184 | 167 | 184 | 178 | 119 | 327 | 893 | 246 | 246 | 178 | 184 | 178 | 184 |

Total AF - 3,268

Bridger Creek has extreme flow levels from dry, downstream near Interstate 90, to nearly 3,000 cfs during heavy runoffs. Esthetics are best when the channel has 10 to 20 cfs in the upper and middle reaches. The lower reach has no esthetic value due to wide, gravel-laden channel. Fishermen that were interviewed during late July and August said fishing was best when flows were between 10 and 20 cfs; however, these flows were rare. Irrigation utilizes considerable water and even though our 4 cfs request is inadequate for maximum public enjoyment or optimum fish biomass, it represents existing leftover water.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Bridger Creek



1. Stream name: Boulder River - Sweet Grass County

2. Stream reach: Mouth to mouth of West Boulder River

3. Location: T1N, R14E, Sec 12 to T2S, R13E, Sec. 15

4. Fish species present:

   Resident: Brown and rainbow trout; mountain whitefish; various cyprinids
   Migratory: none significant

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS flow data; low flow photography; extrapolation of fish population and life history data from an adjacent reach of the river.

8. Why flow is necessary: Flows requested will help maintain fish population and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish population. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 80 | 80 | 80 | 80 | 300 | 1690 | 565 | 185 | 195 | 200 | 80 | 80 | |
| Ac.Ft | 4919 | 4443 | 4919 | 4760 | 18631 | 100562 | 34740 | 11375 | 11603 | 12359 | 4760 | 4919 | 217,990 |

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Boulder River from mouth to mouth of West Boulder River

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Rainbow Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream name: Boulder River - Sweet Grass and Park Counties

2. Stream reach: Mouth of West Boulder River to mouth of Falls Creek

3. Location: T2S, R13E, Sec. 15 to T4S, R12E, Sec. 15

4. Fish species present:

   Resident: Brook, brown, and rainbow trout; various cyprinids
   Migratory transient: None

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: None significant

6. Life history periodicity chart: attached.

7. Methods used for flow determination: USGS flow data; low flow photography; fish population and life history data obtained by electrofishing.

8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow requested to maintain the existing fish populations. Flow for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 50 | 50 | 50 | 50 | 150 | 1080 | 480 | 200 | 145 | 115 | 50 | 50 | |
| Ac.Ft. | 3074 | 2777 | 3074 | 2975 | 9223 | 64264 | 29514 | 12298 | 8628 | 7071 | 2975 | 3074 | 148,947 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Boulder River from mouth to West Boulder River to mouth of Falls Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brook Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | - - - | | |
| Incubation | - - - | - - - | - - - | | | | | | | | - - - | - - - |
| Rearing | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| **Brown Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | - - - | |
| Incubation | - - - | - - - | - - - | - - - | | | | | | | - - - | - - - |
| Rearing | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| **Rainbow Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | - - - | - - - | | | | | | | |
| Incubation | | | | - - - | - - - | - - - | - - - | | | | | |
| Rearing | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| ____ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ____ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ____ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream name: Boulder River - Sweet Grass County

2. Stream reach: Mouth of Falls Creek to mouth of Hawley Creek

3. Location: T4S, R12E, Sec. 15 to T5S, R12E, Sec. 35

4. Fish species present:

   Resident: Brook, cutthroat, and rainbow trout; longnose dace
   Migratory transient: None

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: None significant

6. Life history periodicity chart: attached.

7. Methods used for flow determination: USGS flow data; fish population and life history data obtained by electrofishing.

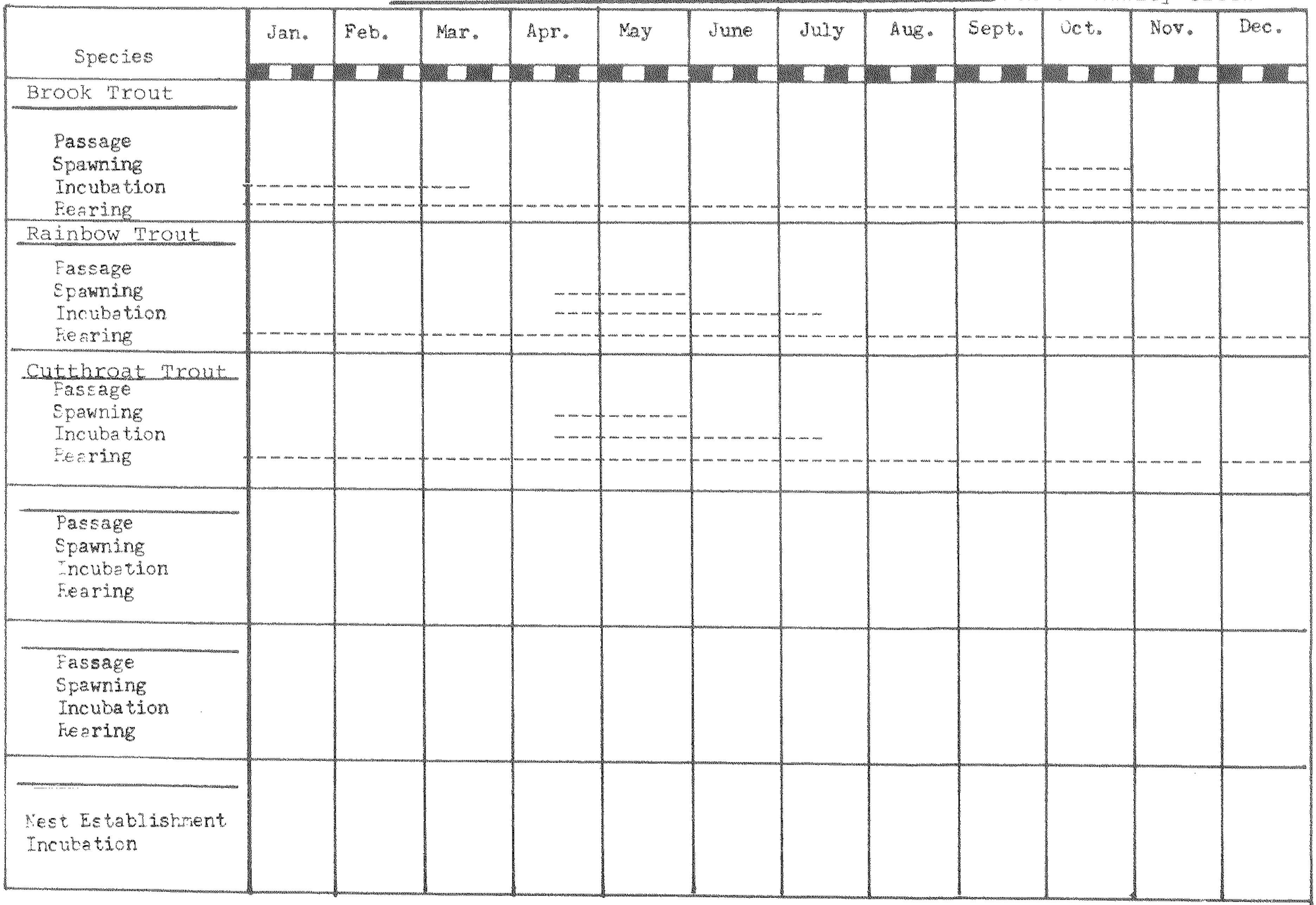
8. Why flow is necessary: Flows requested will help maintain fish population and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish population. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow Request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 40 | 40 | 40 | 40 | 75 | 540 | 240 | 101 | 72 | 56 | 40 | 40 | |
| Ac.Ft. | 2460 | 2221 | 2460 | 2380 | 4612 | 32132 | 14757 | 6210 | 4284 | 3443 | 2380 | 2460 | 79,799 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Boulder River from mouth of Falls Creek to mouth of Hawley Creek



Upper Butcher Creek

Headwaters to and including West Butcher Creek

T7S, R18E, Sec. 8C to T6S, R18E, Sec. 1D

Game fish species present:
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Professional judgment
- Fisheries data collected
- Stream survey and discharge measurements

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| AF | 307 | 278 | 307 | 298 | 198 | 109 | 298 | 307 | 307 | 298 | 307 | 298 | 307 |

Total AF - 3,620

Upper Butcher Creek includes the sum of the tributaries before most flows are consolidated into one channel. Most fishing recreation in this reach exists in 7 miles of West Butcher and 8 miles of Butcher Creek including a portion of East and West Forks. Most fishing pressure is from local residents during early summer. Flows requested are basically maintenance flows and are below optimum conditions.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Butcher Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower Butcher Creek

From confluence with West Butcher Creek to mouth

T6S, R18E, Sec. 1D to T4S, R18E, Sec. 13B

Game fish species present:
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water Surface Profile
- Water discharge measurements and photographs
- Professional judgement
- Fisheries data collections
- Physical measurements of depths, overhanging vegetation and undercut banks

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 10 | 10 | 10 | 15 | 25 | 40 | 40 | 40 | 15 | 15 | 10 | 10 |
| AF | 615 | 555 | 615 | 893 | 1,537 | 2,380 | 2,460 | 2,460 | 893 | 922 | 595 | 615 |

Total AF 14,540

According to results of water surface profile data, physical losses below 15 cfs would reduce existing trout population numbers. The wetted perimeter would be reduced 13% from 25 to 10 cfs, depths would be reduced 36%, and widths 13% at these flow regimens. Habitat, overhanging vegetation would be reduced 32% and undercut banks would be reduced 75% from less than optimum 20 cfs and undesirable 10 cfs. Based on water surface profiles and physical measurements (data on file in Red Lodge, MT), the above request seems a minimal requirement for the existing fishery.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Butcher Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream name: Castle Creek - Stillwater county

2. Stream reach: From mouth to mouth of Lodgepole Creek

3. Location: T4S, R15E, Sec. 26 to T4S, R15E, Sec. 28

4. Fish species present:

   Resident: Brown trout
   Migratory transient: None

5. Riparian wildlife present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: Bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: Water surface profile program; USGS flow data, Montana Fish and Game gaging data; low flow photography; spawning redd velocity measurements; fish population and life history data obtained by electrofishing.

8. Why flow is necessary: On the basis of adult fish habitat, and inundation of backwater young-of-year pools, 15 cfs was determined as the minimum desirable low flow. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance. Data indicate that 20 cfs is a minimum desirable flow for brown trout spawning in November.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 15 | 15 | 15 | 15 | 25 | 60 | 30 | 22 | 22 | 20 | 20 | 15 | |
| Ac.Ft. | 922 | 833 | 922 | 893 | 1537 | 3570 | 1845 | 1353 | 1309 | 1230 | 1190 | 922 | 16,526 |

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Castle Creek from mouth to mouth of Lodgepole Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown Trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | - - - | - - - |
| Incubation | - - - | - - - | - - - | | | | | | | | - - - | - - - |
| Rearing | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream name: Castle Creek - Stillwater County

2. Stream reach: From mouth of Lodgepole Creek to mouth of Picket Pin Creek

3. Location: T4S, R15E, Sec. 28 to T4S, R15E, Sec. 30

4. Fish species present:

   Resident: Brown trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, mink, muskrat, racoon
   Migratory transient: bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: Water surface profile program, Montana Fish and Game gaging data; low flow photography; spawning redd velocity measurements; fish population and life history data obtained by electro-fishing.

8. Why flow is necessary: On the baiss of cover available for adult fish, required spawning velocities, and inundation of backwater, young-of-year pools, 8 cfs was determined as the minimum desirable flow. Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 8 | 8 | 8 | 8 | 10 | 40 | 20 | 12 | 10 | 9 | 8 | 8 | |
| Ac.Ft. | 492 | 444 | 492 | 476 | 615 | 2380 | 1230 | 738 | 595 | 553 | 476 | 492 | 8983 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Castle Creek from mouth of Lodgepole Creek to mouth of Picket Pin Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown Trout<br>Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Nest Establishment<br>Incubation | | | | | | | | | | | | |

1. Stream name: Castle Creek - Stillwater and Sweet Grass Counties

2. Stream reach: From mouth of Picket Pin Creek and upstream for a distance of 1500 stream feet.

3. Location: T4S, R15E, Sec. 30 to T4S, R14E, Sec. 25

4. Fish species present

   Resident: Brook and brown trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: muskrat, mink
   Migratory transient: bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: Stream gaging by Montana Department of Fish and Game and USFS low flow photography; fish population and life history data obtained by electrofishing; spawning redd velocity measurements.

8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows in October and November are required for spawning. Flows for November through April were chosen from studies on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 1 | 1 | 1 | 1 | 2 | 8 | 5 | 3 | 2 | 2 | 1 | 1 | |
| Ac.Ft. | 61 | 56 | 61 | 60 | 123 | 476 | 307 | 184 | 119 | 123 | 60 | 61 | 1691 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Castle Creek from mouth of Picket Pin Creek and upstream for a distance o
1500 stream feet.

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brook Trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Brown Trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Clarks Fork Yellowstone River

Montana-Wyoming line to Bluewater Creek

T7S, R22E, Sec. 31C to T3S, R23E, Sec. 20A

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)
- Otter (*Lutra canadensis*)

Methods:
- Water Surface Profile
- Water discharge measurements
- Professional judgement
- Fisheries data collections

Flow request:

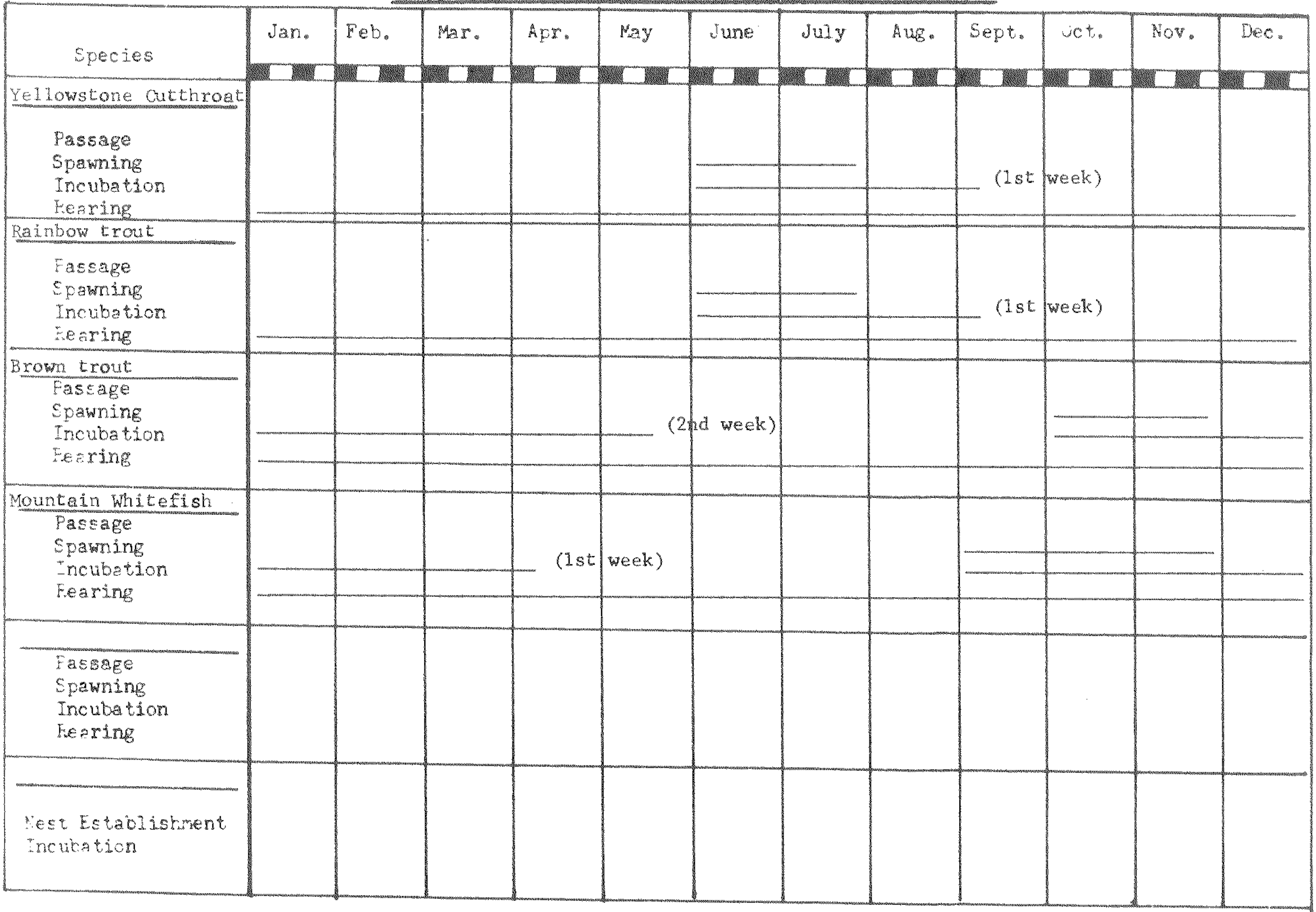
| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 160 | 150 | 150 | 200 | 1,100 | 2,900 | 1,400 | 450 | 250 | 200 | 200 | 175 |
| AF | 9,838 | 8,330 | 9,223 | 11,900 | 67,636 | 172,561 | 86,082 | 13,950 | 14,876 | 12,297 | 11,900 | 10,760 |

Total AF 429,353

The above flow recommendations are 60% of mean monthly discharges measured at the USGS gage near the state line. The area of maximum concern for fisheries is from the state line to Belfry, Montana. The entire river is important to riparian wildlife, waterfowl and birds of prey.

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Clarks Fork Yellowstone River



Lower Clarks Fork Yellowstone River

Bluewater Creek to mouth

T3S, R23E, Sec. 20A to T2S, R24E, Sec. 24B

Game fish species present:
- Brown trout (*Salmo trutta*)
- Mountain whitefish (*Prosopium williamsoni*)
- Sauger (*Stizostedion canadense*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)
- Otter (*Lutra canadensis*)

Methods:
- Water discharge measurements
- Professional judgement
- Fisheries data collections

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 250 | 240 | 240 | 390 | 1,070 | 2,900 | 1,400 | 470 | 400 | 400 | 330 | 260 |
| AF | 15,371 | 13,329 | 14,757 | 23,207 | 65,792 | 172,562 | 86,083 | 28,899 | 23,802 | 24,595 | 19,636 | 15,987 |
| Total AF | 504,020 | | | | | | | | | | | |

The above request is 60 percent of mean monthly discharges at USGS gage station near the confluence with Rock Creek near Rockvale, Montana. This section of river is important for flow maintenance in the lower Yellowstone River and fish and wildlife in the whole system.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Clarks Fork Yellowstone River

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Mountain Whitefish** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | (1st week) | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Sauger** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Clear Creek

Headwaters to mouth

T7S, R20E, Sec. 25B to T5S, R21E, Sec. 28B

Game fish species present:
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water Surface Profile
- Water discharge measurements and photographs
- Professional judgement
- Fisheries data collection

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 15 | 15 | 15 | 15 | 15 | 30 | 30 | 30 | 20 | 20 | 20 | 20 | 18 | 15 |
| AF | 922 | 833 | 922 | 893 | 595 | 655 | 1,785 | 1,190 | 436 | 1,230 | 1,190 | 1,230 | 1,071 | 922 |

Total AF 13,874

Over the last 11 years, Clear Creek has been studied for numerous biological characteristics. These studies (data on file with Pat Marcuson, Red Lodge, Montana) in combination with flow measurements and water surface profile results led to the above request. Flows reduced from 20 cfs to 10 cfs cause a net loss of 24% wetted perimeter, 10% loss of width, 30% loss of depth and 42% loss of nursery area (water to 1½ inches in depth). Fisherman indicate a preference of 20 to 30 cfs when flows are clear and this same range appears ideal for good esthetic quality. Clear creek generates mostly from springs during winter months and therefore could be a quality fish environment without man-caused abuses. Surface runoff and water diversion from Rock Creek constitute spring and summer flows. The above request considers only the accummulation of springs for winter months.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Clear Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2nd week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2nd week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | (1st week) | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Dry Creek

Headwaters to mouth at Rock Creek

T6S, R20E, Sec. 22, 26 to T5S, R21E, Sec. 9D

Game fish species present
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Professional judgment
- Creel census

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| AF | 123 | 111 | 123 | 119 | 123 | 119 | 123 | 123 | 119 | 123 | 119 | 123 |

Total AF - 1,448

Two cubic feet per second will maintain the existing fishery. Discharges range from occasional flows of 4 cfs during peak irrigation periods to 65 cfs during freshet. Obviously more fish would be possible with more flows. Fishermen from Billings and nearby Roberts enjoy Dry Creek and many consider fishing excellent for small brook and brown trout.

Name of stream or stream section Dry Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream: East Boulder River - Sweet Grass County

2. Stream reach: From mouth to mouth of Dry Fork Creek

3. Location: T2S, R13E, Sec. 33 to T4S, R13E, Sec. 11

4. Fish species present:

   Resident: Brown and rainbow trout
   Migratory transient: none

5. Wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS flow data; Montana Fish and Game flow data, low flow photography, fish population and life history data obtained by electrofishing.

8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 15 | 15 | 15 | 15 | 20 | 165 | 50 | 22 | 20 | 18 | 15 | 15 | |
| Ac.Ft. | 922 | 833 | 922 | 893 | 1230 | 9818 | 3074 | 1353 | 1190 | 1107 | 893 | 922 | 23,157 |

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section East Boulder River from mouth to mouth of Dry Fork Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | --- | |
| Incubation | --- | --- | --- | --- | | | | | | | --- | --- |
| Rearing | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Rainbow Trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | --- | --- | | | | | | | |
| Incubation | | | | --- | --- | --- | --- | | | | | |
| Rearing | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream: East Boulder River - Sweet Grass County

2. Stream reach: Mouth of Dry Fork to mouth of Brownlee Creek

3. Location: T4S, R13E, Sec. 11 to T4S, R13E, Sec. 26

4. Fish species present:

   Resident: Brown, rainbow and rainbow-cutthroat hybrid trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS flow data; fish population and life history data obtained by electrofishing.

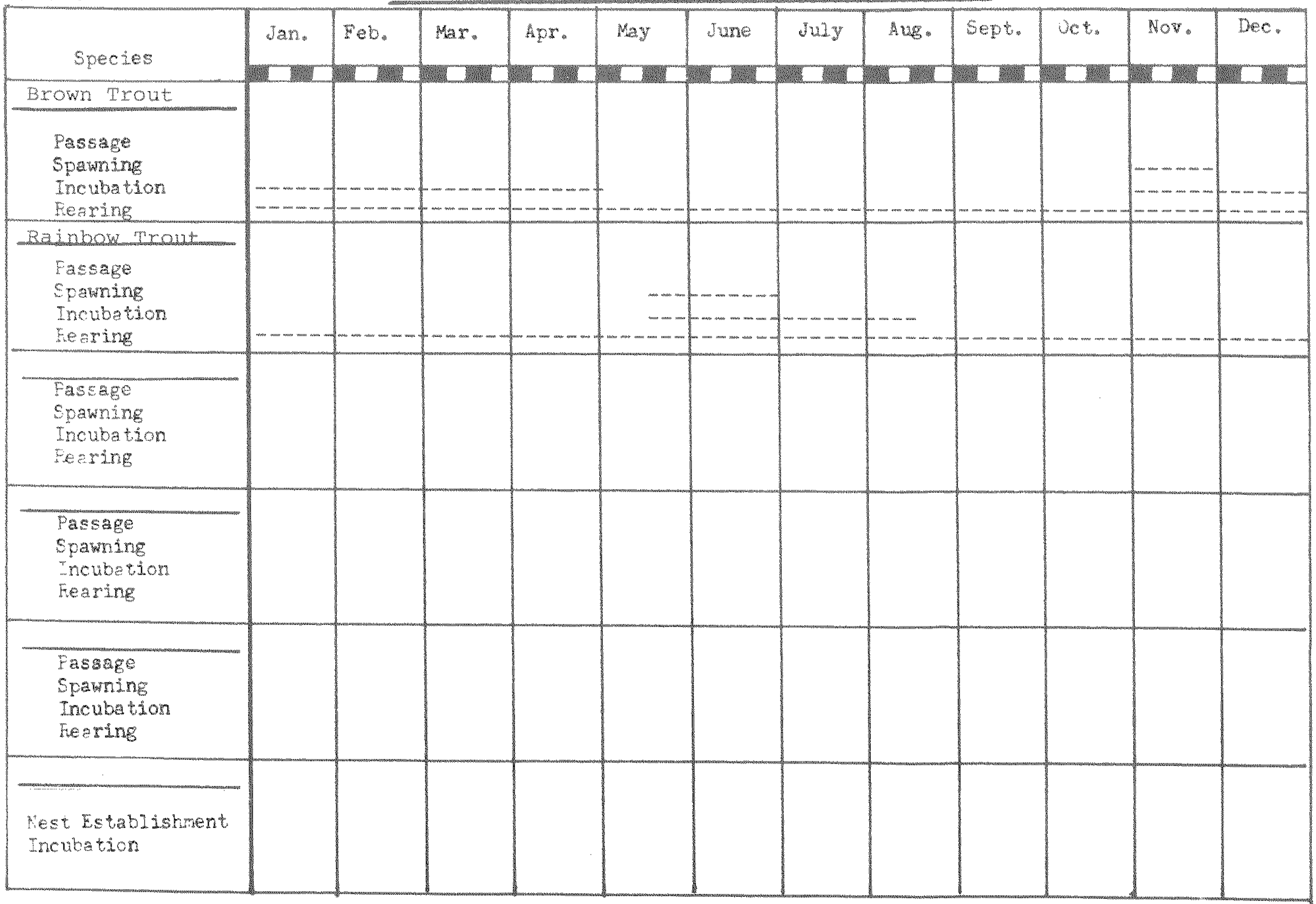
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for November through April were chosen from studies on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 10 | 10 | 10 | 10 | 14 | 120 | 36 | 16 | 14 | 13 | 10 | 10 | |
| Ac.ft. | 615 | 555 | 615 | 595 | 861 | 7140 | 2214 | 984 | 833 | 799 | 595 | 615 | 16,421 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section East Boulder River from mouth of Dry Fork to mouth of Brownlee Creek



1. Stream name: Fishtail Creek - Stillwater County

2. Stream reach: From confluence of East and West Fishtail Creeks to mouth

3. Location: T5S, R17E, Sec. 19 to T4S, R18E, Sec. 28

4. Fish species present:

   Resident: brown and rainbow trout, mountain whitefish
   Migratory transient: None significant

5. Riparian wildlife species present:

   Resident: Beaver, Muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: Low flow stream gaging by Montana Fish and Game; low flow photography; correlation of flow with a nearby USGS gage; fish population and life history data obtained by electrofishing.

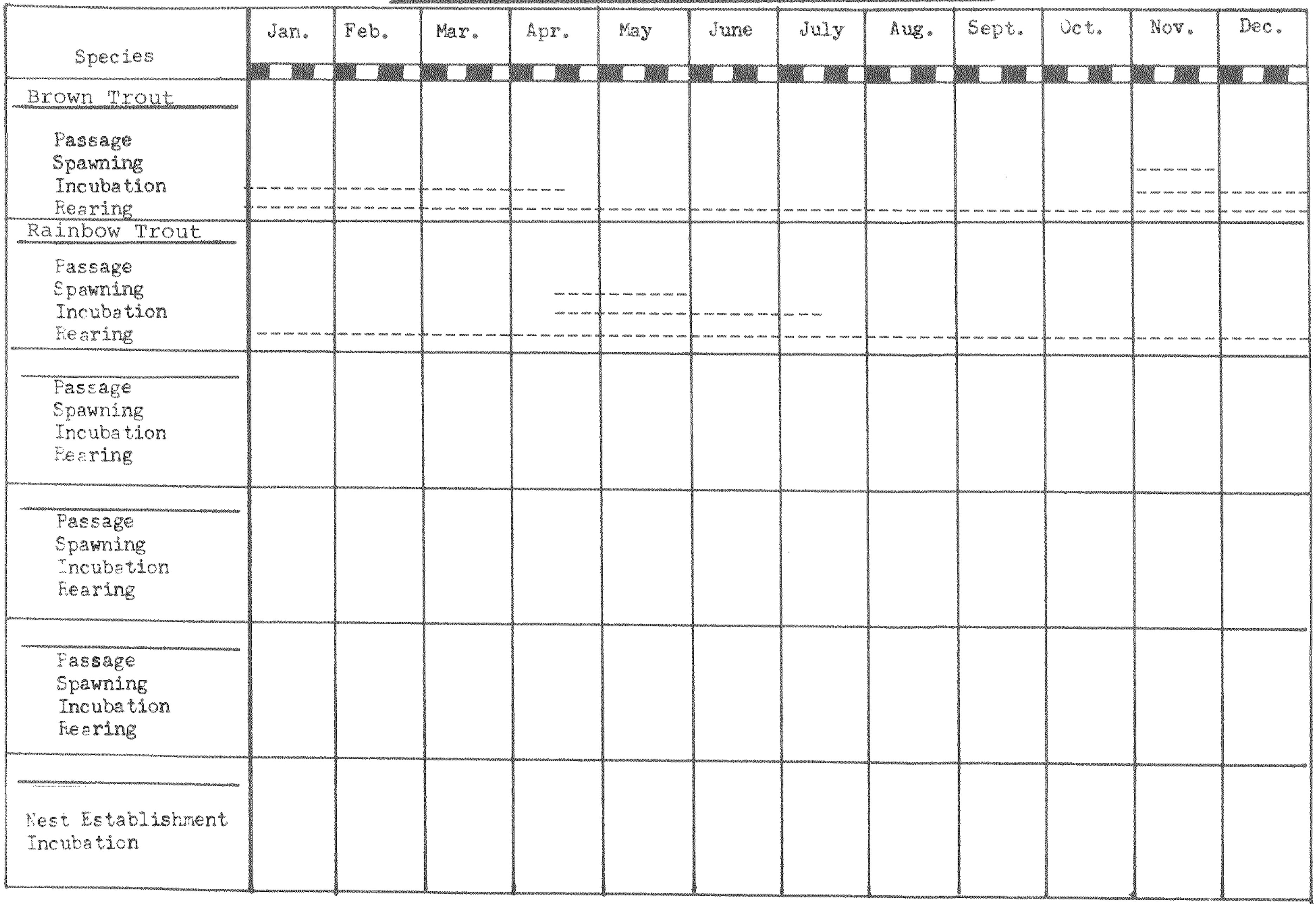
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for August through April are the approximate average annual minimum. They were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows from May through July were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 10 | 10 | 10 | 10 | 14 | 24 | 14 | 10 | 10 | 10 | 10 | 10 | |
| Ac.Ft. | 615 | 555 | 615 | 595 | 860 | 1428 | 860 | 615 | 595 | 615 | 595 | 615 | 8,563 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Fishtail Creek from confluence of East and West Fishtail creeks to mout



1. Stream name: East Fishtail Creek - Stillwater County

2. Stream reach: From junction with West Fishtail Creek to mouth of East Fork of East Fishtail Creek

3. Location: T5S, R17E, Sec. 19 to T5S, R16E, Sec. 26

4. Fish species present:

   Resident: Brook, brown and rainbow trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: Low flow stream gaging by Montana Fish and Game; low flow photography; correlation of low flow with a nearby USGS gage; fish population and life history data obtained by electrofishing.

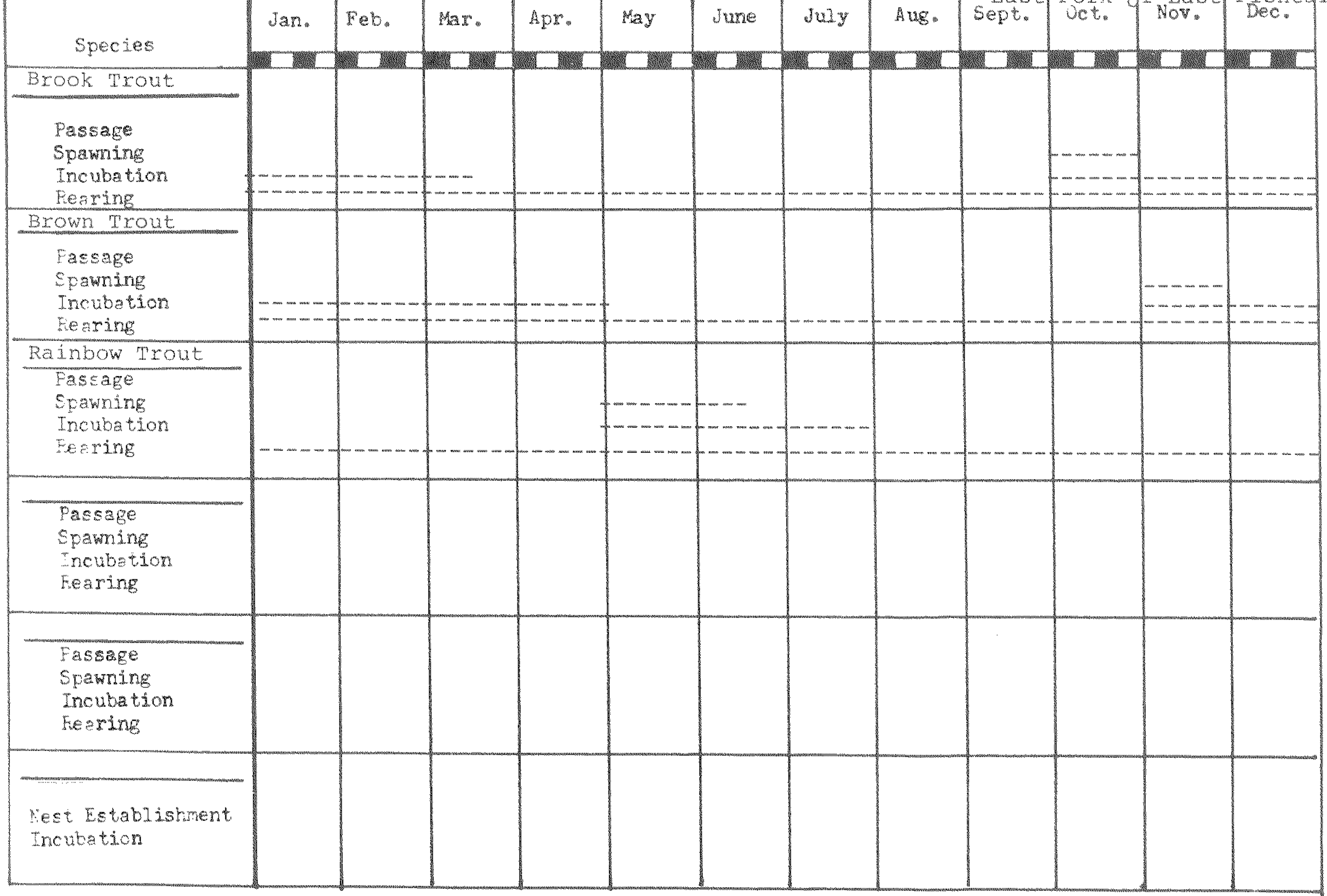
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for August through April are the approximate average annual minimum. They were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through July were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 4 | 4 | 4 | 4 | 7 | 12 | 7 | 4 | 4 | 4 | 4 | 4 | |
| Ac.Ft | 246 | 222 | 246 | 238 | 430 | 714 | 430 | 246 | 238 | 246 | 238 | 246 | 3,740 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section East Fishtail Creek from junction with West Fishtail Creek to mouth of East Fork of East Fishtail creek



1. Stream name; West Fishtail Creek - Stillwater County

2. Stream reach: From junction with East Fishtail Creek to the Richman-Kennedy ditch headgate

3. Location: T5S, R17E, Sec. 19 to T5S, R16E, Sec. 27

4. Fish species present:

   Resident: Brook, brown and rainbow trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: Low flow stream gaging by Montana Fish and Game, low flow photography; correlation of low flow with a nearby USGS gage; fish population and life history data obtained by electrofishing.

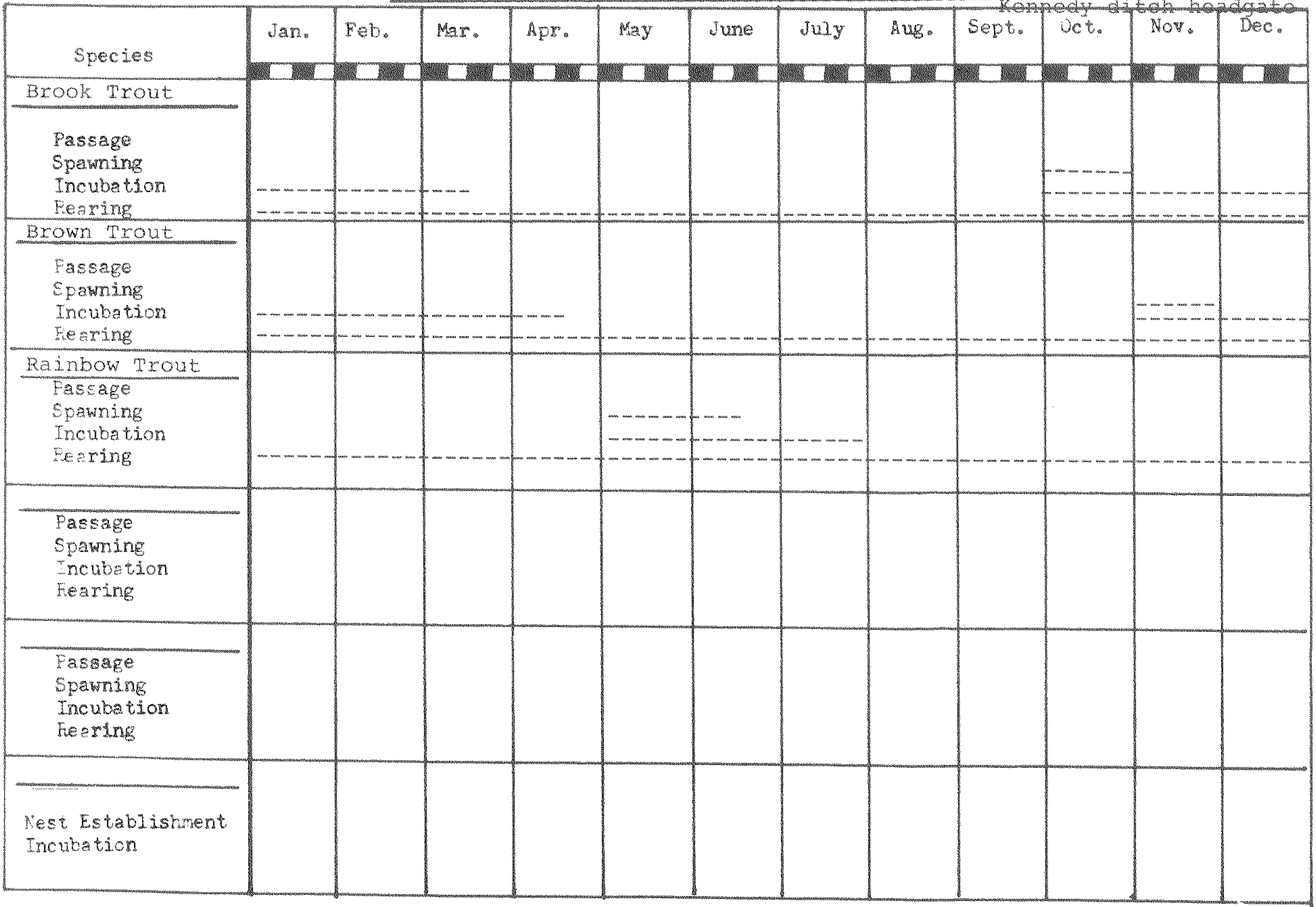
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for August through April are the approximate average annual minimum. They were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through July were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 4 | 4 | 4 | 4 | 10 | 20 | 10 | 4 | 4 | 4 | 4 | 4 | |
| Ac.Ft. | 246 | 222 | 246 | 238 | 615 | 1190 | 615 | 246 | 238 | 246 | 238 | 246 | 4,586 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section West Fishtail Creek from junction with East Fishtail Creek to the Richman-Kennedy ditch headgate



1. Stream name: Little Rocky Creek - Stillwater County

2. Stream reach: from Mouth upstream to crossing of Forest Service Rd. 1414

3. Location: T4S, R16E, Sec. 28 to T5S, R16E, Sec. 21

4. Fish species present:

   Resident: Brown and cutthroat trout; longnose sucker; longnose dace
   Migratory transient: none significant

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: none significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: Spot flow measurements made by USGS and Montana Fish and Game; low flow photography; correlation of low flows with nearby USGS gage; fish population and life history data obtained by electrofishing.

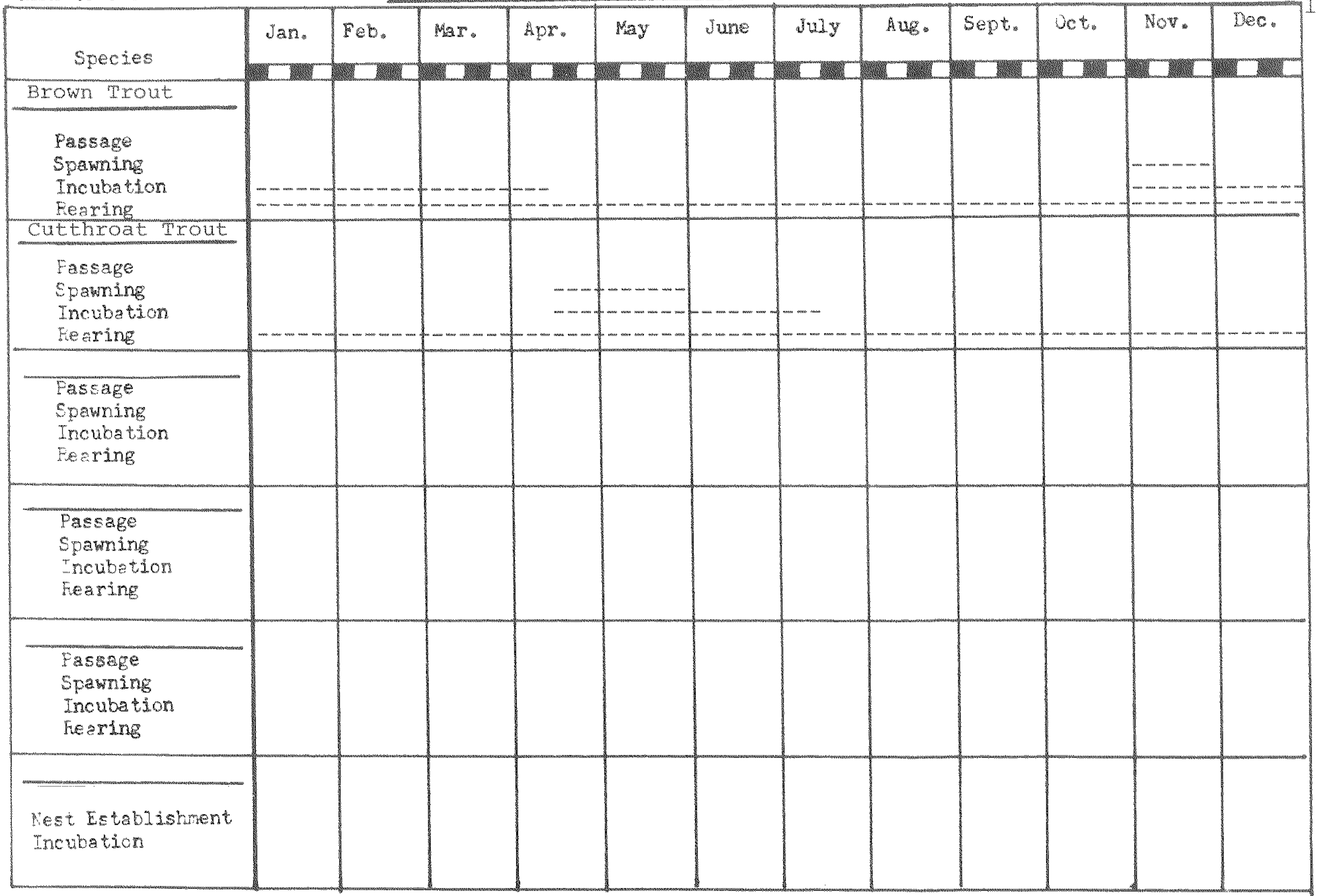
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for August through April are the approximate average annual minimum. They were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through July were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 4 | 4 | 4 | 4 | 6 | 8 | 6 | 4 | 4 | 4 | 4 | 4 | |
| Ac.Ft. | 246 | 222 | 246 | 238 | 369 | 476 | 369 | 246 | 238 | 246 | 238 | 246 | 3,380 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Little Rocky Creek from mouth upstream to crossing of Forest Service Rd. 1414



Lower Deer Creek

Headwaters to Interstate 90

T4S, R1E, Sec. 4 to T1S, R16E, Sec. 6C

Game fish species present:
- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Cutthroat trout (*Salmo clarki*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water Surface Profile
- Water discharge measurements and photographs
- Professional judgement
- Fish data collections

Flow request:

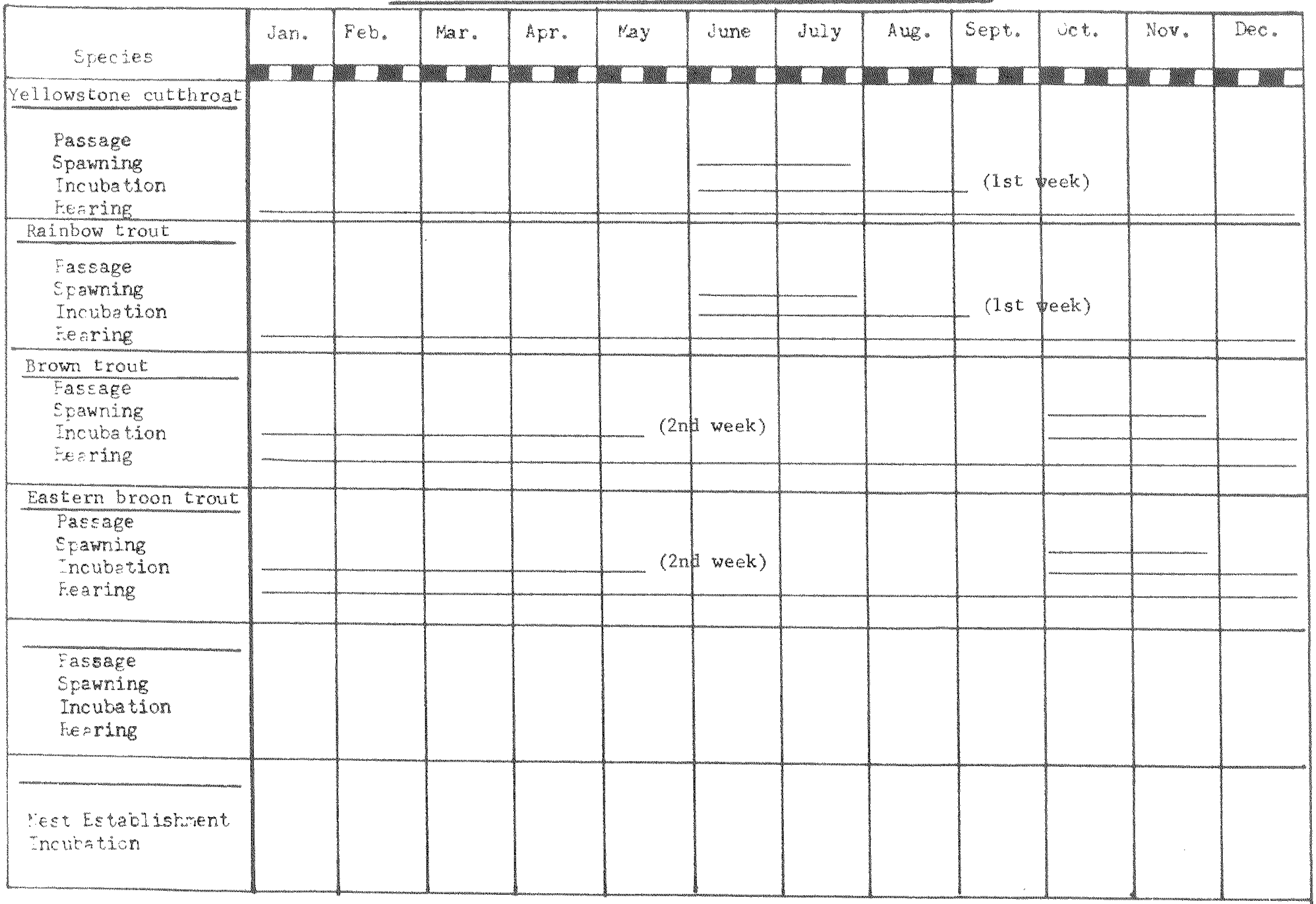
| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 5 | 5 | 5 | 5 | 5 | 25 | 25 | 8 | 8 | 5 | 5 | 5 | 5 |
| AF | 307 | 278 | 307 | 298 | 198 | 545 | 1,488 | 492 | 492 | 298 | 307 | 298 | 307 |
| Total AF | 5,615 | | | | | | | | | | | | |

Extreme fluctuations of flows presently exist in Lower Deer Creek drainage. Water rarely flows through the stream channel from Interstate 90 to the Yellowstone River during the summer. Large gravel deposits and irrigation needs eliminate and/or cause flows to disappear underground. The upper reach is an excellent fishing stream in an esthetically pleasing environment. Headwater reaches contain small numbers of indigenous cutthroat trout whose existence is dependent on adequate flows of quality water.

Water surface profile records suggest that at least 10 cfs is necessary to maintain adequate nursery areas, cover, depths and velocities. Other observations and measurements suggest that the flows requested above are more realistic with the present irrigation needs.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Deer Creek



1. Stream name; Picket Pin Creek - Stillwater and Sweet Grass Counties

2. Stream reach; from mouth to mouth of Swamp Creek

3. Location: T4S, R15E, Sec 30 to T4S, R14E, Sec. 25

4. Fish species present:

   Resident: Brook, Brown and Cutthroat trout
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: Water surface profile program; Montana Fish and Game and USGS gaging data, low flow photography; fish population and life history data obtained by electrofishing, spawning redd velocity measurements.

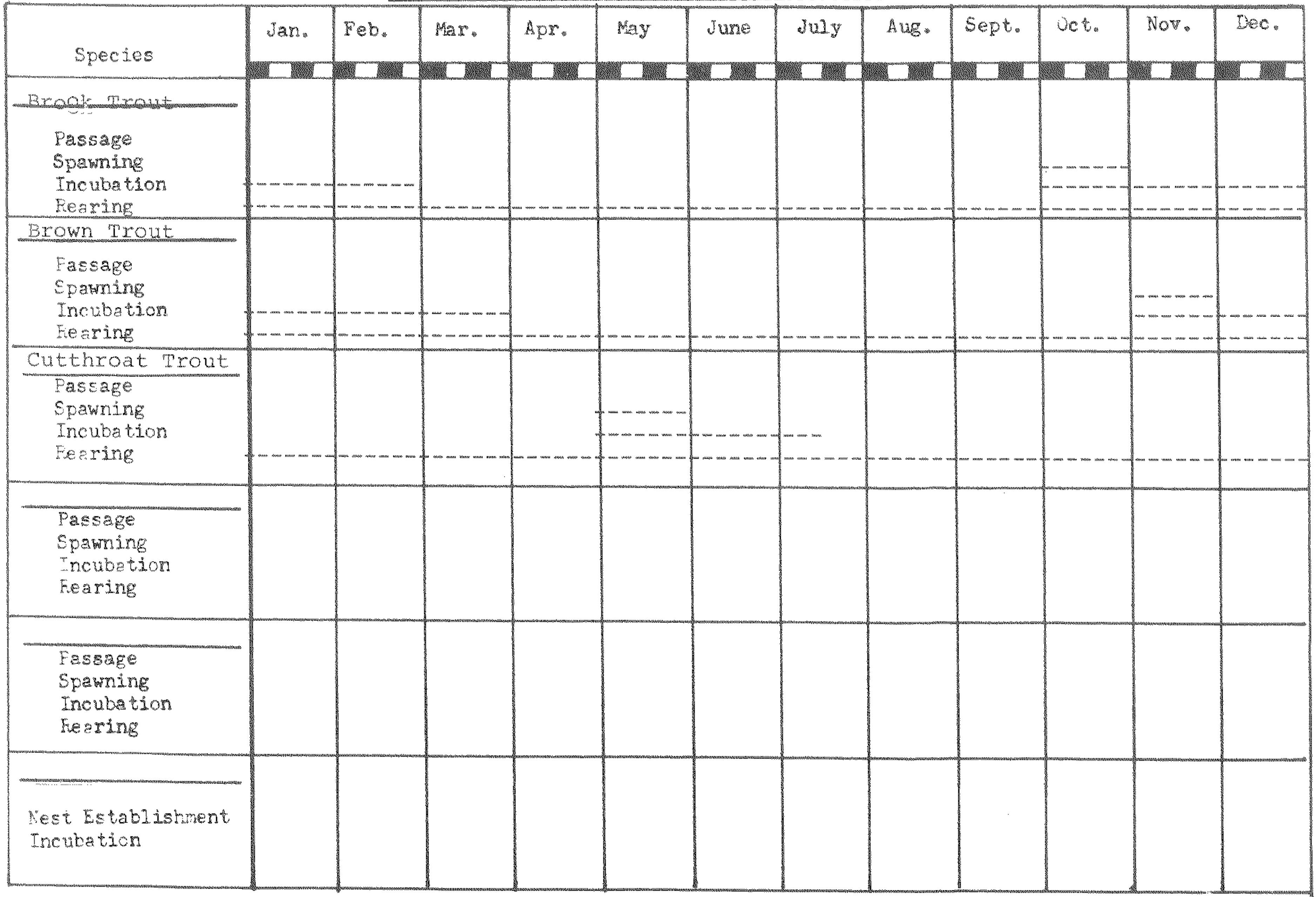
8. Why flow is necessary: Flows requested will help maintain fish populations in their present condition. On the basis of cover available for adult fish and backwater pools for young-of-year fish 5 cfs was determined as minimum desirable flow. These flows are also suitable for riparian wildlife. Flows for June and July are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 5 | 5 | 5 | 5 | 7 | 25 | 10 | 8 | 6 | 6 | 5 | 5 | |
| Ac.ft. | 307 | 278 | 307 | 298 | 430 | 1488 | 615 | 492 | 357 | 369 | 298 | 307 | 5546 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Picket Pin Creek from mouth to mouth of Swamp Creek



Mid Red Lodge Creek

Custer National Forest Service boundary to confluence with East and West Red Lodge Creeks

T7S, R18E, Sec. 1 to T6S, R20E, Sec. 7

Game fish species present:
- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)
- Cutthroat trout (*Salmo clarki*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water discharge measurements
- Professional judgements
- Fisheries data collections
- Measurements of channel parameters

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 10 | 10 | 10 | 10 | 10 | 25 | 25 | 25 | 20 | 20 | 15 | 10 | 10 | 10 |
| AF | 614.9 | 560 | 614.9 | 595 | 396.7 | 545.4 | 1,487.6 | 495.9 | 545.5 | 1,229.8 | 892.6 | 614.9 | 595 | 614.9 |

Total AF 9,803

This section of Red Lodge Creek provides a varied and excellent fishing recreational area. Considerable fisheries investigations (Job Progress Report F-20-R-21 Job Ia Supplement) provide the basis for the above flow request. Tributaries are included with hopes the requested flows will exist in the entire system but no less than 10 cfs at their confluence T6S, R20E, Sec. 7B.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Red Lodge Creek (Mid)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Rainbow trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st | week) | | |
| Rearing | | | | | | | | | | | | |
| **Cutthroat trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st | week) | | |
| Rearing | | | | | | | | | | | | |
| **Mountain whitefish** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

## Lower Red Lodge Creek

Confluence of East and West Red Lodge Creek to Cooney Reservoir

T6S, R20E, Sec. 7 to T4S, R20E, Sec. 34

Game fish species present:

- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)
- Cutthroat trout (*Salmo clarki*)

Riparian wildlife species present:

- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:

- Water discharge measurements and photographs
- Professional judgements
- Fisheries data collections
- Water Surface Profiles

Flow request:

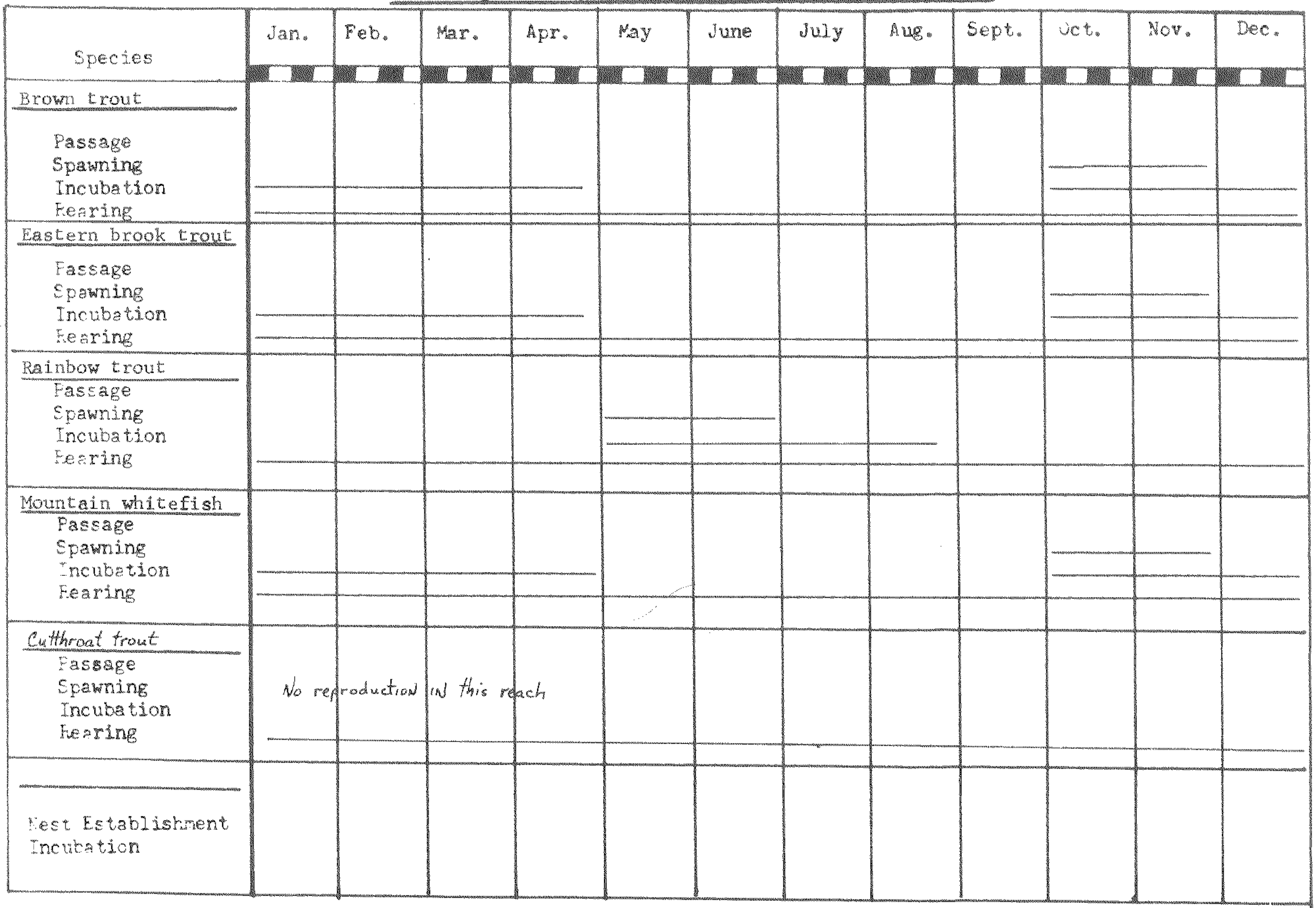
| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-10 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 40 | 40 | 40 | 40 | 40 | 60 | 100 | 100 | 50 | 25 | 50 | 50 | 45 | 40 |
| AF | 2459.5 | 2241.3 | 2459.5 | 2380.2 | 1586.8 | 1309 | 5950 | 1983 | 2083 | 1537 | 2975 | 3074 | 2678 | 2460 |

Total AF 35,175

Lower Red Lodge Creek is a popular fishing spot. Its a stream with lots of potential but is already subject to considerable flow alterations during irrigation season. It is not unusual to find a dry or unmeasurable stream discharge between headgates while agricultural needs are greatest. This greatest need occurs between hay cuttings which is usually around the second week of August. Mean flows for nine years of record are: October - April 59 cfs, May-June 217 cfs, and July-September 72 cfs. Local fishermen suggest that their preferred water depths depended upon fishing methods. Fly fishermen preferred 50 to 70 cfs while bait fishermen liked lots of water but not so high to be turbid. Esthetics is best at or above 75 cfs; these flows cover silt bars and exposed cobble substrate. The requested flows above are below optimum but are considered adequate to maintain a fishery at present fishing levels. Lower flows plus more fishermen would mandate higher cost at reduced fishing quality to provide fishing recreation.

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Red Lodge Creek (lower)



Rock Creek

Montana-Wyoming line to confluence with West Fork Rock Creek

T9S, R18E, Sec. 35A to T8S, R20E, Sec. 4D

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Brown trout (*Salmo trutta*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)

Methods:
- Water discharge measurements and photographs
- Professional judgements
- Fisheries data collections
- Rock Creek Floodplain Study
- Drainage inventory of streams and lakes

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 15 | 15 | 15 | 15 | 45 | 220 | 220 | 135 | 70 | 44 | 25 | 20 |
| AF | 922 | 833 | 922 | 893 | 2,767 | 1,309 | 1,353 | 8,301 | 4,165 | 2,705 | 1,488 | 1,230 |

Total AF 26,888

Rock Creek system generates from Beartooth Mountains in the Custer National Forest. The Rock Creek Water User Association has an impoundment at Glacier Lake near the headwaters of Rock Creek proper. A U.S.G.S. discharge station is located above the confluence with West Fork Rock Creek. The flows requested above are based on discharge measurements existing during winter low flow periods and numerous measurements near Roberts, Montana. Minimum values are 60% of mean monthly flows for nine years of USGS records.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Rock Creek (Upper)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellowstone cutthroat | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| *Brook trout* | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | (2nd week) | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Mid Rock Creek

Confluence of West Fork Rock Creek to Bailey Ditch

T8S, R20E, Sec. 04D to T7S, R20E, Sec. 11C

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Brown trout (*Salmo trutta*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Raccoon (*Procyon lotor*)

Methods:
- Water discharge measurements and photographs
- Professional judgement
- Fisheries data collections
- Rock Creek Floodplain Studies
- Drainage inventory of streams and lakes

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 25 | 25 | 20 | 20 | 60 | 295 | 295 | 170 | 80 | 55 | 35 | 25 |
| AF | 1,537 | 1,388 | 1,230 | 1,190 | 3,689 | 17,553 | 18,139 | 10,453 | 4,760 | 3,382 | 2,083 | 1,537 |

Total AF 66,941

This is the section of Rock Creek flowing through Red Lodge, Montana to the first major diversion. This reach contains a variety of trout species. The lower reach is dominated by fall spawning brown and brook trout. Maintenance of spring and summer flows is critical to the welfare of spring spawning rainbow and cutthroat trout. The above flow requests were based on USGS discharge measurements. Minimum values are 60% of mean monthly flows.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Mid Rock Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellowstone cutthroat | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st | week) | | |
| Rearing | | | | | | | | | | | | |
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st | week) | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2n | d week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2n | d week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower Rock Creek

Bailey Ditch to mouth

T7S, R20E, Sec. 11C to T3S, R23E, Sec. 36D

Game fish species present:
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water surface profiles
- Water discharge measurements and photographs
- Professional judgment
- Fisheries data collections
- Rock Creek Floodplain Studies

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 30 | 30 | 30 | 25 | 65 | 375 | 310 | 95 | 50 | 40 | 35 | 35 |
| AF | 1,845 | 1,666 | 1,845 | 1,488 | 3,997 | 22,314 | 19,061 | 5,841 | 2,975 | 2,460 | 2,083 | 2,152 |

Total AF - 67,677

Lower Rock Creek is subject to intensive water withdraws during the irrigating season The lower drainage also has numerous tributaries adding flows. The reach of stream has excellent brown trout populations where the stream channel is unaltered; however, few of these areas exist. Many of the abuse areas have densities of 150 pounds per surface acre. No spring spawning fish species exist, probably due to lack of water over redds during incubation periods. Brown trout and brook trout spawn during low flow periods and are self-sustaining. Fishing success is highest when flows are between 75 and 100 cfs for fly fishermen and 100 to 200 cfs for bait and lure fishing. Esthetics are best when flows are clear and cover the substrate from bank to bank. This requires 150 to 200 cfs. Discharge measurements during the Rock Creek Floodplain Study and during summer of 1976 were multiplied by .60 and are listed by month for the request.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Rock Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower East Rosebud Creek

Custer National Forest boundary to confluence with West Rosebud Creek

T6S, R18E, Sec. 31B to T4S, R18E, Sec. 13C

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water surface profile
- Water discharge measurements and photographs
- Fish data collections
- Drainage stream and lake survey

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 60 | 60 | 60 | 60 | 50 | 50 | 200 | 200 | 200 | 150 | 80 | 60 | 60 | 60 |
| AF | 3,698 | 3,332 | 3,698 | 3,570 | 1,983 | 1,091 | 1,190 | 7,934 | 4,364 | 9,223 | 4,760 | 3,698 | 3,570 | 3,698 |

Total AF 55,809

Another important and heavily used stream in the Yellowstone River system is this reach of East Rosebud Creek. It's hard to imagine anything less than existing flows. The request, however, is based on water surface profile data, measurements of tributary discharges and the varied fishery. Fishermen indicate that they prefer depths which are realized between 100 and 125 cfs. Esthetic values are always good at present flow regimens, but are super when bank full, 300+ cfs. Floaters enjoy the meandering valley from the Custer National Forest to the Sand Ford bridge. Measurements of flows during August and September were lowest at 125 cfs and were usually in the 190 to 225 cfs range. The above flow request is felt to be the minimum to sustain the fishery.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower East Rosebud Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yellowstone Cutthroat** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Rainbow trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Mountain Whitefish** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

West Rosebud Creek

Mystic Lake to confluence with Fiddler Creek

T7S, R16E, Sec. 9 & 16 to T5S, R17E, Sec. 23D

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water discharge measurements (U. S. Geological Survey flow records)
- Professional judgments
- Fisheries data collected
- Drainage inventory of streams and lakes

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 50 | 50 | 50 | 40 | 40 | 100 | 150 | 200 | 150 | 90 | 50 | 50 | 50 |
| AF | 3,074 | 2,777 | 3,074 | 2,380 | 1,587 | 2,182 | 8,926 | 12,298 | 9,223 | 3,570 | 3,074 | 2,975 | 3,074 |

Total AF - 58,214

Discharge of West Rosebud Creek below Mystic Lake is partially controlled by Montana Power Company. On the basis of 9 years of flow records, water surface profiles and fish data collections generated the above request. Physical values suffer greatest losses below 100 cfs. Esthetics are best when depths cover bottom substrates and water is contiguous with each bank; this would require at least 200 cfs. Fishermen prefer 50 to 75 cfs in the upper reaches and 75 to 200 cfs in lower reaches. The values requested above are slightly above mean monthly flows; however, this request includes Chicken,Line, Black Can, Cold, Fiddler and several unnamed tributaries. The mean yearly contribution of water not presently used for agriculture is approximately 46 cfs. The request is aimed at stream discharge in West Rosebud Creek at an including Fiddler Creek.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper West Rosebud Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yellowstone Cutthroat** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Rainbow trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Mountain Whitefish** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower West Rosebud Creek

Confluence with Fiddler Creek to mouth

T5S, R17E, Sec. 23D to T4S, R18E, Sec. 13C

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water surface profile
- Water discharge measurements and photographs
- Professional judgment
- Fisheries data collections

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 65 | 65 | 65 | 50 | 50 | 130 | 195 | 260 | 145 | 120 | 65 | 65 | 65 |
| AF | 3,997 | 3,610 | 2,997 | 2,975 | 1,983 | 2,836 | 1,160 | 15,987 | 11,990 | 1,140 | 3,997 | 3,868 | 3,997 |

Total AF - 61,537

Lower West Rosebud Creek has several small tributary streams below the U. S. Geological Survey gauge station at Mystic Lake. Most of the above monthly requests are below the mean monthly discharges 32 miles upstream at the gauge station. Water surface profile suggests that many physical features are lost below 100 cfs. This is an important stream in the Yellowstone River system in that it produces considerable fishing and water-based recreation for many people. It also provides need of quality water downstream in Stillwater and Yellowstone Rivers.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower West Rosebud Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Yellowstone Cutthroat** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Rainbow trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | (1st week) | | | |
| Rearing | | | | | | | | | | | | |
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2nd week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (2nd week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Mountain Whitefish** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | (1st week) | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Sage Creek

Headwaters to Crow Indian Reservation

T7S, R27, Sec. 32 to T7S, R26E, Sec. 19

Game fish species present:
- Brook trout (*Salvelinus fontinalis*)
- Rainbow trout (*Salmo gairdneri*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Mink (*Mustela vison*)
- Muskrat (*Ondatra zibethicus*)

Methods:
- Water Surface Profile
- Fish data collections
- Professional judgement

Flow request:

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| AF | 922 | 840 | 922 | 893 | 922 | 893 | 922 | 922 | 893 | 922 | 893 | 922 |

Total AF 10,866

According to data collected for Water Surface Profiles the amount of wetted perimeter becomes seriously depleted at 15 cfs. Below 15 cfs losses of physical character of Sage Creek would reduce it to an unmanagable fishery. All ratings of fisherman preference and esthetics suggest 15 cfs is satisfactory but 20 cfs would be closer to optimum.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Sage Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (1st week) | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

1. Stream name: Stillwater River - Stillwater County

2. Stream reach: Mouth to mouth of Rosebud River

3. Location: T2S, R20E, Sec. 29 to T3S, R19E, Sec. 31

4. Fish species present:

   Resident: Brown and rainbow trout, whitefish, various cyprinids
   Migratory transient: none significant

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS gaging data; low flow photography; extrapolation of fish population and life history data from an adjacent reach of the Stillwater River.

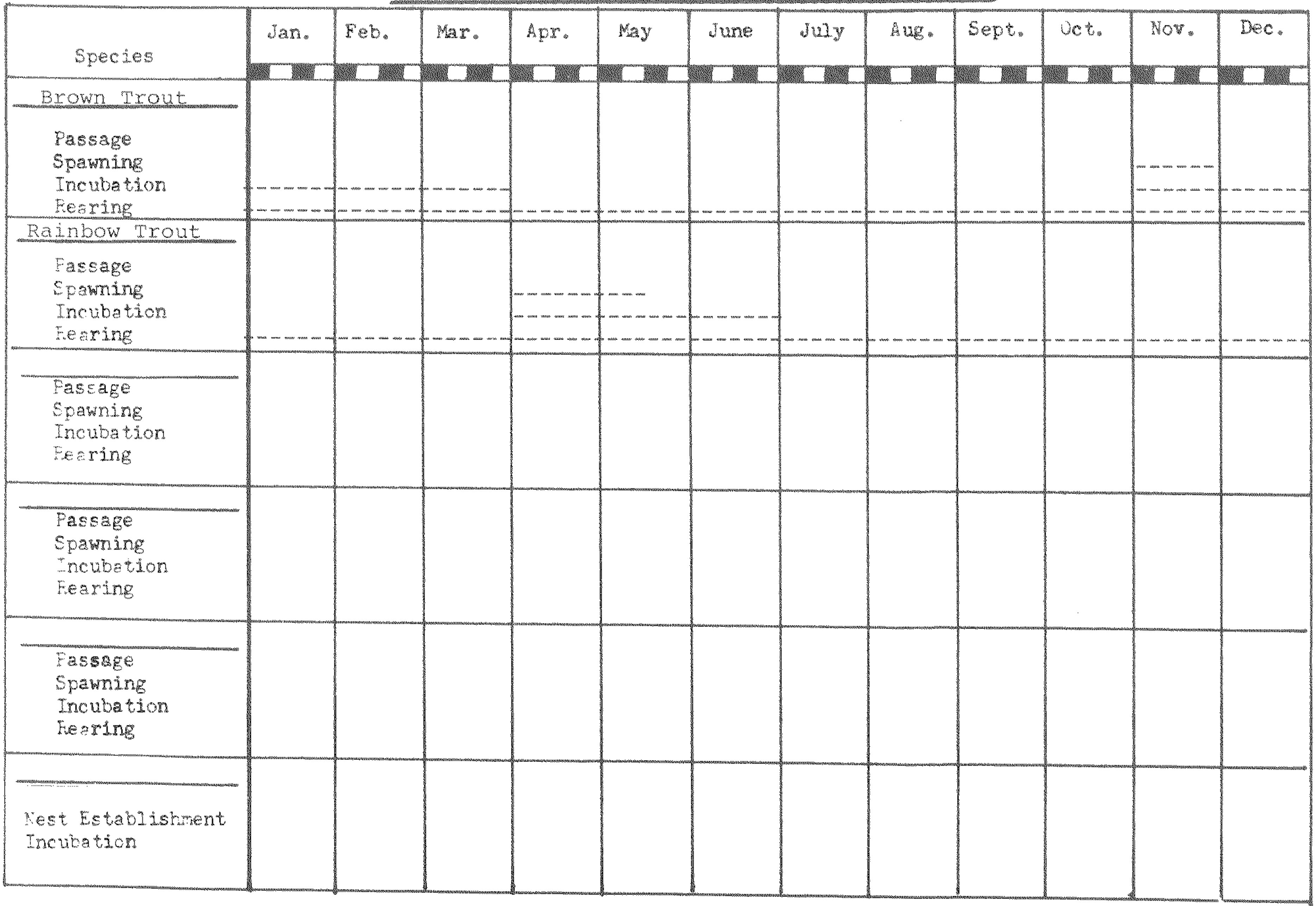
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in the period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 225 | 225 | 225 | 225 | 560 | 2075 | 1480 | 740 | 630 | 440 | 225 | 225 | |
| Ac.Ft. | 13835 | 12496 | 13835 | 13388 | 34433 | 123471 | 91002 | 45501 | 37488 | 27055 | 13388 | 13385 | 438,827 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Stillwater River from mouth to mouth of Rosebud River



1. Stream name: Stillwater River - Stillwater County

2. Stream reach: From mouth of Rosebud River to mouth of West Fork Stillwater River

3. Location: T3S, R19E, Sec. 31 to T4S, R16E, Sec. 31

4. Fish species present:

   Resident: Brown and rainbow trout; whitefish; various cyprinids
   Migratory transient: none

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS gaging data; low flow photography; fish population and life history data obtained by electrofishing.

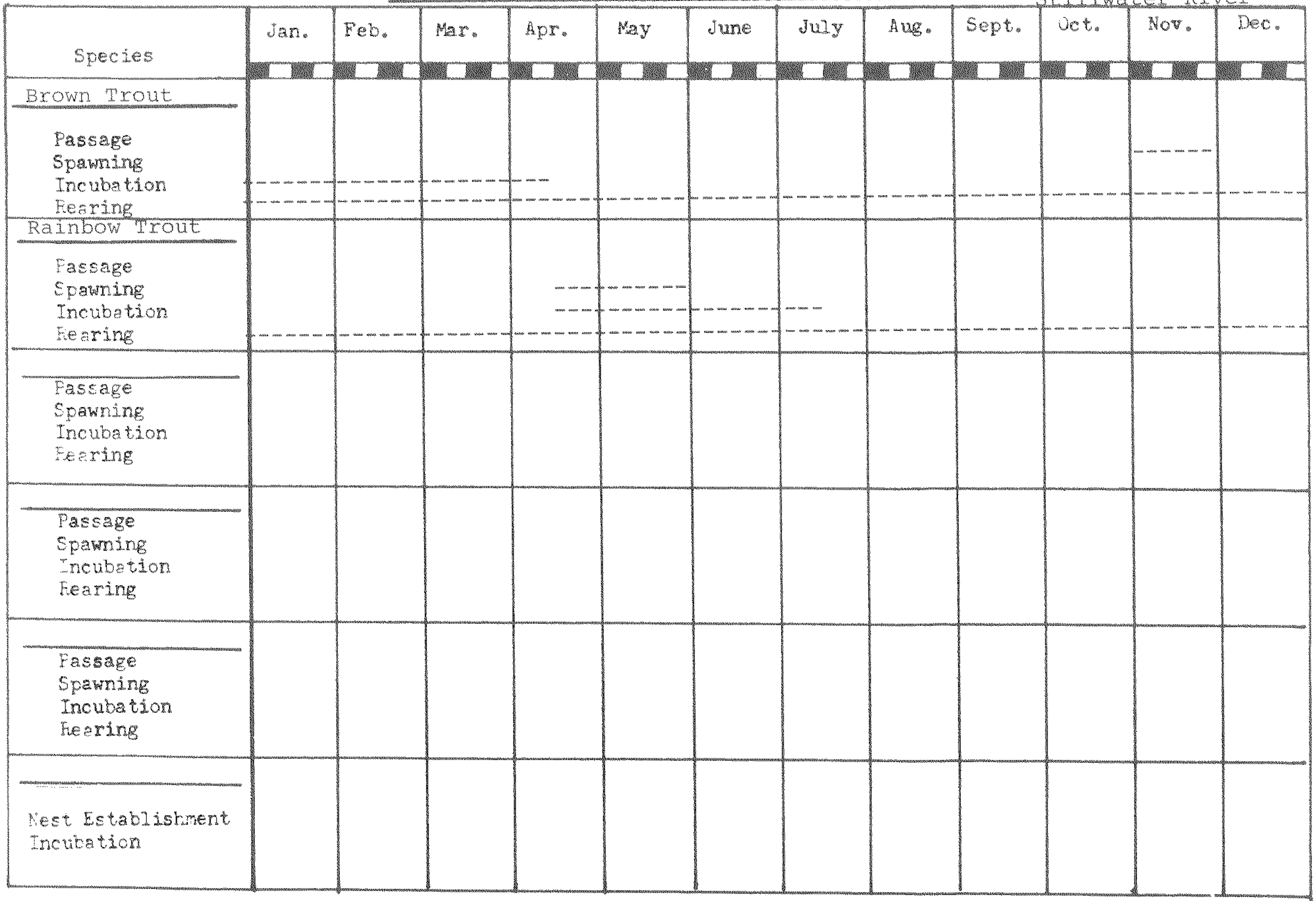
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for November through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 75 | 75 | 75 | 75 | 190 | 1200 | 760 | 350 | 275 | 180 | 75 | 75 | |
| Ac.Ft. | 4612 | 4165 | 4612 | 4463 | 11683 | 71405 | 46731 | 21521 | 16364 | 11068 | 4463 | 4612 | 205,699 |

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Stillwater River from mouth of Rosebud River to mouth of West Fork Stillwater River



1. Stream name: Stillwater River - Stillwater county

2. Stream reach: From mouth of West Fork Stillwater River to north end of Sioux Charlie Lake

3. Location: T4S, R16E, Sec. 31 to T6S, R14E, Sec. 1

4. Fish species present:

   Resident: Brook, brown and rainbow trout, whitefish, longnose sucker, mountain sucker, longnose dace
   Migratory transient: None

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, otter, racoon
   Migratory transient: Bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS gaging data; low flow photography; fish population and life history data obtained by electrofishing.

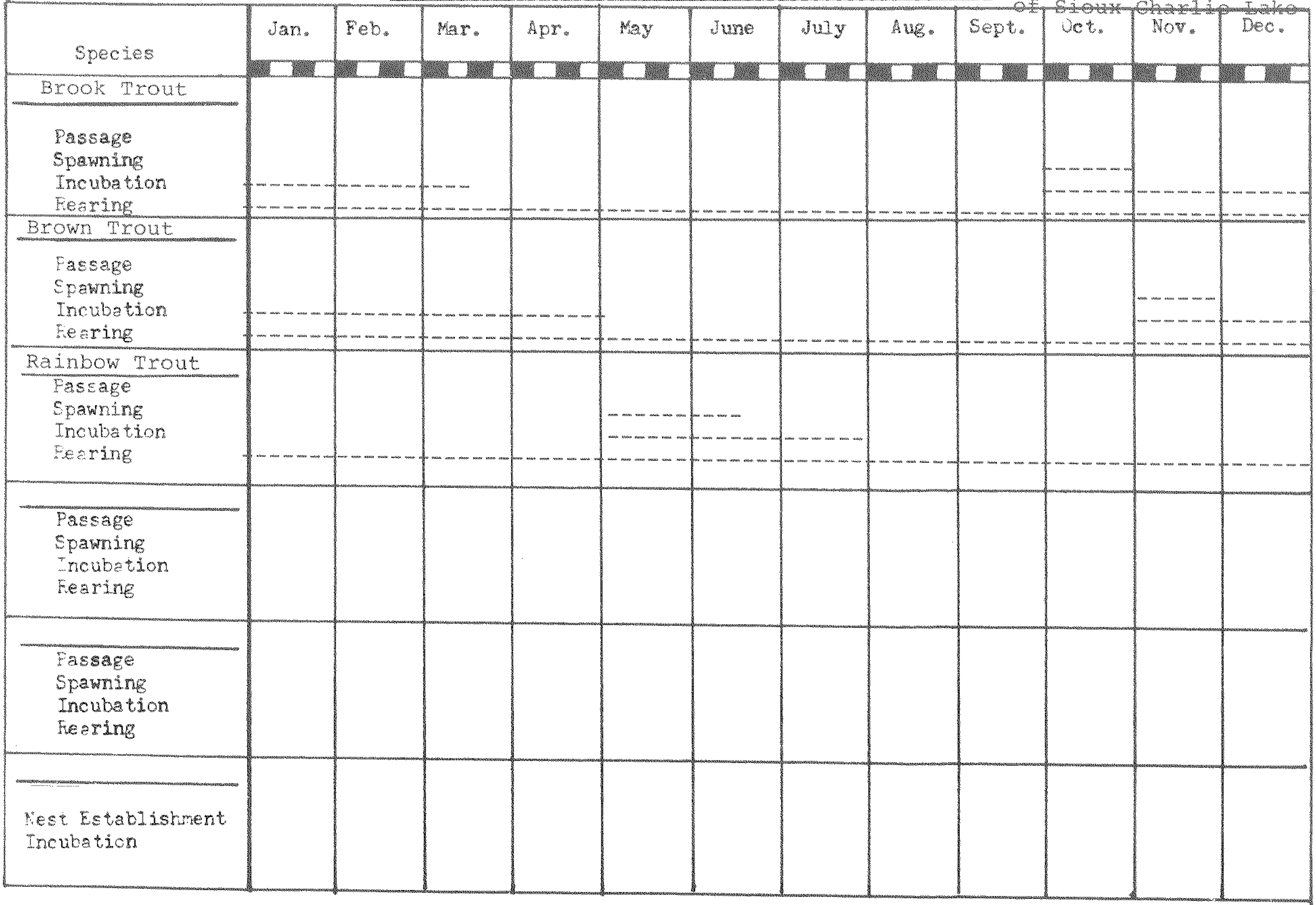
8. Why flow is necessary: Flows requested will help maintain fish populations and riparian wildlife in their present condition. Flows for October through April were derived by extending water surface profile data obtained on nearby similar streams where it was found that typical natural flows in this period were near the minimum flow required to maintain the existing fish populations. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 45 | 45 | 45 | 45 | 150 | 710 | 480 | 175 | 120 | 100 | 45 | 45 | |
| Ac.Ft. | 2767 | 2499 | 2767 | 2678 | 9223 | 42248 | 29514 | 10822 | 7140 | 6149 | 2678 | 2767 | 121,252 |

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Stillwater River from mouth of West Fork Stillwater River to north end of Sioux Charlie Lake



Mid Sweet Grass Creek

Forest Service boundary to Lake Adam diversion

T4N, R12E, Sec. 10A to T4N, R15E, Sec. 34A

Game fish Species present:
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Brown trout (*Salmo trutta*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water discharge measurements, photographs and USGS gage records
- Professional judgement
- Fisheries data collections and creel census

Flow request:

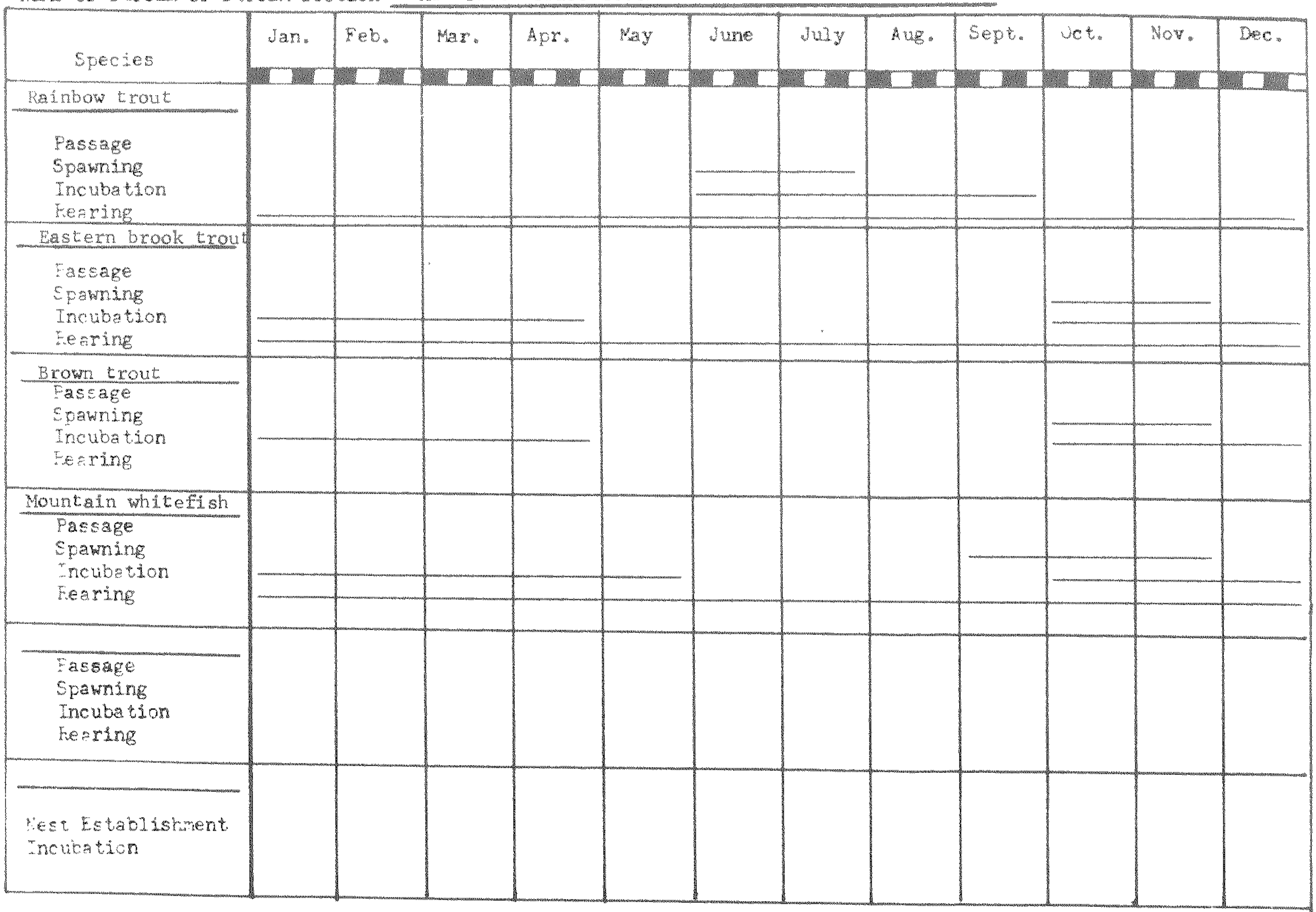
| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 15 | 15 | 15 | 15 | 25 | 100 | 200 | 100 | 100 | 45 | 25 | 25 | 25 | 25 |
| AF | 922 | 833 | 922 | 893 | 500 | 2,182 | 6,000 | 3,967 | 2,182 | 2,767 | 1,488 | 1,537 | 1,488 | 1,537 |

Total AF 27,218

Mid Sweet Grass Creek is the most productive portion. Good quality water generating from the Crazy Mountains combining with more productive soils make this stretch the best reach on Sweet Grass Creek for fish and fishing recreation. Waters are already heavily appropriated for irrigation. Measurements of discharge and associated biological investigation at two flow levels reveal considerable physical and habitat losses from 75 to 21 cfs. Losses of nursery area along shoals is most intense. Habitat in this section is best when flows are greater than 75 cfs. At these flows, bank and overbank vegetation occupies 79% of stream channel in 300 feet studied, at flows of 21 cfs only 18% of this cover is available (specific data filed with Pat Marcuson, Red Lodge, Montana). At 75 cfs, water touched both permanent banks (not bank full), at 21 cfs, water touched the permanent banks in 3 outside meanders. When all the substrate of the stream was covered at 75 cfs only 44% was covered at 21 cfs. During winter ice-up even a smaller area would be available for fish with a discharge of 21 cfs. The above request is considerably less than optimum summer and fall flows of 75+ cfs; however, with the present demand for water, this request asks for a minimum of 15 cfs to maintain a fishery over winter months.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Mid Sweet Grass Creek



Lower Sweet Grass Creek

Lake Adam diversion to mouth at Yellowstone River

T4N, R15E, Sec. 34A to T1N, R16E, Sec. 31C

Game fish species present:
- Brown trout (*Salmo trutta*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Raccoon (*Procyon lotor*)

Methods:
- Water Surface Profile
- Water discharge measurements and photographs
- Professional judgement

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 20 | 20 | 20 | 20 | 40 | 100 | 200 | 100 | 60 | 60 | 40 | 40 | 20 | 20 |
| AF | 1,230 | 1,110 | 1,220 | 1,190 | 1,587 | 2,182 | 11,900 | 3,967 | 1,309 | 3,689 | 2,380 | 2,460 | 1,190 | 1,230 |

Total AF 36,644

Lower Sweet Grass Creek is a large stream channel with extreme fluctuations of flows. Irrigation withdraws considerable water and waste waters return of poor quality. Fish have use of leftover flows during irrigation season. There is no way to accurately select a minimum reservation of flow for fish in this section. However, based on our measurements and search of recorded flow data, the above request possibly represents minimum requirements for trout. Lower flows would cause excessive silt deposition, oxygen lags, higher temperatures and increased predation of fish. Fisherman indicate a preference of flows around 100 to 150 cfs. Esthetics would be best when water extends to the banks which is in excess of 200 cfs. Neither of the above conditions exist during irrigation season.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower Sweet Grass Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Upper Deer Creek

Headwaters to mouth

T3S, R14E, Sec. 28D to T1N, R15E, Sec. 35B

Game fish species present:
- Cutthroat trout (Salmo clarki) indigenous
- Brown trout (Salmo trutta)
- Brook trout (Salvelinus fontinalis)

Riparian wildlife species present:
- Beaver (Castor canadensis)
- Muskrat (Ondatra zibethicus)
- Mink (Mustela vison)
- Racoon (Procyon lotor)

Methods:
- Water surface profile
- Water discharge measurements and photographs
- Professional judgment
- Fish data collections

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 5 | 5 | 5 | 5 | 5 | 25 | 25 | 8 | 8 | 5 | 5 | 5 | 5 |
| AF | 307 | 278 | 307 | 298 | 198 | 545 | 1,487 | 492 | 492 | 298 | 307 | 298 | 307 |

Total AF 5,614

Upper Deer Creek is another stream subject to extreme high and low flows. Low flows are both natural and from irrigation demands. Little or no flow exists downstream from Interstate 90 during irrigation season. The above flow request is basically a maintenance request. Upper reaches provide excellent small stream fishing. Fishermen prefer flows between 10 to 20 cfs and esthetic values are best at 15 cfs during the summer.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Upper Deer Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cutthroat trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (2nd week) | | |
| Rearing | | | | | | | | | | | | |
| **Brown trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| **Eastern brook trout** | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ________ | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Lower West Boulder River

Gallatin National Forest boundary to mouth

T3S, R11E, Sec. 24 to T2S, R13E, Sec. 15

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Brown trout (*Salmo trutta*)
- Rainbow trout (*Salmo gairdneri*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra* zibethicus)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water surface profile
- Fish data collections
- Professional judgment

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July 1-20 | July 21-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 50 | 50 | 50 | 50 | 50 | 300 | 300 | 300 | 200 | 75 | 75 | 75 | 60 | 50 |
| AF | 3,074 | 2,802 | 3,074 | 2,975 | 1,984 | 6,545 | 17,851 | 11,901 | 4,364 | 4,612 | 4,463 | 4,612 | 3,570 | 3,074 |

Total AF 74,096

The West Boulder River is one of the most senic streams in the Yellowstone River drainage. Flows of 250 cfs and greater are esthetically pleasing. Waters are generally clear and little turbidity is ever seen. Fishermen indicate a preference of 125 to 200 cfs fly fishing and the same to greater volumes for bait or spin fishing. Cutthroat, rainbow, brook and brown trout offer a variety of fishing opportunities. The flows requested above are 30% of the known instantaneous discharges.

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Lower West [redacted] Boulder River

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellowstone cutthroat | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (1st week) | | |
| Rearing | | | | | | | | | | | | |
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (1st week) | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Nest Establishment Incubation | | | | | | | | | | | | |

1. Stream name: West Fork Stillwater River - Stillwater County

2. Stream reach: from mouth to mouth of Castle Creek

3. Location: T4S, R16E, Sec. 31 to T4S, R15E, Sec. 26

4. Fish species present:

   Resident: Brown and rainbow trout; mountain whitefish
   Migratory transient: None

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: Bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: USGS and Montana Fish and Game gaging data; water surface profile program; low flow photography; fish population and life history data obtained by electrofishing.

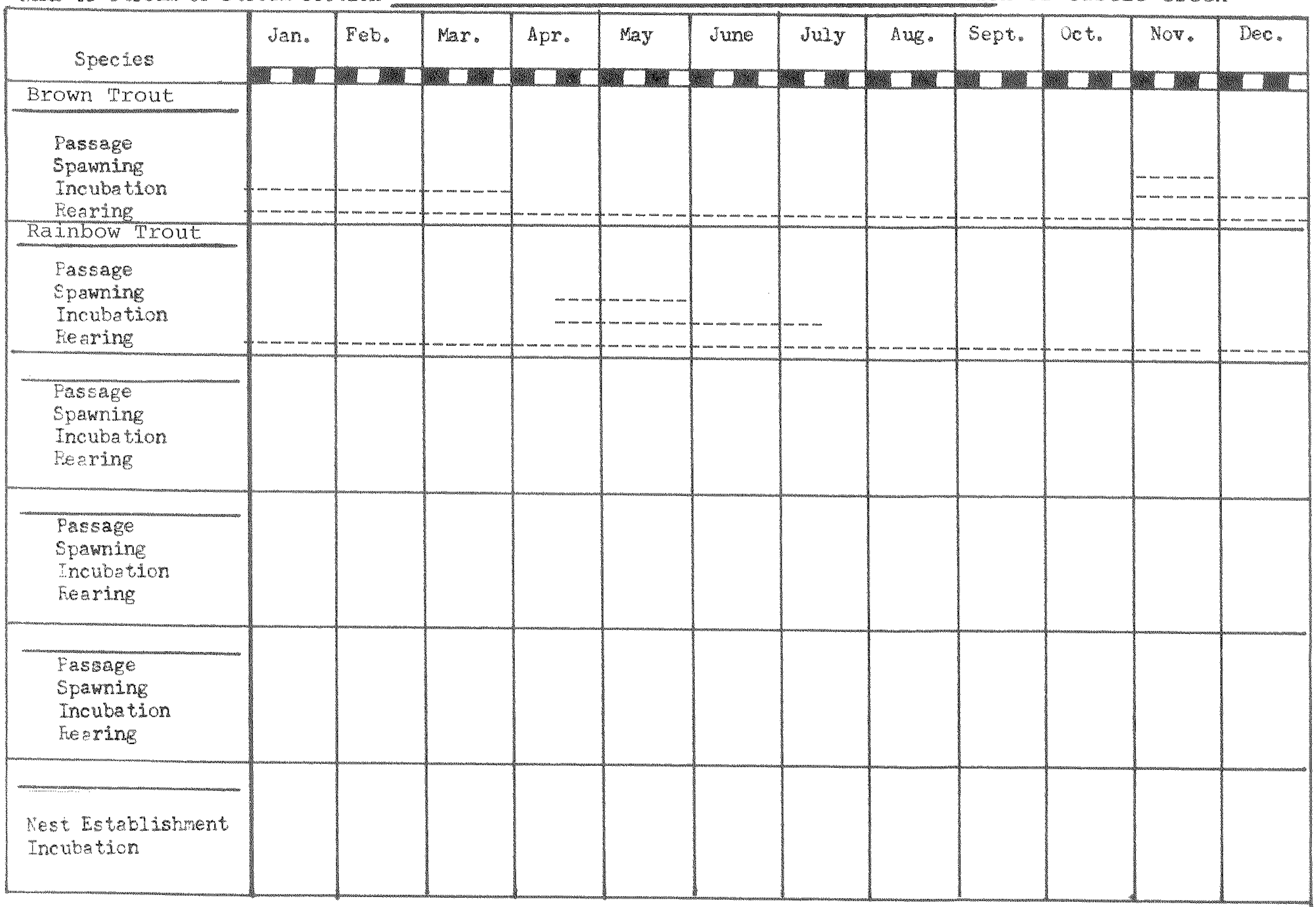
8. Why flow is necessary: Minimum desirable flow of 35 cfs was determined largely on the basis of backwater pool inundation for young-of-year fish. Fifty cfs in November is a minimum for brown trout spawning. Flows for May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance. Flows requested are also suitable for riparian wildlife.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 35 | 35 | 35 | 35 | 70 | 350 | 125 | 75 | 60 | 50 | 50 | 35 | |
| Ac.Ft. | 2152 | 1944 | 2152 | 2083 | 4304 | 20826 | 7686 | 4612 | 3570 | 3074 | 2975 | 2152 | 57,530 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section West Fork Stillwater River from mouth to mouth of Castle Creek



1. Stream name: West Fork Stillwater River - Stillwater County

2. Stream reach: From mouth of Castle Creek to Stillwater-Sweet Grass County line

3. Location: T4S, R15E, Sec. 26 to T5S, R15E, Sec. 6

4. Fish species present:

   Resident: Brown and rainbow trout; mountain whitefish
   Migratory transient: None

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, mink, racoon
   Migratory transient: Bald eagle

6. Life history periodicity chart: attached

7. Methods used for flow determination: Montana Fish and Game gaging data; water surface profile program; low flow photography; fish population and life history data obtained by electrofishing.

8. Why flow is necessary: A minimum desirable flow of 30 cfs was determined largely on the basis of inundation of young-of-year backwater pools. Flows from May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenence. Flows requested are also suitable for riparian wildlife.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 30 | 30 | 30 | 30 | 60 | 300 | 110 | 65 | 50 | 45 | 30 | 30 | |
| Ac.Ft. | 1845 | 1666 | 1845 | 1785 | 3689 | 17851 | 6764 | 3997 | 2975 | 2767 | 1785 | 1845 | 48,814 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section West Fork Stillwater River from mouth of Castle Creek to Stillwater - Sweet Grass county line

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brown Trout | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Rainbow Trout | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Passage<br>Spawning<br>Incubation<br>Rearing | | | | | | | | | | | | |
| Nest Establishment<br>Incubation | | | | | | | | | | | | |

1. Stream name: West Fork Stillwater River - Sweet Grass County

2. Stream reach: From Sweet Grass - Stillwater County line to mouth of Tumble Creek

3. Location: T5S, R14E, Sec. 1 to T5S, R14E, Sec. 29

4. Fish species present

   Resident: Brown and rainbow trout
   Migratory transient: None

5. Riparian wildlife present:

   Resident: Beaver, muskrat, mink
   Migratory transient: None significant

6. Life history periodicity chart: attached

7. Methods used for flow determination: Montana Fish and Game and U. S. Forest Service gaging data; water surface profile program; low flow photography; fish population and life history data obtained by electro-fishing.

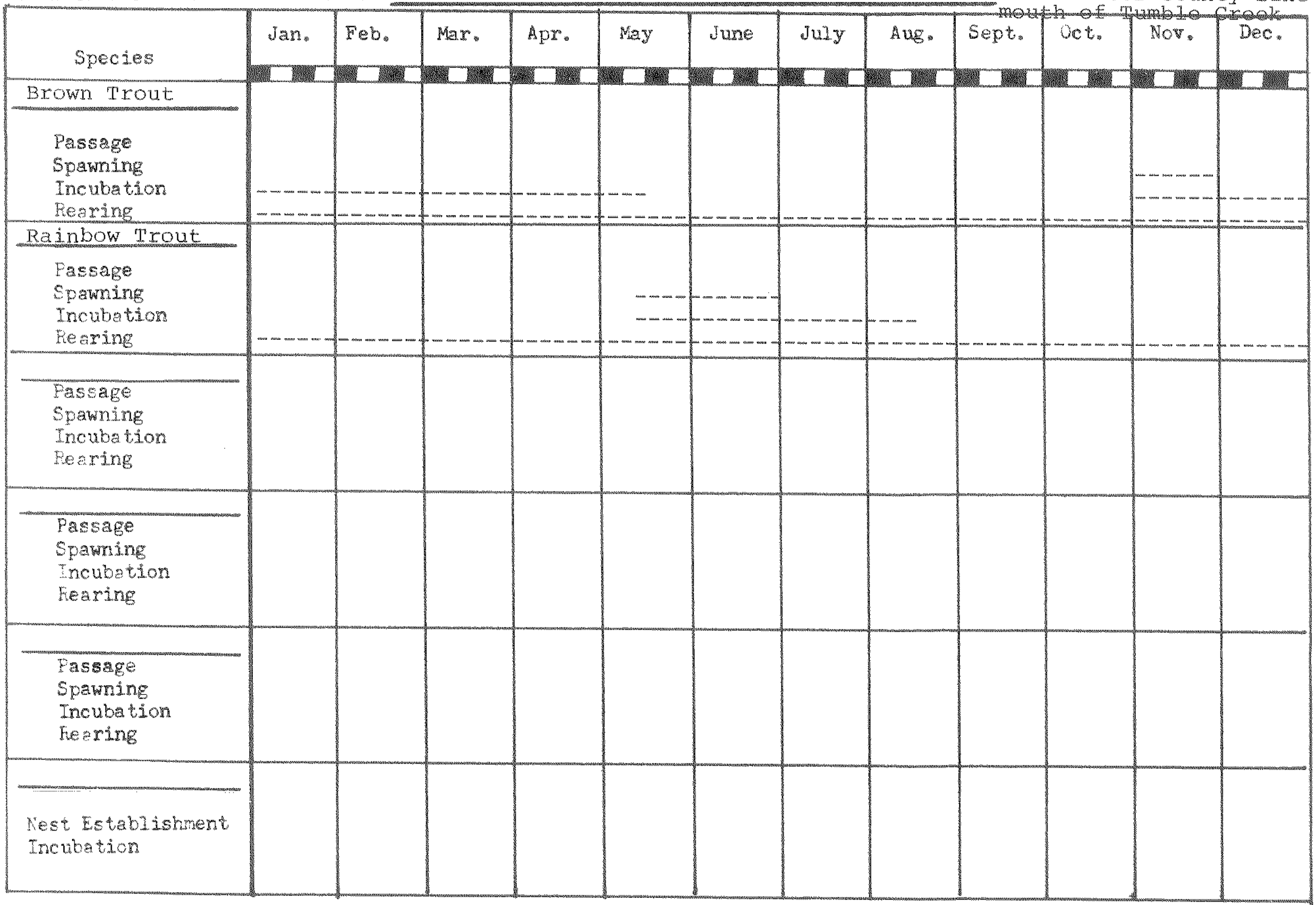
8. Why flow is necessary: A minimum flow of 25cfs was determined as necessary for inundation of backwater pools for rearing of young-of-year fish. This flow is also suitable for adult fish habitat. Flow from May through October are approximate average monthly minimum flows. They were chosen to insure a semblance of natural flows for channel flushing and maintenance. Flows requested are also suitable for riparian wildlife.

9. Flow request:

| | J | F | M | A | M | J | J | A | S | O | N | D | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CFS | 25 | 25 | 25 | 25 | 25 | 200 | 100 | 40 | 25 | 25 | 25 | 25 | |
| Ac.Ft. | 1537 | 1388 | 1537 | 1488 | 1537 | 11901 | 6149 | 2460 | 1488 | 1537 | 1488 | 1537 | 34,047 |

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section West Fork Stillwater River from Sweet Grass-Stillwater County line to mouth of Tumble Creek



Mid-Willow Creek

Forest Service boundary to Spring Creek

T7S, R20E, Sec. 31D to T6S, R20E, Sec. 28A

Game fish species present:
- Cutthroat trout (*Salmo clarki*)
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Professional judgment
- Fisheries data collection and creel census
- Water discharge measurements

Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 10 | 10 | 10 | 10 | 10 | 25 | 25 | 15 | 15 | 15 | 10 | 10 | 10 |
| AF | 615 | 555 | 615 | 595 | 397 | 545 | 1,488 | 922 | 922 | 893 | 615 | 595 | 615 |

Total AF - 9,372

This request asks for a minimum of 10 cfs, hopefully to be accumulated in Willow Creek at its confluence with Spring Creek. This value is considerably below discharge that normally exists at this spot (based on almost daily observations for 4 years). Local fishermen dominate fishing intensity. Most of the pressure occurs during June, July and early August. Reproduction of spring and fall spawning fish is still possible and contributes some downstream recruitment. This area is not as productive as lower Willow Creek, but is enjoyed by numerous recreationists.

LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Mid-Willow Creek

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellowstone cutthroat | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (1st week) | | |
| Rearing | | | | | | | | | | | | |
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | (1st week) | | |
| Rearing | | | | | | | | | | | | |
| Brown trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Eastern brook trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | (2nd week) | | | | | | |
| Rearing | | | | | | | | | | | | |
| Mountain whitefish | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | (1st week) | | | | | | | |
| Rearing | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | |
| Nest Establishment Incubation | | | | | | | | | | | | |

Lower Willow Creek

Confluence with Spring Creek to Cooney Reservoir

T6S, R20E, Sec. 28A to T5S, R20E, Sec. 2B

Game fish species present:
- Rainbow trout (*Salmo gairdneri*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Mountain whitefish (*Prosopium williamsoni*)

Riparian wildlife species present:
- Beaver (*Castor canadensis*)
- Muskrat (*Ondatra zibethicus*)
- Mink (*Mustela vison*)
- Racoon (*Procyon lotor*)

Methods:
- Water surface profile
- Water discharge measurements and photographs
- Professional judgment
- Fisheries data collection

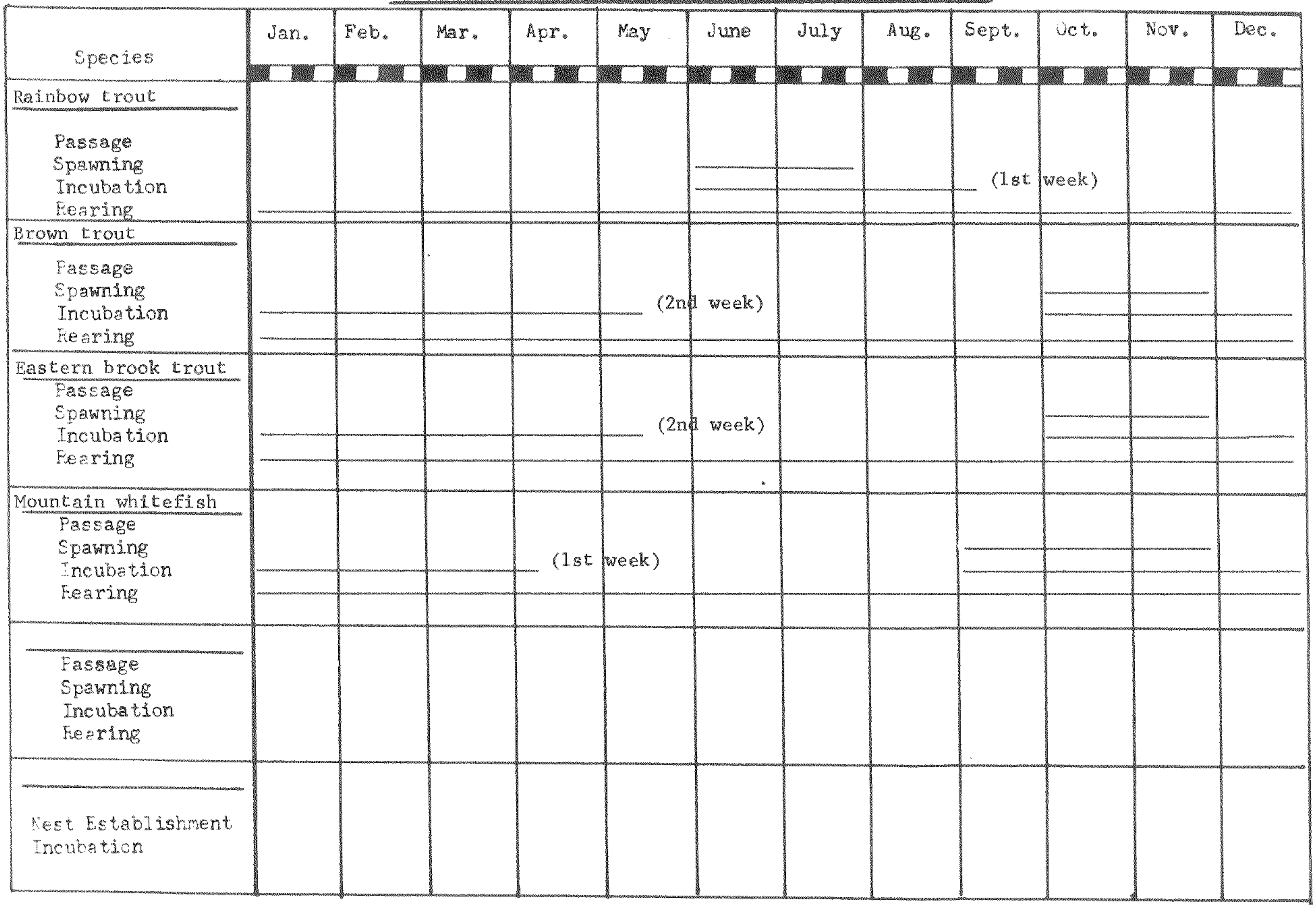
Flow request:

| | Jan | Feb | Mar | Apr | May 1-20 | May 21-31 | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| cfs | 25 | 25 | 25 | 25 | 25 | 50 | 50 | 50 | 30 | 30 | 30 | 25 | 25 |
| AF | 1,537 | 1,388 | 1,537 | 1,488 | 992 | 1,091 | 2,975 | 3,074 | 1,845 | 1,785 | 1,845 | 1,488 | 1,537 |
| Total AF - 22,562 | | | | | | | | | | | | | |

Water surface profile data suggest that lower Willow Creek would lack adequate physical characteristics below a minimum flow of 25 cfs. Discharge measurements indicate that considerably more than 25 cfs exist at most times of the year. Considerable irrigation exists, but is usually well supplemented by subflows from diverted water from Rock Creek on gravelly soils of the East Bench. Brown and brook trout and mountain whitefish populations are self-sustaining. Silt deposition restricts spring spawning fish, but some downstream dispersement is known to occur. Fishermen indicate a preference of approximately 40 cfs, at this discharge, good pools adjacent to brush covered banks provide fishing. Water surface profile shows physical losses are greatest below 25 cfs.

## LIFE CYCLE PERIODICITY CHART

Name of stream or stream section  Lower Willow Creek



1. Name: Yellowstone River

2. Stream reach: Boulder River to Stillwater River

3. Location: T1N, R14E, Sec. 12 to T2S, R20E, Sec. 29

4. Fish species present:

   Resident: LL, Rb, Wf, LNSu, WSu, JSu, stonecat, short-head redhorse, burbot, longnose dace, mottled sculpin.

   Migratory transient: None known.

5. Riparian wildlife present:

   Resident: Similar to upriver reaches as stated by Constan (1975): Beaver, muskrat, marten, river otter, raccoon, white-tailed deer pheasants

   Migratory transient: Similar to upriver reaches as stated by Hook (1975): Waterfowl, pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red-breasted merganser, common goldeneye, Barrows golden-eye, bufflehead, ruddy duck, blue-wing teal, green-wing teal, cinnamon teal, coot, ringneck duck and Canada goose. Nongame - bald eagle, great blue heron.

6. Life history periodicity chart: (See Armstrong Spring Creek)

7. Methods used for flow determination:

   Requests are based on discharge frequency data at USGS gaging stations, the dominant discharge concept, existing water rights held by the Department of Fish and Game and current biological data.

   Biological-streamflow data obtained in the Yellowstone River below the Big Horn River was used as the basis for the flow requests. Flows selected in that reach were based on physical and biological needs of the fish and wildlife species present. Flows from approximately August through April, although based on field data, approach those historical flows which were equaled or exceeded 50% of the time (1942-1971) according to USGS records.

   Flows during May, June and July were found to approach the 70% exceedance level. Thus to be consistent with those recommendations and because this reach is part of the whole Yellowstone system, the 50% and 70% exceedance flows minus this department's "existing rights," (see below), periods when 50% and 70% exceedance flows we used are as follows:

| | |
|---|---|
| Jan. 1 - May 10 | 50% exceedance |
| May 11 - Aug. 10 | 70% exceedance |
| Aug. 11 - Dec. 31 | 50% exceedance |

The USGS gage "Yellowstone River near Livingston" was used as the base for flow requests. Inflow from major tributaries was added to the flow at Livingston. The 50% exceedance flows from tributaries were added to the 50% exceedance flows at Livingston, as were the corresponding 70% exceedance flows. Tributaries included in this reach are the Shields and Boulder Rivers. This department's "existing rights" (see below) were subtracted from the 50% and 70% exceedance flows obtained to arrive at the requested flows.

Existing Rights of Department of Fish and Game[1/]

| | | |
|---|---|---|
| From Boulder River to Stillwater River: | April 16-October 31 | 2200 cfs |
| | November 1-April 16 | 1300 cfs |

The estimated dominant discharge was requested for a 24-hour period. The dominant discharge for this reach was estimated from the known dominant discharge at Livingston (18,200 cfs) and for the "Boulder River at Big Timber" gage (5,378 cfs). Dominant discharges at gaged sites were furnished by Koch (1976, personal communication).

8. Why flow is necessary:

These flows are necessary to help maintain and preserve fish and wildlife populations at current levels, to allow continued, high-quality recreational use of the stream, and to maintain a flow regime which adequately performs channel maintenance processes.

9. Flow request:

| | CFS | AC. FT. | | CFS | AC. FT. |
|---|---|---|---|---|---|
| January | 0 | 0 | July 1-10 | 6,800 | 134,876 |
| February | 0 | 0 | July 11-20 | 4,500 | 89,256 |
| March | 200 | 12,298 | July 21-31 | 2,800 | 61,091 |
| April 1-15 | 400 | 11,901 | Aug. 1-10 | 1,600 | 31,736 |
| April 16-30 | 0 | 0 | Aug. 11-31 | 1,100 | 45,818 |
| May 1-10 | 500 | 9,917 | September | 300 | 17,851 |
| May 11-20 | 2,600 | 51,570 | October | 0 | 0 |
| May 21-31 | 5,900 | 128,727 | November | 600 | 35,702 |
| June 1-10 | 10,200 | 202,314 | December | 300 | 18,446 |
| June 11-20 | 11,600 | 230,083 | | | |
| June 21-30 | 9,100 | 180,495 | | | |
| | | | | Total: | 1,262,081 |

Flow to equal or exceed 23,578 cfs for one continuous 24-hour period between May 11 and August 10 (= 46,766 Ac. Ft.).

Total Ac. Ft. = 1,308,847 (includes 23,587 cfs for one day).

1/Section 89-801, R.C.M. 1947, Chapter 345; Laws of 1969; Constitution of the state of Montana; Montana Water Use Act.

1. Name: Yellowstone River

2. Stream reach: Stillwater River to the north-south Carbon-Stillwater county lines

3. Location: T2S, R20E, Sec. 29 to T3S, R21E, Sec. 10

4. Fish species present:

   Resident: LL, Rb, Wf, LNSu, WSu, JSu, stonecat, shorthead redhorse, burbot, longnose dace, mottled sculpin

   Migratory transient: None known

5. Riparian wildlife species present:

   Resident: Similar to upriver reaches as stated by Constan (1975): Beaver, muskrat, marten, river otter, raccoon, white-tailed deer, pheasants

   Migratory transient: Similar to upriver reaches as stated by Hook (1975): Waterfowl - pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red-breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-winged teal, green-winged teal, cinnamon teal, coot, ring-necked duck and Canada goose. Nongame - bald eagle, great blue heron.

6. Life history periodicity chart - See Armstrong Spring Creek

7. Methods used for flow determination:

   Methods are the same as Yellowstone River from Boulder River to Stillwater River, except Stillwater River inflow at 50 and 70 percent exceedance levels is added and existing rights (see below) are higher.

| Existing Rights of Dept. of Fish and Game1/ | | |
|---|---|---|
| From mouth of Stillwater River to North-South Carbon-Stillwater County lines. | April 16-Oct. 31 | 2600 cfs |
| | Nov. 1 -April 15 | 1500 cfs |

   The estimated dominant discharge is requested for a 1-day period and includes the known dominant discharge at USGS gage "Stillwater River near Absarokee" (5908 cfs), as furnished by Koch (1976 pers. comm.).

8. Why flow is necessary:

   These flows are necessary to help maintain and preserve fish and wildlife populations at current levels, to allow continued high-quality recreational use of the stream, and to maintain a flow regime which adequately performs channel maintenance processes.

1/ Section 89-801 R.C.M. 1947, Chapt. 345, Laws of 1969; Constitution of the state of Montana, Montana Water Use Act.

9. Flow request:

| Period | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 100 | 6,149 | July 1-10 | 9,000 | 178,512 |
| February | 100 | 5,554 | 11-20 | 5,900 | 117,025 |
| March | 300 | 18,446 | 21-31 | 3,600 | 78,545 |
| April 1-15 | 500 | 14,876 | Aug. 1-10 | 2,100 | 41,653 |
| 16-30 | 0 | 0 | 11-31 | 1,400 | 58,314 |
| May 1-10 | 600 | 11,901 | Sept. | 500 | 29,752 |
| 11-20 | 3100 | 61,488 | Oct. | 100 | 6,149 |
| 21-31 | 7000 | 152,727 | Nov. | 800 | 47,603 |
| June 1-10 | 12,100 | 240,000 | Dec. | 400 | 24,595 |
| 11-20 | 14,000 | 277,686 | Total | | 1,550,082 |
| 21-30 | 11,300 | 224,132 | | | |

Flow to equal or exceed 29,486 cfs for one continuous 24-hour period between May 11 and August 10 (=58,485 Ac. Ft.).

Total Ac. Ft. = 1,608,567

1. Name: Yellowstone River

2. Stream reach: North-south Carbon-Stillwater county lines to Clarks Fork of Yellowstone River.

3. Location: T3S, R21E, Sec. 10 to T2S, R24E, Sec. 13

4. Fish species present:

   Resident: LL, Rb, Wf, LNSu, WSu, River carpsucker, shorthead redhorse, flathead chub, black bullhead, channel catfish, sauger, burbot, stonecat, goldeye (Marcuson 1973).

   Migratory transient: None known

5. Riparian wildlife species present:

   Resident: Similar to upriver reaches as stated by Constan (1975): beaver, muskrat, marten, river otter, raccoon, white-tailed deer, pheasants

   Migratory transient: Similar to upriver reaches as stated by Hook (1975): waterfowl - pintail, shoveler, canvasback, redhead, mallard, gadwall, baldpate, lesser scaup, whistling swan, common merganser, red-breasted merganser, common goldeneye, Barrows goldeneye, bufflehead, ruddy duck, blue-winged teal, green-winged teal, cinnamon teal, coot, ringneck duck and Canada goose. Nongame - bald eagle, great blue heron.

6. Life history periodicity chart: See Armstrong Spring Creek

7. Methods used for flow determination:

   Methods are same as previous two Yellowstone River reaches, except that the Department of Fish and Game has no existing rights in this reach. Consequently requested flows are greater than in the previous two reaches, and are equal to the 50 and 70 percent exceedance flow levels. Dominant discharge is same as previous reach.

8. Why flow is necessary:

   These flows are necessary to help maintain and preserve fish and wildlife populations at current levels, to allow continued high-quality recreational use of the stream and to maintain a flow regime which adequately performs channel maintenance processes.

9. Flow request:

| Period | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 1600 | 98,380 | | | |
| February | 1600 | 88,859 | July 1-10 | 11,600 | 230,083 |
| March | 1800 | 110,678 | 11-20 | 8,500 | 168,595 |
| April 1-15 | 2000 | 59,504 | 21-31 | 6,200 | 135,273 |
| 16-30 | 2600 | 77,355 | Aug. 1-10 | 4,700 | 93,223 |
| May 1-10 | 3200 | 63,471 | 11-31 | 4,000 | 166,611 |
| 11-20 | 5700 | 113,058 | Sept. | 3,000 | 178,512 |
| 21-31 | 10,000 | 218,182 | Oct. | 2,700 | 166,016 |
| June 1-10 | 14,700 | 291,570 | Nov. | 2,300 | 136,859 |
| 11-20 | 16,600 | 329,256 | Dec. | 1,900 | 116,826 |
| 21-30 | 13,900 | 275,702 | | | |
| | | | Total AF | | 3,118,013 |

Flow to equal or exceed 29,486 cfs for one continuous 24-hour period between May 11-August 10 (= 58,485 Ac. Ft.)

Total Ac. Ft. = 3,176,498

1. Name: Yellowstone River

2. Stream reach: Clarks Fork to Bighorn River

3. Location: T2S, R24E, Sec. 13 to T5N, R34E, Sec. 28

4. Fish species present:

   Resident: LL, Rb, Wf, Channel catfish, stonecat, sauger, walleye, ling, white crappie, LnSu, WSu, river carpsucker, shorthead redhorse, smallmouth buffalo, GE, flathead chub, carp (Marcuson 1973)

   Migratory transient - None known

5. Riparian wildlife species present:

   Resident: Beaver, muskrat, marten, mink, raccoon, pheasants, white-tailed deer, ducks, raptors

   Migratory transient: Bald eagles, Canada geese, ducks, great blue herons, whistling swan, sandhill crane

6. Life history periodicity chart: Attached

7. Methods used for flow determination:

   Flow requests were derived the same as previous reaches of the Yellowstone, except that flows were obtained from the USGS gage "Yellowstone River near Billings" which is located downstream from the Clarks Fork of the Yellowstone. Flows equaled or exceeded 50 percent and 70 percent of the time between 1932 and 1971 were used. The dominant discharge at Billings (34,500 cfs) as furnished by Koch (1976 pers. comm.) was requested for this reach.

8. Why flow is necessary:

   These flows are necessary to help maintain and preserve fish and wildlife populations at current levels, to allow continued high-quality recreational use of the stream, and to maintain a flow regime which adequately enables channel maintenance processes to occur.

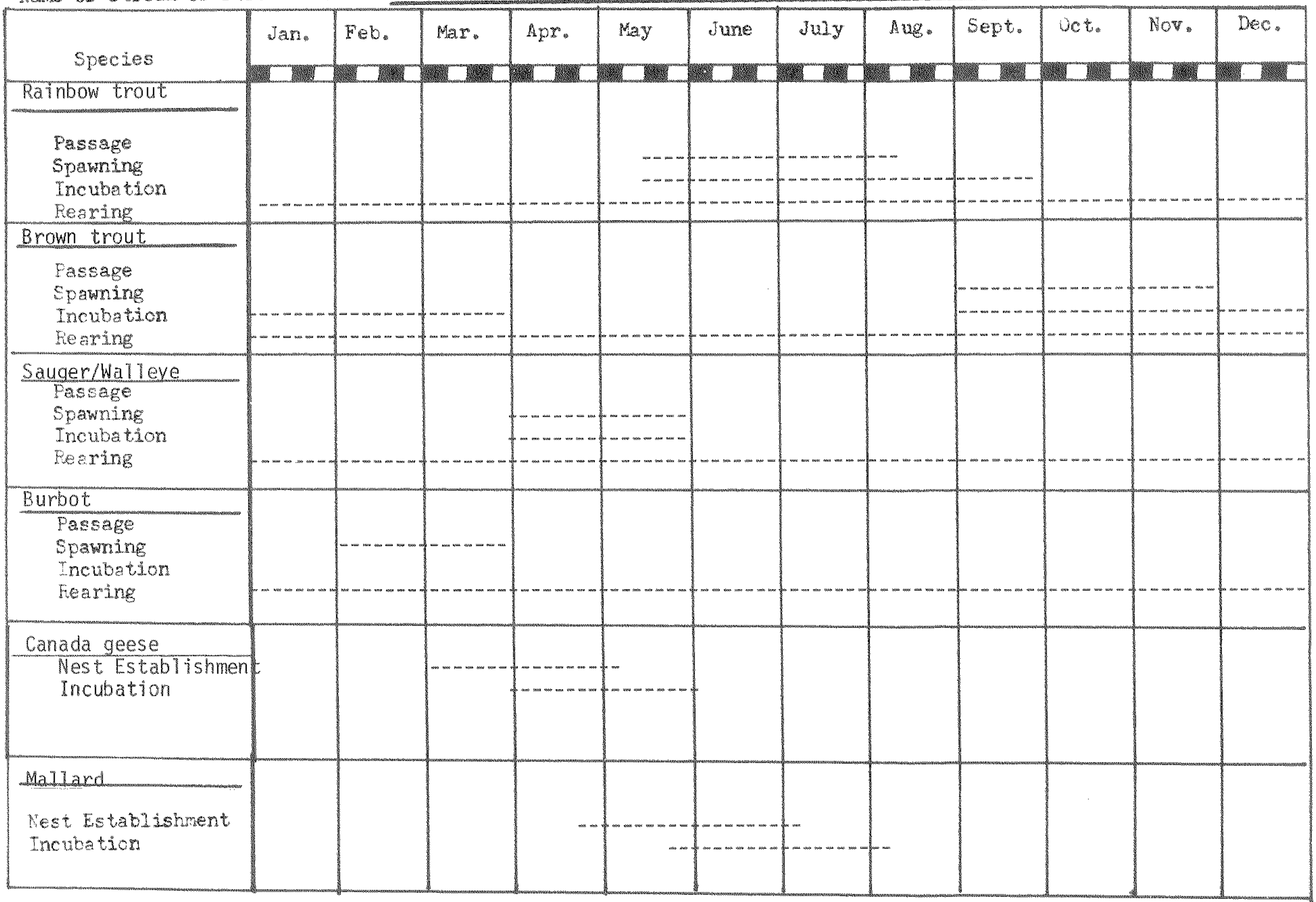
9. Flow request:

| Period | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 2500 | 153,719 | July 1-20 | 11,100 | 440,330 |
| February | 2500 | 138,843 | 21-31 | 6,300 | 137,454 |
| March | 2900 | 178,314 | Aug. | 4,800 | 295,140 |
| April | 3600 | 214,215 | Sept. | 3,700 | 220,165 |
| May 1-20 | 6100 | 241,983 | Oct. | 3,600 | 221,355 |
| 21-31 | 12,500 | 272,727 | Nov. | 3,500 | 208,264 |
| June 1-7 | 17,900 | 248,529 | Dec. | 2,800 | 172,165 |
| 8-30 | 19,700 | 898,710 | Total AF | | 4,041,913 |

Flow to equal or exceed 34,500 cfs for one continuous 24-hour period between May 1 and July 31 (=68,430 Ac. Ft.)
Total Ac. Ft. = 4,110,343

# LIFE CYCLE PERIODICITY CHART

Name of stream or stream section Yellowstone River - Clarks Fork to Bighorn River



Fronts only
this page

LOWER YELLOWSTONE BASIN

Big Horn River to North Dakota state line

1. Name: Bighorn River

2. Stream reach: Section A - Afterbay dam to the mouth of the Little Bighorn River

3. Location: T6S, R31E, S16 to T1S, R34E, S18

4. Fish species present: See Attachment $A_1$

5. Wildlife species present: See Attachment $A_1$

6. Life history periodicity chart: See Attachment $A_2$

7. Methods used for flow determination: See methods for "Bighorn River flows at mouth" under section on "Yellowstone River from Bighorn River to North Dakota state line."

8. Why flow is necessary:

Flows are necessary to maintain the existing growth of aquatic plants which are necessary as food for the aquatic invertebrate and insect populations and to maintain an important trout fishery as expressed by Stevenson (1975). Stevenson estimated the number of fisherman days per mile of stream to be 3,720 (Section B) and 630 (Section C) in 1973. Stevenson 's estimated total yield in trout for 1973 was 37,321, for an average catch of 2.00 fish per day. Swedberg (1975) from 16 days of creel census within the period of June through September expressed a catch rate (for game fish) of .4 fish per hour.

Flows in June and July need to be sufficient to transport the yearly accumulation of sediment and control excessive aquatic weed growth. High flows at this time of year also sweep the gravel bars free of some vegetation, which aids the Canada geese in their nesting activities the following spring.

9. Flow request:1/

| Period | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 3300 | 202,950 | July 1-20 | 3800 | 150,708 |
| February | 3200 | 179,263 | July 21-31 | 3200 | 63,456 |
| March | 4000 | 264,000 | Aug. | 2800 | 172,200 |
| April | 3600 | 214,200 | Sept. | 2600 | 154,700 |
| May 1-20 | 3800 | 150,708 | Oct. | 2700 | 166,050 |
| May 21-31 | 3800 | 75,354 | Nov. | 3100 | 184,450 |
| June 1-7 | 5200 | 72,181 | Dec. | 3200 | 196,800 |
| June 8-30 | 5200 | 237,167 | | | |
| | | | Total | AF | 2,484,187 |

1/ Flows reflect operation of Yellowtail Dam

ATTACHMENT $A_1$

A PARTIAL CHECKLIST OF FISHES FOR THE BIGHORN RIVER 1/

SECTION A

| Common Name | Resident | Migratory |
|---|---|---|
| Rainbow trout | x | |
| Brown trout | x | x |
| Cutthroat trout | x | |
| Mountain whitefish | x | |
| Northern pike | | x |
| Walleye | x | |
| Sauger | x | x |
| Burbot | | x |
| Channel catfish | | x |
| Goldeye | | x |
| Yellow perch | x | |
| Plains killifish | x | |

1/ Other species of fish having been collected from the Bighorn River are described in "Fishes of Montana" by Brown (1971).

WILDLIFE ON/OR ADJACENT TO THE BIGHORN RIVER

| Resident | Migratory Transient |
|---|---|
| Beaver | Otter |
| Muskrat | Black bear |
| Mink | Mountain lion |
| Raccoon | Bald eagle |
| Fox squirrel | Golden eagle |
| White-tailed deer | Canada goose |
| Mule deer | Mallard |
| Coyote | Gadwall |
| Skunk | Widgeon |
| Bobcat | Goldeneye |
| Red fox | Green wing teal |
| | Blue wing teal |
| | Wood duck |
| | Osprey |

LIFE CYCLE PERIODICITY CHART



Name of stream or stream section Bighorn River (Section A)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainbow trout | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | ---- | -------- | | | | | | -------- | ---- | |
| Incubation | | | xxx | xxxxxxxx | xxxxxxxx | xxxxx | | | | xxxxxxxx | xxxxxxxx | xxxx |
| Rearing | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo |
| Brown trout | | | | | | | | | | | | |
| Passage | | | ***** | ******** | | | | | | | | |
| Spawning | | | | | | | | | | ---- | -------- | -------- |
| Incubation | xxxxxxxx | xxxxxxxx | xxxxxxxx | | | | | | | xxxx | xxxxxxxx | xxxxxxxx |
| Rearing | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo |
| Sauger | | | | | | | | | | | | |
| Passage | ******** | | | | | | | | ******** | ******** | ******** | ******** |
| Spawning | | | | ---- | -------- | | | | | | | |
| Incubation | | | | xxx | xxxxxxxx | xxxxx | | | | | | |
| Rearing | | | | | | | | | | | | |
| Northern pike | | | | | | | | | | | | |
| Passage | | | | ******** | ******** | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Burbot | | | | | | | | | | | | |
| Passage | ******** | ******** | ******** | | | | | | | ******** | ******** | ******** |
| Spawning | | -------- | ---- | | | | | | | | | |
| Incubation | | xxxxxxxx | xxxxxxxx | xxxxxxxx | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Canada goose | | | | | | | | | | | | |
| Nest Establishment | | | nnnnnn | nnnnnnnn | | | | | | | | |
| Incubation | | | iii | iiiiiiiii | iiiii | | | | | | | |

1. Name: Bighorn River

2. Stream reach: Section B - From the mouth of the Little Bighorn River to the mouth of the Bighorn River

3. Location: T1S, R34E, S18 to T5N, R34E, S28

4. Fish species present: See Attachment $B_1$

5. Wildlife species present: See Attachment $B_1$

6. Life history periodicity chart: See Attachment $B_2$

7. Methods used for flow determination: See methods for "Bighorn River flows at mouth" under section on Yellowstone River from Bighorn River to North Dakota state line.

8. Why flows are necessary:

Flows are necessary to maintain existing populations of channel catfish, sauger, and burbot and for potential paddlefish spawning. Flows are also needed to pass migratory species over the Manning and Kemph diversion dams during spring and fall months. March, April and early May flows are necessary for protection of goose nests from flooding and predation.

9. Flow request:1/

| Period | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 3300 | 202,950 | July 1-20 | 3800 | 150,708 |
| February | 3200 | 179,263 | July 21-31 | 3200 | 63,456 |
| March | 4000 | 264,000 | August | 2800 | 172,200 |
| April | 3600 | 214,200 | September | 2600 | 154,700 |
| May 1-20 | 3800 | 150,708 | October | 2700 | 166,050 |
| May 21-31 | 3800 | 75,354 | November | 3100 | 184,450 |
| June 1-7 | 5200 | 72,181 | December | 3200 | 196,800 |
| June 8-30 | 5200 | 237,167 | | | |
| | | | | Total AF | 2,484,187 |

1/ Flows reflect operation of Yellowtail Dam.

ATTACHMENT $B_1$

A PARTIAL CHECKLIST OF FISHES FOR THE BIGHORN RIVER 1/

SECTION B

| Common Name | Resident | Migratory |
|---|---|---|
| Brown trout | | x |
| Northern pike | | x |
| Sauger | | x |
| Burbot | | x |
| Channel catfish | x | x |
| Goldeye | | x |
| Black crappie | x | |
| Largemouth bass | x | |
| Sunfish sp. | x | |
| Plains killifish | x | |
| Emerald shiner | x | |

1/ Other species of fish having been collected from the Bighorn River are described in "Fishes of Montana" by Brown (1971).

WILDLIFE ON/OR ADJACENT TO THE BIGHORN RIVER

| Resident | Migratory Transient |
|---|---|
| Beaver | Bald eagle |
| Muskrat | Osprey |
| Mink | Cormorant |
| Raccoon | Canada goose |
| Fox squirrel | Mallard |
| White-tailed deer | Gadwall |
| Mule deer | Widgeon |
| Coyote | Green wing teal |
| Skunk | Blue wing teal |
| Bobcat | Goldeneye |
| Red fox | Pintail |

# LIFE CYCLE PERIODICITY CHART

ATTACHMENT $B_2$

Name of stream or stream section Bighorn River (Section B)

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel catfish | | | | | | | | | | | | |
| Passage | | | | | | | | ******* | ******* | ******* | | |
| Spawning | | | | | | | | ------- | - | | | |
| Incubation | | | | | | | | xxxxxxx | xxxx | | | |
| Rearing | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo | ooooooo |
| Burbot | | | | | | | | | | | | |
| Passage | ******* | ******* | ******* | ******* | | | | | | ******* | ******* | ******* |
| Spawning | | ------- | -- | | | | | | | | | |
| Incubation | | xxxxxxx | xxxxxxx | xxxxxxx | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Sauger | | | | | | | | | | | | |
| Passage | | | | | | | | ******* | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Canada goose | | | | | | | | | | | | |
| Nest Establishment | | | nnnnnnn | nnnnnnn | | | | | | | | |
| Incubation | | | iiii | iiiiiiii | iiiii | | | | | | | |

## LOWER YELLOWSTONE RIVER TRIBUTARIES

### Background

As all streams are developed from surface runoff, the Yellowstone is a product of its tributaries. Each tributary brings with it its own identity. Through an adoption of these characters, the Yellowstone River then forms its own identity. So to protect the integrity of the Yellowstone means to protect the integrity of its tributaries. From the Bighorn River to its confluence with the Missouri, three tributaries, Rosebud Creek, Tongue River and Powder River, are the major contributors to the lower Yellowstone identity. To protect these streams and their tributaries is to protect the honor of the lower Yellowstone.

Biological phases have been recognized in the life history of fishes: migration, spawning, incubation and rearing (Stalnaker and Arnette 1976). It is generally agreed that depth and velocity are the most important as potential limiting factors during these life history stages. Depth is significant in maintaining suitable passage requirements and in supplying the necessary wetted areas for spawning and food production. Velocity is important in maintaining desirable insect species composition, influencing stream carrying capacity and determining spawning site preferences.

In prairie stream ecosystems, Bovee (1975) suggested that if passage requirements were met, spawning requirements would also be met. Since incubation periods of warm water fishes are short, incubation is not considered a biological phase for flow criteria. Rearing, as a life stage, generally encompasses those times of the year when fish are not engaged in the other activities. Rearing flows are those which will maintain the habitat necessary for the sustenance of the fish species present.

A study was begun on the Tongue River in 1974 to determine species distribution, composition, diversity and relative abundance of resident and migrant fish populations. Special interest was to evaluate instream flow needs of the fishes of a prairie stream. The study was funded by the Old West Regional Commission.

The fall flow period encompasses the months of August (late summer) through November. These are critical flows for fish, coinciding with late irrigation withdrawals often accompanied by warm water temperatures. Temperature and water quality requirements must be met during this time. A reduction in flow during these months may elevate water temperatures above tolerable limits and result in degraded water quality.

December, January and February (winter) are also critical low flow periods. Dewatering results in accelerated freeze-up of riffles and depleted oxygen levels. It is during this time period that population levels are reduced to make room for recruitment. Fall and winter are considered rearing phases in the life cycle periodicity.

Spring (March through May) corresponds with the migration and spawning seasons of most warm water species. If adequate flows are maintained to insure passage, it is assumed that adequate water would be available for spawning and rearing.

The peak run-off period of May through July is also important for passage, spawning and rearing. Additionally spring peaks scour the channel, cleansing the interstices for food production and successful reproduction. High spring flows are necessary to maintain the integrity of a stream; i.e. channel form, sediment transport, and island identity.

Habitat requirements of all fish, wildlife and other aquatic organisms have, through the long evolutionary processes, come to be dependent upon the natural flow regimen of a river system. Fish production in rivers depends upon the maintenance of spawning and rearing areas, sufficient shelter, adequate food supply and water quality. The stream discharge, as influenced by channel configuration, must meet the hydrologic requirements necessary to provide these factors.

## Tongue River

### Reach

Montana - Wyoming state line to Tongue River Reservoir (figure 1).

### Fish Present

Important sport fish present in this reach of the Tongue River include: sauger, walleye, smallmouth bass, rock bass and channel catfish. Sport fishing is provided by sauger, smallmouth bass and channel catfish. The rock bass population is unique since the Tongue River supports the only population of this species in Montana (table 1 ).

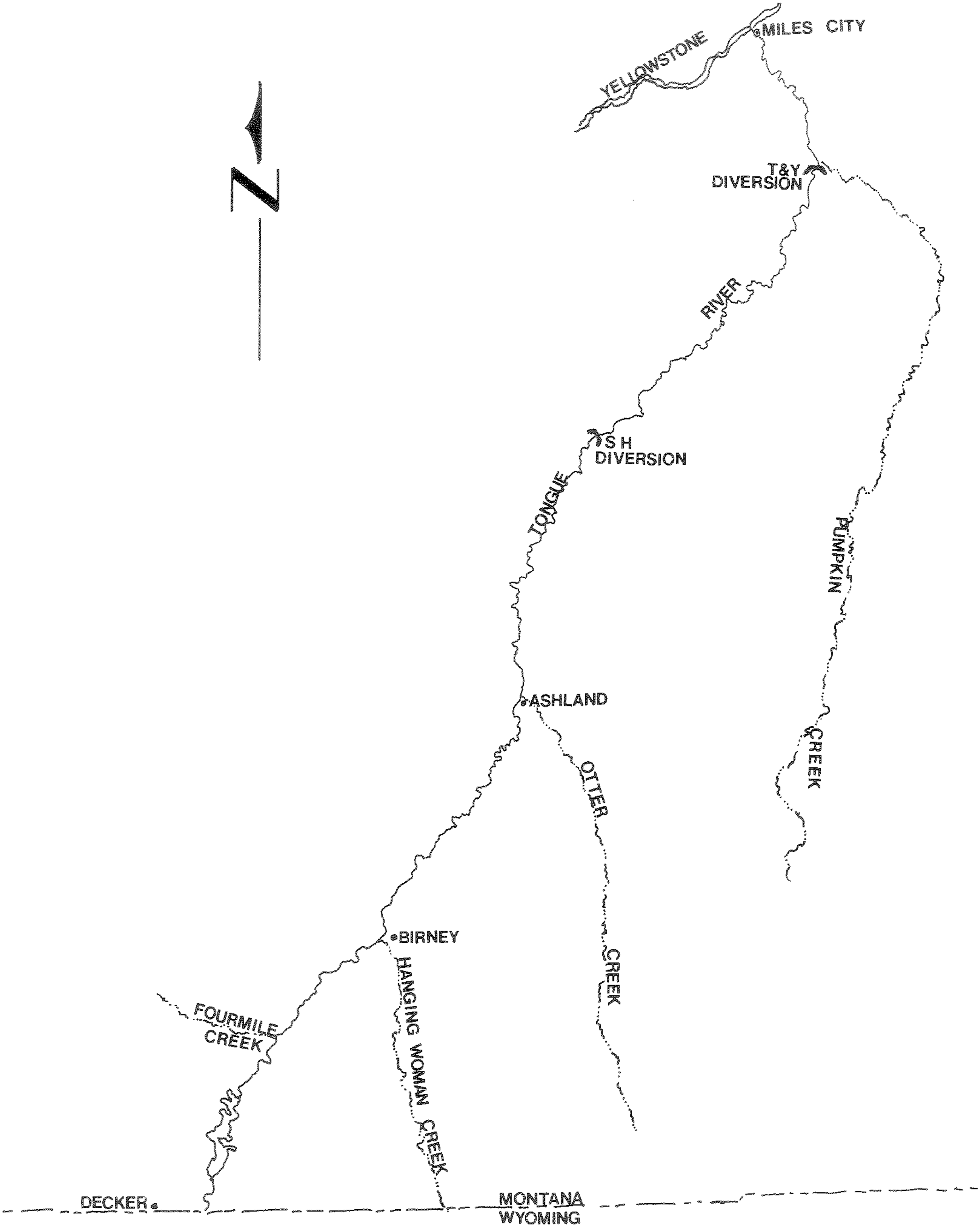



Figure 1. Map of Tongue River.

Table 1 . Distribution of fishes in the Tongue River by reach.

| Species | Reach 1/ 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Carp | * | * | * | * | * |
| Stonecat | * | * | * | * | * |
| Shorthead redhorse | * | * | * | * | * |
| White sucker | * | * | * | * | * |
| Longnose sucker | * | * | * | * | * |
| Longnose dace | * | * | * | * | * |
| White crappie | | * | * | * | * |
| Mountain sucker | * | * | * | * | |
| Rainbow trout | | * | * | | |
| Rock bass | * | * | * | * | |
| Black crappie | | * | * | | |
| Yellow perch | * | * | * | | |
| Northern pike | | * | * | | |
| Yellow bullhead | * | * | * | | |
| Whitefish | | * | | | |
| Brown trout | | * | | | |
| Green sunfish | * | | * | * | |
| Smallmouth bass | * | * | * | * | * |
| Pumpkinseed | | * | * | | * |
| Black bullhead | * | | * | | |
| Flathead chub | | | * | * | * |
| Sauger | * | | * | * | * |
| River carpsucker | | * | * | * | * |
| Channel catfish | | | * | * | * |
| Goldeye | | | | | * |
| Burbot | | | | | * |
| Walleye | | | | | * |
| Paddlefish | | | | | * |
| Shovelnose sturgeon | | | | | * |
| Blue sucker | | | | | * |
| Sturgeon chub | | | | | * |
| Total No. Species | 14 | 19 | 22 | 15 | 20 |

1/ Reach are numbered as follows: 1) State line to Tongue River Reservoir; 2) Tongue River Dam to Four-Mile Creek; 3) Four-Mile Creek to S-H Diversion; 4) S-H Diversion to T&Y Diversion; and 5) T&Y Diversion to Yellowstone River.

Sampling in this area suggests that sauger and walleye migrate out of the Tongue River Reservoir during the spring to spawn. It is also possible that some channel catfish movements may exist, but these have not been documented.

The life history periodicity chart for this reach of stream is presented in table 2.

Methods

Flows derived by the U. S. Fish and Wildlife Service for the Northern Great Plains Resource Program (NGPRP) were used as the basis for flow recommendations in this section. However, flows during the runoff period were judged to be too low. May and June flows are those flows equaled or exceeded 70 percent of the time. Gage records for the Tongue River at state line near Decker for the period 1966-1974 were used to determine the exceedence levels. Recommended flows into the Tongue River Reservoir were compared with out flow recommendations. Outflow approximated inflow with the exception of late summer and fall, or the irrigation season. Since management of the Tongue River Reservoir is directed toward irrigation, outflows would naturally be greater than inflow during this season. Instream flow estimates are shown in table 3 .

Justification

These flow levels are necessary to provide rearing habitat for resident sport fish and unique fish populations. Spring migration of sauger and walleye out of the Tongue River Reservoir are important to the fishery of the reservoir and flow recommendations should reflect their passage and spawning needs.

Reach

Tongue River Dam - Four Mile Creek

Fish Present

A remnant, reproducing population of brown trout exists in this reach of the Tongue River. It is the only "wild" trout fishery in the area and definitely should be protected. Other sport fish present in the reach include northern pike, walleye and black and white crappie. Northern pike and walleye are "spill-overs" from the reservoir populations while the crappie are reproducing populations. Other non-sport fish populations are also found in this reach (table 1 ).

Table 2. Life history periodicity chart for Tongue River - State Line - Tongue River Reservoir.

| Species | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sauger | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Walleye | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Smallmouth Bass | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Rock Bass | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | |

Table 3. Instream flow estimates (cfs and thousand acre-feet) Tongue River, Montana.

| Reach | Jan | Feb | Mar | April | May 1-20 | May 21-31 | June | July 1-15 | July 16-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Montana-Wyoming State Line to Tongue River Reservoir | 160 | 160 | 200 | 200 | 700 | 1200 | 1350 | 360 | 360 | 100 | 100 | 200 | 200 | 150 |
| (thousands of acre-feet) | 9.83 | 8.89 | 12.29 | 11.90 | 27.76 | 24.98 | 76.67 | 10.71 | 11.42 | 5.87 | 5.68 | 11.74 | 11.36 | 8.80 |
| Tongue River Dam to Four-Mile Creek | 150 | 150 | 150 | 150 | 700 | 700 | 700 | 700 | 150 | 150 | 150 | 190 | 190 | 150 |
| (thousands of acre-feet) | 9.22 | 8.33 | 9.22 | 8.92 | 27.76 | 15.47 | 41.64 | 20.82 | 4.76 | 9.22 | 8.92 | 11.68 | 11.30 | 9.22 |
| Four-Mile Creek to S-H Diversion | 150 | 150 | 150 | 390 | 390 | 700 | 700 | 700 | 150 | 150 | 150 | 150 | 150 | 150 |
| (thousands of acre-feet) | 9.22 | 8.33 | 9.22 | 23.20 | 15.47 | 15.27 | 41.64 | 20.82 | 4.76 | 9.22 | 8.92 | 9.22 | 8.92 | 9.22 |
| S-H Diversion to T&Y Diversion | 190 | 190 | 190 | 400 | 400 | 700 | 700 | 700 | 190 | 190 | 190 | 190 | 190 | 190 |
| (thousands of acre-feet) | 11.68 | 10.55 | 11.68 | 23.80 | 15.85 | 15.27 | 41.64 | 20.82 | 6.03 | 11.68 | 11.30 | 11.68 | 11.30 | 11.68 |
| T&Y Diversion to Yellowstone River | 190 | 190 | 525 | 525 | 600 | 600 | 600 | 600 | 225 | 225 | 190 | 190 | 190 | 190 |
| (thousands of acre-feet) | 11.68 | 10.55 | 32.27 | 31.23 | 23.80 | 13.09 | 35.69 | 17.85 | 7.14 | 13.83 | 11.30 | 11.68 | 11.30 | 11.68 |

## Methods

Life history aspects of important species are shown in table 4 for this reach. WSP profiles were taken on a reach of the Tongue River approximately one mile downstream from the Tongue River dam and provide the basis for flow determinations. Preferred spawning depths for brown trout range from 0.5 to 0.8 feet (Stalnaker and Arnette 1976). Utilizing those cross-sections which represent brown trout spawning habitat (riffles), predicted flow values ranged from 125 - 375 cfs. Utilizing 75 percent of optimum (250 cfs) as the sustaining discharge for prairie streams, as defined by Bovee (1974), recommended spawning flows for brown trout for October and November are 190 cfs. Predicted mean velocities for the recommended flows ranged between 1.30 and 1.70 feet per second, well within recommended velocities. Thompson (1972) recommended incubation criteria equivalent to about two-thirds of the flow required for spawning. Incubation flow recommendations for the months of November - February are 125 cfs (table 3).

Black and white crappie are spring spawners, building nests in protected areas when water temperatures rise to 56 F (Pflieger 1975a). Temperatures reached 56 by mid-May. Preferred spawning depths for black and white crappie were reported as 2.0 - 8.2 feet and 0.7 - 19.6 feet, respectively (Bovee 1974). Since spawning velocities are listed as "still", WSP predicted flow values for pool areas were used to determine necessary spawning flows for crappie. A mean discharge of 925 cfs would provide a depth of 4 feet over substrate and provide adequate spawning habitat for both species of crappie. Thus the recommended flow level for May and June is 700 cfs. The incubation period is reported as about 3 days (Pflieger 1975a). Therefore if spawning flows are maintained, flows should be adequate for incubation.

Rearing flows for all species were determined by the wetted perimeter method as described by White and Cochnauer 1975. Wetted perimeter was determined for several transects based on WSP predicted flow values. Starting at zero discharge, wetted perimeter increases rapidly for small increases in discharge up to the point where the river nears its maximum width. Beyond this inflection point, wetted perimeter increases slowly, while discharge increases rapidly. The optimum quantitiy of water for rearing is selected near this

Table 4. Life history periodicity chart for Tongue River: Tongue River Dam - Four-Mile Creek.

| Species | cfs | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Brown Trout** | cfs | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 190 | | | | | | | | | | | | |
| Incubation | 125 | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| **Northern Pike** | cfs | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| **Walleye** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| **Black and White Crappie** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 700 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| **Stonecat** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 90 | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

inflection point (figure 2 ). Optimum rearing flows for this reach of the Tongue River was 200 cfs, so the recommended flow value (75% of optimum) was 150 cfs.

Bovee (1975) suggests using the stonecat as a rearing flow indicator species. The stonecat was selected for its preference of fast, shallow water areas. Stonecat samples collected by Bovee in the Tongue River showed a marked depth preference ranging between 1.0 and 2.0 feet. Using the WSP predicted flows for riffle areas, a rearing flow of 90 cfs was obtained for stonecats.

Justification

The Tongue River immediately downstream from the Tongue River Dam represents the only stream trout fishery in the area. While catchable rainbow trout are stocked annually by the Department of Fish and Game, brown trout are reproducing in the stream. Fish population sampling revealed that while the brown trout population is not large, it is a fishable population. Each year, a few "trophy" sized browns are taken. Therefore, it is important to recognize and protect this remnant trout population.

The Tongue River Reservoir creel census conducted in 1975 and 1976 also interviewed anglers fishing the river downstream from the dam. In 1975, 70.2 percent of the recorded catch below the dam was crappie. Walleye made up 15.3 percent of the catch and northern pike added about 2.0 percent. This reach of the Tongue River is important from a sport fishing standpoint and the populations of sport fish present should be protected.

Reach

Four-Mile Creek - S-H Diversion

Fish Present

Smallmouth bass are the most important sport fish found in this reach of the stream. Smallmouth were planted in the Tongue River during the late 1960's and early 1970's and are reproducing in the river system. This is the only stream supported smallmouth bass population in Montana and is becoming increasingly popular with anglers. Rock bass are also found in large numbers throughout this reach. Other important sport fish are northern pike, sauger and walleye. All are considered resident, self-sustaining fish populations. A list of species found in this reach is shown in table 1 .

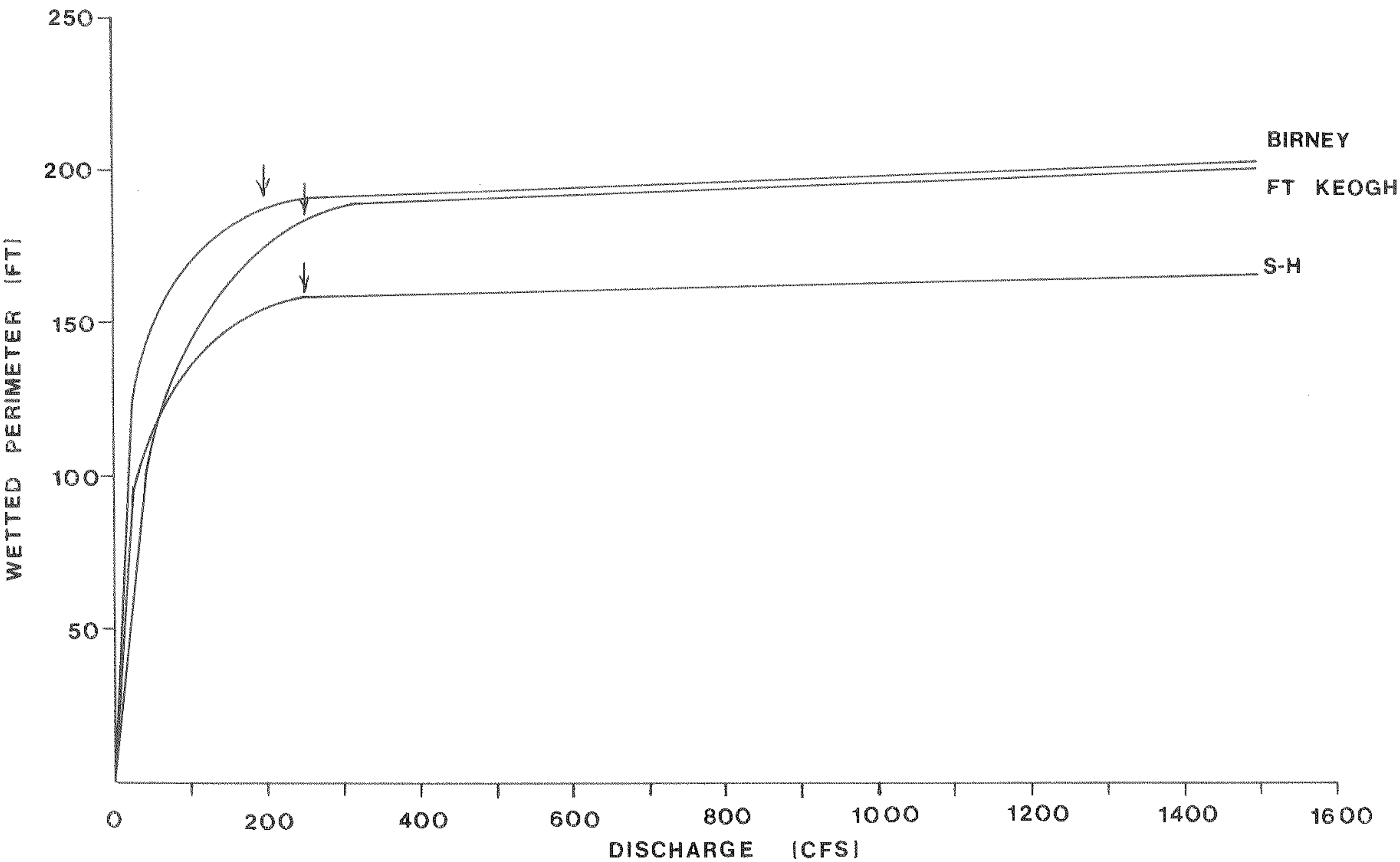



Figure 2 Wetted perimeter in relation to discharge for three sections of the TOngue River, showing the inflection point used to determine rearing flows.

## Methods

Smallmouth bass spawn in the spring as water temperatures near 60 F (Pflieger 1975b). Temperatures recorded near Ashland warmed to 60 F by mid-May and spawning of smallmouth extends through mid-July (table 5 ). Smallmouth spawning depth preferences have been reported to range from 1 to 3 feet (Coble 1975), 2.9 to 5.9 feet (Bovee 1975) and 2 to 20 feet (Scott and Crossman 1973). Smallmouth bass were selected as a key species for stream resource maintenance flows in the Snake River (White and Cochauer 1975). However, they felt that a stable flow during the spawning and incubation period of smallmouth bass was more important for spawning success than a specific flow recommendation. Thus, the flow recommended to meet spawning needs of smallmouth bass is 700 cfs (same as reach immediately upstream). Rock bass are likewise spring spawners and illustrate needs similar to smallmouth bass, therefore 700 cfs is recommended as spawning flow for rock bass. Instream flow needs are shown in table 3 .

Sauger spawn earlier in the spring than smallmouth, commencing when the water temperatures approach 50 F. Tongue River water reached this temperature around the first of April and sauger spawning extended through May. Depth criteria for spawning sauger is reported as between 3.94 and 4.92 feet, while velocity ranged from 0 - 1.64 feet per sec. (Bovee 1974). Utilizing the WSP predicted flow values for sauger spawning habitat, an optimum flow of 520 cfs was obtained for a recommended flow of 390 cfs.

Rearing flows for all species were determined by the wetted perimeter method. Wetted perimeter was obtained for several transects in the Birney area based on WSP predicted flow values. Optimum rearing flows were found to be 200 cfs and 75 percent of optimum (150 cfs) was recommended as rearing flows for this reach. Preferred stonecat habitat as identified by Bovee (1974), based on WSP predicted flow values resulted in a rearing flow recommendations of 125 cfs.

## Justification

Fish population sampling on the Tongue River near Birney and Ashland indicates an excellent population of smallmouth bass. Smallmouth bass made up over 11 percent of the total sample in 1974 (Elser 1976a). Anglers take many smallmouth, with fish ranging to 3 pounds reported. Reproductive success in the Birney area apparently depends on flow conditions. The total number of age 0 smallmouth bass collected at Birney ranged from 28 in the fall of 1974 to 4 in the fall of 1975.

Table 5. Life history periodicity chart for the Tongue River - Four-Miles Creek-S-H Diversion

| Species | cfs | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Smallmouth bass | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 700 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| Sauger | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 390 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| Northern Pike | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| Rock Bass | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 700 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| Stonecat | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 125 | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

Continued high discharges during the spring and summer of 1975 apparently resulted in a lower reproductive success. Reynolds (1965) suggested that water levels might be more important than temperature in initiating spawning of smallmouth in tributaries of the Des Moines River, Iowa. In Courtois Creek, Missouri, smallmouth nesting always began during a period of stable or gradually declining water levels and was delayed or interrupted some years by floods (Pflieger 1975b). This further supports the argument for stablized flows for smallmouth bass spawning.

Sauger and northern pike are popular with fishermen in the Birney-Ashland area and provide excellent fishing in the spring. The Tongue River supports the only rock bass population in Montana, which should be protected.

Reach

S-H Diversion - T&Y Diversion

Fish Present

Sauger, smallmouth bass and channel catfish are the important sport fish found in this reach. Rock bass are also found in this area and while they do not provide a fishery, are important because they are unique to the Tongue River. A total of 15 species of fish have been collected in this area (table 1 ).

Methods

The life history periodicity for this reach is shown in table 6 . Sauger spawn during April and May, and Bovee (1974) reported their preferred spawning depth as 3.94 and 4.92 feet, while Scott and Crossman (1973) presented preferred depths of 2.0 to 20.0 feet. Utilizing predicted flow values from WSP cross-sections over sauger spawning habitat, an optimum flow of 533 cfs was obtained, thus a spawning flow of 400 cfs was recommended for this reach (table 3 ). This discharge results in adequate depths for sauger spawning over 2/3 of the available stream bed.

Smallmouth bass spawning flows equal those recommended for the upstream sections to provide for a stable flow condition as recommended by White and Cochnauer (1975).

Channel catfish spawn at temperatures between 75-85 F. Water temperatures in this reach of the Tongue River generally warm to this level by the first of July, with spawning and incubation extending through August. Therefore requirements for this species are established for that time period. Spawning

Table 6. Life history periodicity chart for the S-H Diversion - T&Y Diversion.

| Species | cfs | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sauger** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 400 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Smallmouth Bass** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 700 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Channel catfish** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 155 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Rock bass** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 700 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Stonecat** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 150 | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

depth preferences are not available for channel catfish, but Bovee (1974) suggested depth preferences ranging from 1.0 to 5.0 feet. Other workers agree that spawning takes place in holes, undercut banks, and log jams and that semi-darkness and seclusion are major factors in nest selection. Using WSP predicted flow values for pool areas, an optimum flow value 206 cfs was determined, resulting in a recommended sustaining flow of 155 cfs.

Rearing flows for all species were determined by the wetted perimeter method. Wetted perimeter was obtained for several transects in this reach of the Tongue River based on WSP predicted flows. Optimum rearing flows were found to be 256 cfs and a discharge of 190 cfs (75% of optimum) was recommended as the rearing flow. Using stonecat habitat to determine rearing flows as suggested by Bovee (1974), resulted in a recommended flow of 150 cfs.

Justification

Sport fishing in this reach, particularly immediately downstream from the S-H Diversion is becoming increasingly popular. Sauger, channel catfish and smallmouth bass are favorite targets of anglers from Miles City, Ashland, Forsyth, and the surrounding area. Fish population sampling shows fair concentrations of smallmouth bass and sauger and an excellent catfish population. Baited traps fished for channel catfish resulted in a catch of almost 5 cats per trap (99 fish in 20 trap sets). Catfish averaged 17.8 inches and 2.35 pounds (Elser and McFarland 1976). Recommended flow levels are important in considering the sport fish potential of this reach of the Tongue River.

Reach

T&Y Diversion to Yellowstone River

Fish Present

Resident sport fish populations include sauger, channel catfish (table 1). Migrant sport fish moving out of the Yellowstone include: paddlefish, shovelnose sturgeon, sauger, walleye and burbot. Blue suckers, while not considered a sport fish are found migrating into the Tongue River during the spring spawning season.

Methods

Indicator species selected by Bovee (1974) for passage and spawning flows were paddlefish (large rivers) and sauger (smaller streams). However, for the Tongue River shovelnose sturgeon were substituted for paddlefish because of greater abundance and channel catfish were added since they migrate and spawn later in the season (table 7 ).

Sauger are found moving out of the Yellowstone into the Tongue during March. Presence of sauger was noted until the end of June, hence the periodicity for sauger spawning was March - June. According to Bovee (1974), the spawning depth criteria for sauger spawning is 3.94 - 4.92 feet. Since it is assumed if passage criteria is met then spawning criteria is also met, the reverse is also judged to be true. Therefore one flow is recommended to meet the needs for passage and spawning. Based on predicted flow conditions from the WSP program, flows ranging from 700-1725 cfs would provide adequate passage and spawning depths. The minimum sustaining discharge is defined as 75 percent of optimum (Bovee 1974). Recommended passage and spawning flows for sauger for the months of March-June is 525 cfs (table 3 ).

The spawning migration of shovelnose sturgeon commences around the first of May. Depth requirements for shovelnose sturgeon are reported as 1.0 - 2.9 feet (Bovee 1974). Sampling of shovelnose in the lower Tongue River revealed that nearly 80 percent of the fish sampled were taken in depths ranging from 1.96 to 3.28 feet. Based on WSP program predicted flows, discharges of 800-2200 cfs are required to meet shovelnose sturgeon criteria. The recommended flow level for shovelnose sturgeon during May, June and half of July is 600 cfs.

Channel catfish spawn at temperatures ranging between 23.9 and 29.5 C (75-85 F). Water temperatures in the Tongue River generally reach these levels during June, July and August. Therefore requirements for this species are established for this time period. Spawning depths for catfish are not available, but Bovee (1974) presented depth preferences ranging from 1.0 to 5.0 feet. Using WSP predicted flows for pool areas, flow ranges of 300 to 750 cfs were established. Based on 75 percent of optimum, the recommended flow for channel catfish is 225 cfs.

Rearing flow recommendations are based on the wetted perimeter. Wetted perimeter was plotted for several cross sections and based on predicted flow values (WSP), the optimum flow value was 250 cfs, with a recommended flow of 190 cfs (75% of optimum). Stonecat rearing flows based on WSP predicted flows were 180 cfs.

## Justification

Migrations of spawning populations of shovelnose sturgeon, sauger and channel catfish into the Tongue River are important

Table 7. Life history periodicity chart for Tongue River - T&Y Diversion to Yellowstone River.

| Species | cfs | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sauger** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 525 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Shovelnose Sturgeon** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 600 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| **Channel catfish** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 225 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 190 | | | | | | | | | | | | |
| **Stonecat** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 180 | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

to the integrity of the Yellowstone River. Passage and spawning flows identified for these species are important not only to the Tongue River, but to the Yellowstone River as well.

## Discussion

Many techniques and methodologies are available for the recommendation of instream flow needs. While physical and chemical parameters form the basis for some methodologies, biological parameters, particularly the fishery, are utilized in most techniques. Relating the environmental needs of the organism to the physical characteristics is the most critical and difficult problem in recommending instream values. Our determination of instream needs on the Tongue River relies on criteria developed for warm water species related to predicted flows from WSP data.

A major question concerning the use of the WSP method is one of accuracy. The reliability of any methodology is only as good as the confidence field biologists, engineers, water programmers and lay people have in it. Repairs to the Tongue River Dam in 1975 provided an opportunity to compare predicted values for depth and velocity with actually measured values (Elser 1976b).

A non-parametric, two-tailed significance test (Wilcoxon) was run between program predicted and measured water surface elevations. No significant difference was detected at the 80 percent level ($p > .20$). The greatest difference at any transect was 0.11 feet with an average deviation of 0.004 feet and an average absolute deviation of 0.04 feet. Therefore predicted deviations are considered to be very reliable. The use of the WSP as a methodology for determining instream flow needs for a prairie stream appears to be valid. Comparisons of measured water surface elevations with predicted values adds credibility to the method. While hydraulic characteristics predicted by the WSP are mean values, they are adequate for use with current knowledge of fish requirements.

# HANGING WOMAN CREEK

## Reach

East Fork Hanging Woman Creek to Tongue River.

## Fish Present

Fish sampling in the lower reaches of Hanging Woman Creek produced a total of 18 species of fish (Schoenthal 1975, Elser and McFarland 1975). The majority of the fish collected were cyprinids (minnows), however, the presence of small channel catfish suggests the stream may be important for this species. Fish species found in Hanging Woman Creek are shown in table 8 .

Migrant fish include northern pike moving into the stream from the Tongue River. Channel catfish may also move into the stream to spawn. Other non sport species also move into the stream to spawn .

## Methods

Northern pike spawn in the spring, as water temperatures reach 40 F, moving into marshes and other shallow water. Eggs are broadcast over submerged vegetation. Spawning migrations by northerns into tributaries of lakes and streams is well documented and the availability of suitable wetlands bordering these streams determines the degree of successful spawning (table 9 ).

A temporary trap was installed near the mouth of Hanging Woman Creek on April 17, 1975 to monitor fish use of the stream. The leads of the trap were constructed from 1-inch mesh chicken wire; a frame trap net served as the body of the trap. The trap was fished a total of 10 days and captured 134 fish. Mature northern pike of both sexes were captured in the trap indicating that this stream is important in maintaining the integrity of the Tongue River system.

Discharges during the time the trap was in ranged from 11 to 20 cfs, and were influenced by local weather. Spring runoff peaked during early March. Based on observed use of Hanging Woman Creek by northern pike, and the associated flow levels, an instream flow of 15 cfs is recommended for April and May 1-15 (table 10 ). While flow records for Hanging Woman Creek are sparse, the existing flow data suggests that historically this flow level is not unreasonable for this time period.

Since channel catfish spawn in dark secluded areas, the most important aspect of recommending a flow for them is passage. If water is available to allow them to move into the stream, enough water would be present in the deep pools of the creek. Therefore, historical flows for the period of interest of channel catfish were averaged. The mean flow for the period May 16 - July 15, for the period of record (1974 and 1975) was 5.85 cfs. Therefore, a flow of 4.5 cfs (75% of optimum) is recommended.

## Justification

Northern pike and channel catfish provide a good deal of the sport fishing potential for the Tongue River in the Birney

Table 8. Fish species found in Hanging Woman Creek, Otter Creek and Pumpkin Creek, Montana.

| Species | Hanging Woman Creek | Otter Creek | Pumpkin Creek |
|---|---|---|---|
| Flathead chub | * | * | * |
| White sucker | * | * | * |
| Green sunfish | * | * | |
| Carp | * | * | * |
| Lake chub | * | * | * |
| *Hybopsis* sp. | * | * | * |
| Longnose dace | * | * | * |
| Black bullhead | * | * | * |
| Yellow bullhead | * | * | |
| White crappie | * | * | * |
| Golden shiner | * | | |
| Fathead minnow | * | * | |
| River carpsucker | * | * | * |
| Shorthead redhorse | * | * | * |
| Longnose sucker | * | | |
| Channel catfish | * | | * |
| Smallmouth bass | * | * | |
| Sauger | * | | * |
| Pumpkinseed | | * | * |
| Yellow perch | | * | |
| Stonecat | | * | * |
| Goldeye | | | * |
| Mountain sucker | | | * |

Table 9 . Life history periodicity chart for Hanging Woman Creek.

| Species | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern pike | | | | | | | | | | | | | |
| Passage | 15 | | | | | | | | | | | | |
| Spawning | 15 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Channel Catfish | | | | | | | | | | | | | |
| Passage | 4.5 | | | | | | | | | | | | |
| Spawning | 4.5 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| ______ | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

Table 10. Instream flow estimates (cfs and acre-feet) for Hanging Woman Creek, Otter Creek and Pumpkin Creek Montana.

| Stream & Reach | Jan | Feb | Mar | April | May 1-15 | May 16-31 | June | July 1-15 | July 16-31 | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hanging Woman Creek E. Fk Hanging Woman Creek to Tongue River | | | | 15 | 15 | 4.5 | 4.5 | 4.5 | | | | | | |
| Acre-feet | | | | 892.4 | 446.2 | 142.8 | 267.7 | 133.9 | | | | | | |
| Otter Creek Bear Creek to Tongue River | | | | 15 | 15 | 5.0 | 5.0 | 5.0 | | | | | | |
| Acre-feet | | | | 892.4 | 446.2 | 158.6 | 297.5 | 148.7 | | | | | | |
| Pumpkin Creek Deer Creek to Tongue River | | | 20 | 20 | 35 | 35 | 35 | 5 | 5 | 5 | | | | |
| Acre-feet | | | 1229.5 | 1189.8 | 1041.1 | 1110.5 | 2082.2 | 148.7 | 158.6 | 307.3 | | | | |

area. Northerns weighing up to 10 pounds are caught at the mouth of Hanging Woman Creek each year. Since both species, as well as non-sport species, utilize Hanging Woman Creek as a spawning and nursery stream, it is important to maintain flows adequate to insure continued production in the stream. In order to maintain the integrity of the Tongue River itself, the integrity of tributaries must also be preserved.

## OTTER CREEK

### Reach

Bear Creek (T7S, R45E, S24) to Tongue River.

### Fish Present

Fish collections from this reach of Otter Creek produced a total of 18 species of fish (Schoenthal 1975; Elser and McFarland 1975). The majority of these fish are minnows and suckers (table 8 ). Northern pike and channel catfish are known to inhabit the Tongue River near the mouth of Otter Creek and we suspect that they migrate into Otter Creek in the spring to spawn.

### Methods

Since northern pike and channel catfish use of Otter Creek during the spring spawning season are the critical periods of fish use, a flow is recommended for April through July 15 (table 11). This will accommodate northern pike spawning (April 1 - May 15) and channel catfish (May 16 - July 15).

Flows during the period of northern pike spawning ranged from 3.3 to 9.0 cfs with a mean of 6.3 cfs in 1974 and from 18.0 to 55.0 with a mean of 26.0 in 1975. Based on observed flows during the northern spawning run and northern pike spawning needs, a passage and spawning flow of 15.0 cfs is recommended for April through May 15 (table10).

Channel catfish spawn from late May until mid-July. As in Hanging Woman Creek, if passage is insured, spawning an incubation should also be successful. Mean flow for these months for the period of record (1972-1975) 7.0 cfs. A sustaining flow of 5.0 cfs (75% of optimum) is therefore recommended for Otter Creek.

### Justification

Since sport fish migrate into Otter Creek to spawn, the importance of this stream as a spawning and nursery area should be recognized and protected. Northern pike and channel

Table 11. Life history periodicity chart for Otter Creek.

| Species | cfs | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Northern pike | | | | | | | | | | | | | |
| Passage | 15 | | | | | | | | | | | | |
| Spawning | 15 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Channel Catfish | | | | | | | | | | | | | |
| Passage | 5.0 | | | | | | | | | | | | |
| Spawning | 5.0 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

catfish provide a recreational fishery in the Tongue River in the vicinity of Ashland. In order to maintain the integrity of the mainstem Tongue River, the integrity of its tributaries must also be protected.

## PUMPKIN CREEK

### Reach

Deer Creek (T4N, R50E, S31) to Tongue River

### Fish Present

A total of 16 species of fish have been collected from this reach of stream (Schoenthal 1975; Elser and McFarland 1975). Cyprinids and suckers represented the bulk of the sample (table 8 ). The presence of young of the year channel catfish, sauger and crappie suggest that these species may migrate into Pumpkin Creek to spawn.

### Methods

The important consideration in this reach of stream is for spring and summer flows which are adequate for passage and spawning requirements for sauger, white crappie and channel catfish (table 12). Sauger migrate up the Tongue River during March - May. Their upstream progress is blocked by the T&Y Diversion structure which probably results in their movement into Pumpkin Creek. Flows during this period should be adequate to allow passage of the sauger. If passage flows are maintained, the water should be adequate for successful spawning.

Flows during March - May are generally quite low, but fluctuate drastically with local weather conditions. Flows varied between .65 - 397 cfs in 1973, .35 to 155 in 1974 and 4.8 to 1880 in 1975. Means for these years were 4.9, 14.6 and 100.1 cfs, respectively. Mean monthly flows for the months of March, April and May were 29.1, 26.5 and 63.9 cfs, respectively. Based on observed sauger use of the Tongue River and flow patterns in Pumpkin Creek, a passage-spawning flow for sauger of 20 cfs is recommended (table 10). This flow would provide adequate depth over riffles for passage and spawning and is below the mean monthly flow patterns for this time period.

Crappie spawning occurs during May and June, in deep water (2.0 to 20.0 feet, Bovee 1974). Discharges during May and June are somewhat higher, but still show wide

Table 12. Life history periodicity chart for Pumpkin Creek.

| Species | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sauger** | | | | | | | | | | | | | |
| Passage | 20 | | | | | | | | | | | | |
| Spawning | 20 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| **White Crappie** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 35 | | | | | | | | | | | | |
| Incubation | 35 | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| **Channel Catfish** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 5 | | | | | | | | | | | | |
| Incubation | 5 | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

fluctuations. Mean monthly flows for the period of record (1973-1975) for May and June were 52.5 cfs. Assuming 70 percent of this mean flow would be adequate to provide suitable depths for crappie spawning, a flow of 35 cfs is recommended for May and June to protect spawning crappie.

Flows during the channel catfish spawning season are minimal. During the short period of flow record for Pumpkin Creek (1973-1975), no flow has been recorded by early July. However, if water is flowing in the stream during this time period, enough should be allowed to flow to provide the channel catfish access to spawning areas and to insure some exhange of water in the remaining pool areas. Therefore, a flow of 5 cfs during July and August is recommended for channel catfish migration and spawning. This recommendation is made with the understanding that in many instances, flow will drop well below that level.

### Justification

Sauger migrate from the Yellowstone River into the Tongue River each spring to spawn. Estimated size of this run during the spring of 1976 was 3,873 (95% confidence interval of 3265-4759) based on a Schnabel mark and recapture (Elser and McFarland 1976). This run is fished heavily in the Tongue River and in the lower reach of Pumpkin Creek. Since sauger migration is blocked by the T&Y Diversion, many fish move into Pumpkin Creek. Channel catfish also move out of the Yellowstone into the Tongue to spawn. It is therefore important to maintain flow levels in Pumpkin Creek which would be adequate to protect current fish population levels.

## POWDER RIVER

### Background and Fish Present

A study was initiated on the Powder River in 1975, funded by Utah International, Inc., to collect baseline data of the aquatic populations of the Powder River to determine the effects of an impoundment and large scale water withdrawals. Resident fish populations were sampled throughout the drainage to determine species composition, distribution and diversity. A total of 18 species were collected, with the flathead chub the dominant species (Rehwinkel et al, 1976). Only rare occurrences of game species were found to be residents. Migrant fish populations were monitored during the spring to assess the importance of Yellowstone River fish movements into the Powder. Sauger, shovelnose sturgeon and channel catfish were found moving into the Powder in large numbers. While paddlefish were not taken during spring sampling, anglers suggest that they do move into the Powder during their spring migration.

Reach

State line - Little Powder River

Methods

The life history periodicity chart for the Powder River (State line to Little Powder River is shown in table 13.) Flow estimates for this reach are based on flows recommended by the U.S. Fish and Wildlife Service for the Northern Great Plains Resource Program (NGPRP). These flows are adequate to meet the needs of channel catfish spawning during July and for rearing of channel catfish, sauger and sturgeon chub for the months of August through December and January through February. To insure adequate passage and spawning flows for sauger during March and April and passage and spawning flows for shovelnose sturgeon during May and June, 70 percent exceedence levels were used. Those flows were identified, by month, which were equaled or exceeded 70 percent of the time as recorded at the USGS gage "Powder River at Moorhead" for the period 1934-1972. Instream flow estimates for this reach are shown in table 15.

Reach

Little Powder River to Yellowstone River

Methods

Flow recommendations for this reach are also based on NGPRP estimates except for March, April, May and June. These flows are adequate to provide for channel catfish spawning in July and for rearing of sauger, channel catfish and sturgeon chub for the period August through December and January-February (table 14). The 70 percent exceedence level was used to insure adequate passage and spawning flows for sauger during March and April, passage and spawning flows for shovelnose sturgeon during May and June. Instream flows estimates for this reach are shown in table 15.

Justification

Spring sampling in 1976 in the Powder River resulted in the capture of 178 sauger. Age structure and gonadal

Table 13 Life history periodicity chart for Powder River - Little Powder River to Yellowstone River.

| Species | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sauger | | | | | | | | | | | | | |
| Passage | 500 | | | | | | | | | | | | |
| Spawning | 500 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 80 | | | | | | | | | | | | |
| Shovelnose Sturgeon | | | | | | | | | | | | | |
| Passage | 800 | | | | | | | | | | | | |
| Spawning | 800 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Channel Catfish | | | | | | | | | | | | | |
| Passage | 200 | | | | | | | | | | | | |
| Spawning | 200 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 80 | | | | | | | | | | | | |
| Sturgeon Chub | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 40 | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

Table 14. Life history periodicity chart for Powder River - State Line to Little Powder River.

| Species | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sauger** | | | | | | | | | | | | | |
| Passage | 400 | | | | | | | | | | | | |
| Spawning | 400 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 100 | | | | | | | | | | | | |
| **Shovelnose Sturgeon** | | | | | | | | | | | | | |
| Passage | 600 | | | | | | | | | | | | |
| Spawning | 750 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| **Channel catfish** | | | | | | | | | | | | | |
| Passage | 120 | | | | | | | | | | | | |
| Spawning | 120 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 100 | | | | | | | | | | | | |
| **Sturgeon chub** | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 30 | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

Table 15. Instream flow estimates (cfs and thousand acre-feet) for the Powder River, Montana.

| Reach | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| State Line to Little Powder River | 100 | 100 | 400 | 400 | 600 | 750 | 120 | 30 | 30 | 100 | 100 | 100 |
| (thousand acre-feet) | 6.15 | 5.55 | 24.59 | 23.80 | 36.88 | 44.62 | 7.38 | 1.80 | 1.78 | 6.15 | 5.95 | 6.15 |
| Little Powder River to Yellowstone River | 80 | 80 | 500 | 500 | 800 | 800 | 200 | 40 | 40 | 80 | 80 | 80 |
| (thousand acre-feet) | 4.92 | 4.44 | 30.74 | 29.75 | 49.18 | 47.59 | 12.29 | 2.46 | 2.38 | 4.92 | 4.76 | 4.92 |

Table 16. Instream flow estimates (cfs and acre-feet) for Rosebud Creek, Montana.

| Reach | Jan | Feb | Mar | April | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cottonwood Creek to Yellowstone River | 15.0 | 15.0 | 15.0 | 50.0 | 50.0 | 10.0 | 10.0 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| (acre-feet) | 922.0 | 832.9 | 922.0 | 2974.5 | 3073.7 | 594.9 | 614.7 | 307.4 | 297.5 | 307.4 | 297.5 | 307.4 |

development of these sauger indicated that they were on a spawning migration out of the Yellowstone River (Rehwinkel et al, 1976). Shovelnose sturgeon were also found migrating up the Powder. These fish provide a fishery for those anglers who have learned where and how to catch them. The other migrant found during the spring was the channel catfish which is also a highly sought after game fish. Fishermen interviews indicate that catfish provide the major contribution to the Powder River sport fishery. The importance of Yellowstone River game fish movements into the Powder River has not been assessed in terms of the potential or realized fishery of the Powder River or to the reproduction of Yellowstone River game fish. However, flows adequate to maintain the spawning populations and resident fishes in the Powder must be maintained.

The sturgeon chub was used as a rearing indicator species because of its uniqueness in Montana. According to Brown (1971) this minnow is uncommon to rare in Montana. However, it is widely distributed throughout the Powder River (Rehwinkel et al, 1976).

## ROSEBUD CREEK

### Reach

Cottonwood Creek (T4N, R42E, S13) to Yellowstone River.

### Fish Present

A total of 20 species of fish have been sampled in this reach of Rosebud Creek. While most of these species were non-sport fishes, a few sport fish were found. These included: sauger, walleye, northern pike, channel catfish and burbot. Burbot are considered migrants only, moving into the lower Rosebud in the late winter to spawn. The others, while also exhibiting movement out of the Yellowstone, are also considered resident species.

### Methods

A study was initiated in 1975 to evaluate the current status of the aquatic communities of Rosebud Creek. The study was funded by EPA-WQO; administered by the Fisheries Bioassay Laboratory at MSU.

Burbot spawn during the winter months (January - February) under the ice (Brown 1971), often moving into tributaries to deposit their eggs. Spent burbot were collected in Rosebud Creek in February and March, indicating spawning had taken place in the stream. Flows during this period (January - March) fluctuate widely, but average about 50 cfs (1974 - 1975). In order to insure flows adequate to allow for passage and spawning of burbot, a flow of 15 cfs is recommended for this time period (table 16).

Northern pike are found in large numbers throughout this reach (table 17). A total of 71 northerns were tagged near the mouth (Elser and Schreiber 1976), with fish taken during spring and fall sampling seasons. One tag has been returned by an angler to date. This fish was tagged in Rosebud Creek and recaptured in the Yellowstone River downstream from Rosebud Creek. While this represents a small sample (1.4% return rate), it does suggest that the Rosebud is important to Yellowstone River northern pike. Northerns spawn during April and early May. Flows during this period have varied quite drastically during the past two water years (mean April flows were 159 cfs in 1975 and 77 cfs in 1976). Since 1976 was judged to be a more nearly representative year, these flows were used as a basis for northern pike passage and spawning flows. Low flow during April was 68 cfs ranging to a high of 137 cfs. A trap installed near the mouth of Rosebud Creek to monitor fish movements into the Creek showed peak northern pike movements on April 7 (Elser and Schreiber 1976). The discharge on that date was 69 cfs. Assuming this flow to be somewhere near optimum, a sustaining passage-spawning flow of 50 cfs is recommended (75% of optimum). This flow would allow passage of migrant fish and would provide adequate spawning habitat.

As with other tributaries, sauger move into the Rosebud during April and May to spawn. Fish sampling has revealed sauger during both the spring and fall. Gonadal development of spring samples indicated a spawning population. And a tag returned from the Yellowstone River suggests the importance of the Rosebud. May flows are similar to April flows and a discharge of 50 cfs is likewise recommended for sauger passage-spawning.

Water temperatures reached 70 F in the Rosebud around the first of June, which corresponds to the period when channel catfish begin to move into the Rosebud to spawn. Flows during June and July fluctuate greatly, ranging from 35 to 182 in June 1976 and from 7.8 to 56 in July 1976. Since channel catfish spawn in secluded holes, and since this reach of Rosebud Creek is deeply incised, with adequate depth, the most important consideration is allowing for passage with stable flow conditions for spawning. Based on flow records for 1975 and 1976 and known channel catfish use of the stream, a flow of 10 cfs is recommended for June and July to maintain channel catfish use of Rosebud Creek.

Table 17. Life history periodicity chart for Rosebud Creek: Cottonwood Creek (T4N, R42E, S13) to Yellowstone River.

| Species | | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burbot | | | | | | | | | | | | | |
| Passage | 15 | | | | | | | | | | | | |
| Spawning | 15 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | | | | | | | | | | | | | |
| Northern Pike | | | | | | | | | | | | | |
| Passage | 50 | | | | | | | | | | | | |
| Spawning | 50 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 5 | | | | | | | | | | | | |
| Sauger | | | | | | | | | | | | | |
| Passage | 50 | | | | | | | | | | | | |
| Spawning | 50 | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 5 | | | | | | | | | | | | |
| Channel catfish | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | 10 | | | | | | | | | | | | |
| Incubation | 10 | | | | | | | | | | | | |
| Rearing | 5 | | | | | | | | | | | | |
| ~~Stonecat~~ | | | | | | | | | | | | | |
| Passage | | | | | | | | | | | | | |
| Spawning | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |
| Rearing | 5 | | | | | | | | | | | | |
| Nest Establishment | | | | | | | | | | | | | |
| Incubation | | | | | | | | | | | | | |

Rearing flows are based entirely on historic flow patterns for the years 1951-53 and 1975-76. Flows have been higher for the last few years (suspected as a result of aquifer recharge from Big Horn Canyon Reservoir). Mean monthly flows for October, November and December, 1951-53 were 4.7, 4.1, and 4.3, respectively. In 1975-76, the mean flows were 25.5, 26.5 and 27.1, respectively, which reflects an almost five fold increase. Based on historic flow patterns, a rearing flow of 5 cfs is recommended for this reach of the Rosebud.

Justification

Sport fishing in the vicinity of the mouth of Rosebud Creek is increasing in popularity. While the importance Rosebud Creek plays in maintaining a sport fishery in the Yellowstone is undetermined, the fact that Yellowstone River fish utilize the Rosebud, makes it imperative to protect flows in the lower Rosebud.

## DISCUSSION

The instream flows requested for lower Yellowstone River tributaries as flow reservation are summarized in table 18. Water controls all activity in this semiarid region and the industrial future of the Fort Union coal fields is no exception. Since most coal fields are far removed from the existing sources of surface water, the nature and extent of development would depend on the quantity of water available at the mine site. Withdrawal of large volumes of water from Great Plains rivers and streams will include storage facilities and diversion structure which will certainly affect the current flow regimen and associated aquatic communities. Data on the distribution of fish species, their relative abundance and diversity in the important tributaries to the lower Yellowstone River will be necessary to evaluate changes in fish populations as related to coal development and energy production. By maintaining the integrity and identity of her tributaries, the integrity and identity of the Yellowstone will likewise be maintained.

Table 18. Summary of total amount of instream flows requested for reservation of Yellowstone River tributary water.

| Stream and Reach | Thousand acre-feet |
|---|---|
| Tongue River: State Line to Tongue River Reservoir | 237.90 |
| Tongue River Dam to Four-Mile Creek | 206.20 |
| Four-Mile Creek to S-H Diversion | 193.43 |
| S-H Diversion to T&Y Diversion | 214.96 |
| T&Y Diversion to Yellowstone River | 243.09 |
| Hanging Woman Creek: E. Fk Hanging Woman Creek to Tongue River | 1.88 |
| Otter Creek: Bear Creek to Tongue River | 1.94 |
| Pumpkin Creek: Deer Creek to Tongue River | 7.27 |
| Powder River: State Line to Little Powder River | 170.80 |
| Little Powder River to Yellowstone River | 198.35 |
| Rosebud Creek: Cottonwood Creek to Yellowstone River | 11.45 |

1. Name of Stream or Lake

   Yellowstone River

2. Stream Reach

   Big Horn River to Montana - North Dakota State Line

3. Location - T5N, R34E, Sec 28 to T24N R60E, Sec 29

   From the mouth of the Bighorn River to Montana-North Dakota State Line. A recommended flow for the Bighorn River at its mouth is included, based on inflow from the Bighorn necessary to maintain the proposed instream flows for the Yellowstone.

4. Fish Species Present. See Table 1.

   Of the fish species listed in table 1, the paddlefish is the most notable migrant. Spending most of the year in Garrison Reservoir, the paddlefish ascend the Yellowstone each spring to spawn. Also, during April and May, a portion of the walleye population in the lower 70 miles of river is believed to consist of upstream migrants from Garrison Reservoir.

5. Riparian Wildlife Species Present. See Tables 2 and 3.

   Table 2 lists selected species of birds observed in the lower Yellowstone valley (Hinz 1976). Resident upland game birds and big game mammals common to islands and riparian areas of the lower Yellowstone are listed in table 3. Also listed in table 3 are the furbearers of the lower river.

   In addition to the wildlife species listed in tables 2 and 3, a number of small mammals and predators inhabit the lower Yellowstone River bottom. For a more complete picture of the bird life inhabiting the lower Yellowstone area, refer to Montana Bird Distribution by Skaar (1975) and the 8 May 1976 supplement, also by Skaar.

6. Life History Periodicity Chart

   Table 4 contains a life history periodicity chart for selected fish and waterfowl species inhabiting the lower Yellowstone River. Several important species were not included, since their life histories are poorly understood at present. Specific dates for the life history periodicity chart (table 4) are listed in table 5.

Table 1. Fish species recorded for the Yellowstone River (family, scientific and common names), from the mouth of the Bighorn River to its confluence with the Missouri.

| | |
|---|---|
| ACIPENSERIDAE (Sturgeon Family) | |
| *Scaphirhynchus albus* | Pallid sturgeon |
| *Scaphirhynchus platorynchus* | Shovelnose sturgeon |
| POLYODONTIDAE (Paddlefish Family) | |
| *Polyodon spathula* | Paddlefish |
| HIODONTIDAE (Mooneye Family) | |
| *Hiodon alosoides* | Goldeye |
| SALMONIDAE (Trout Family) | |
| *Salmo gairdneri* | Rainbow trout |
| *Salmo trutta* | Brown trout |
| ESOCIDAE (Pike Family) | |
| *Esox lucius* | Northern pike |
| CYPRINIDAE (Minnow Family) | |
| *Cyprinus carpio* | Carp |
| *Carassius auratus* | Goldfish |
| *Notemigonus crysoleucas* | Golden shiner |
| *Semotilus margarita* | Pearl dace |
| *Semolitus atromaculatus* | Creek chub |
| *Hybopsis gracilis* | Flathead chub |
| *Hybopsis gelida* | Sturgeon chub |
| *Couesius plumbeus* | Lake chub |
| *Notropis atherinoides* | Emerald shiner |
| *Notropis stramineus* | Sand shiner |
| *Hybognathus hankinsoni* | Brassy minnow |
| *Hybognathus placitus* | Plains minnow |
| *Hybognathus nuchalis* | Silvery minnow |
| *Pimephales promelas* | Fathead minnow |
| *Rhinichthys cataractae* | Longnose dace |
| CATOSTOMIDAE (Sucker Family) | |
| *Carpoides carpio* | River carpsucker |
| *Cycleptus elongatus* | Blue sucker |
| *Ictiobus bubalus* | Smallmouth buffalo |
| *Ictiobus cyprinellus* | Bigmouth buffalo |
| *Moxostoma macrolepidotum* | Shorthead redhorse |
| *Catostomus catostomus* | Longnose sucker |
| *Catostomus commersoni* | White sucker |
| *Catostomus platyrhynchus* | Mountain sucker |
| ICTALURIDAE (Catfish Family) | |
| *Ictalurus melas* | Black bullhead |
| *Ictalurus punctatus* | Channel catfish |
| *Noturus flavus* | Stonecat |
| GADIDAE (Codfish Family) | |
| *Lota lota* | Burbot |
| CENTRARCHIDAE (Sunfish Family) | |
| *Ambloplites rupestris* | Rock bass |
| *Lepomis cyanellus* | Green sunfish |
| *Lepomis gibbosus* | Pumpkinseed |
| *Lepomis macrochirus* | Bluegill |
| *Micropterus dolomieui* | Smallmouth bass |
| *Micropterus salmoides* | Largemouth bass |
| *Pomoxis annularis* | White crappie |
| *Pomoxis nigromaculatus* | Black crappie |
| PERCIDAE (Perch Family) | |
| *Perca flavescens* | Yellow perch |
| *Stizostedion canadense* | Sauger |
| *Stizostedion vitreum* | Walleye |
| SCIAENIDAE (Drum Family) | |
| *Aplodinotus grunniens* | Freshwater drum |

Table 2. Selected species of birds observed in the Lower Yellowstone Valley from September 1974 to October 1976, (from Hinz 1976 - in progress).

| | Spring Migrant | Breeding | Summering 1/ | Fall Migrant | Wintering |
|---|---|---|---|---|---|
| Common loon (*Gavia immer*) | x | | | x | |
| Western grebe (*Aechmophorus occidentalis*) | x | | x | x | |
| Horned grebe (*Podiceps auritus*) | x | | x | x | |
| Eared grebe (*Podiceps caspicus*) | x | | x | x | |
| Pied-billed grebe (*Podilymbus podiceps*) | x | x | | x | |
| White pelican (*Pelecanus erythrorhynchos*) | x | | x | x | |
| Double-crested cormorant (*Phalacrocorax auritus*) | x | x | | x | |
| Whistling swan (*Olor columbianus*) | x | | | x | |
| Giant Canada goose (*Branta canadensis maxima*) | x | x | | x | x |
| Great Basin Canada goose (*Branta canadensis moffitti*) | x | x | | x | x |
| Lesser Canada goose (*Branta canadensis parvipes*) | x | | | x | |
| Richardson's Canada goose (*Branta canadensis hutchinsii*) | x | | | x | |
| White-fronted goose (*Anser albifrons frontalis*) | x | | | x | |
| Snow goose (*Chen hyperborea*) | x | | | x | |
| Mallard (*Anas platyrhynchos*) | x | x | | x | x |
| Pintail (*Anas acuta*) | x | x | | x | |
| Gadwall (*Anas strepera*) | x | x | | x | |
| American widgeon (*Anas americana*) | x | x | | x | x |
| Shoveler (*Anas clypeata*) | x | x | | x | |
| Blue-winged teal (*Anas discors*) | x | x | | x | |
| Green-winged teal (*Anas crecca carolinensis*) | x | x | | x | |
| Wood duck (*Aix sponsa*) | x | x | | x | |
| Redhead (*Aythya americana*) | x | | | x | |
| Canvasback (*Aythya valisineria*) | x | | | x | |
| Ring-necked duck (*Aythya collaris*) | x | | | x | |
| Lesser scaup (*Aythya affinis*) | x | | | x | |
| Common goldeneye (*Bucephala clangula*) | x | | | x | x |
| Bufflehead (*Bucephala albeola*) | x | | | x | |
| Ruddy duck (*Oxyura jamaicensis*) | x | | x | x | |
| Common merganser (*Mergus serrator*) | x | x | | x | x |

Table 2 continued.

| | Spring Migrant | Breeding | Summering 1/ | Fall Migrant | Wintering |
|---|---|---|---|---|---|
| Red-breasted merganser (*Mergus serrator*) | x | | | | |
| Turkey vulture (*Cathartes aura*) | | | x | | |
| Rough-legged hawk (*Buteo lagopus*) | x | | | | x |
| Red-tailed hawk (*Buteo jamaicensis*) | x | x | | x | |
| Golden eagle (*Aquila chrysaetos*) | | x | | | x |
| Bald eagle (*Haliaeetus leucocephalus*) | x | x | | x | x |
| Osprey (*Pandion haliaetus*) | x | | | x | |
| Prairie falcon (*Falco mexicanus*) | x | x | | x | |
| Great blue heron (*Ardea herodias*) | x | x | | x | |
| Black-crowned night heron (*Nycticorax nycticorax*) | x | | | | |
| Lesser sandhill crane (*Grus canadensis canadensis*) | x | | | x | |
| American coot (*Fulica americana*) | x | x | | x | |
| American avocet (*Recurvirostra americana*) | x | | x | | |
| Black-bellied plover (*Squatarola squatarola*) | x | | | | |
| Killdeer (*Charadrius vociferus*) | x | x | | x | |
| Long-billed curlew (*Numenius americanus*) | x | | | | |
| Upland plover (*Bartramia longicauda*) | x | | x | | |
| Spotted sandpiper (*Actitis macularia*) | x | x | | x | |
| Willet (*Catoptrophorus semipalmatus*) | x | | | | |
| Greater yellowlegs (*Totanus melanoleucus*) | x | | | | |
| Lesser yellowlegs (*Totanus flavipes*) | x | | | | |
| Long-billed dowitcher (*Limnodromus scalopaceus*) | x | | | | |
| Sanderling (*Crocethia alba*) | x | | | | |
| White-rumped sandpiper (*Erolia fuscicollis*) | x | | | | |
| Least sandpiper (*Erolia minutilla*) | x | | | | |
| Wilson's phalarope (*Steganopus tricolor*) | x | | | | |
| Common snipe (*Capella gallinago*) | x | x | | | |
| Ring-billed gull (*Larus delawarensis*) | x | | x | x | |
| Franklin's gull (*Larus pipixcan*) | x | | | | |
| Common tern (*Sterna hirundo*) | x | | x | x | |
| Forster's tern (*Sterna forsteri*) | x | | | | |
| Black tern (*Chlidonias niger*) | x | | | | |

Table 2 continued.

| | Spring Migrant | Breeding | Summering 1/ | Fall Migrant | Wintering |
|---|---|---|---|---|---|
| Great horned owl (*Bubo virginianus*) | x | x | | x | |
| Snowy owl (*Nyctea scandiaca* | | | | x | |
| Belted kingfisher (*Megaceryle alcyon*) | x | x | | x | |
| Black-billed magpie (*Pica pica*) | x | x | | x | x |
| Common crow (*Corvus brachyrhynchos*) | x | | x | x | |

1/ Present in summer but not known to breed in the area.

Table 3. Resident upland game birds, big game mammals and furbearers commonly occurring in and adjacent to the lower Yellowstone River.

| | |
|---|---|
| Upland Game Birds | |
| Ring-necked pheasant | *Phasianus colchicus* |
| Sharptailed grouse | *Pediocetes phasianellus* |
| Gray partridge | *Perdix perdix* |
| Big Game Mammals | |
| Mule Deer | *Odocoileus hemionus* |
| White-tailed deer | *Odocoileus virginianus* |
| Furbearers | |
| Beaver | *Castor canadensis* |
| Mink | *Mustela vison* |
| Muskrat | *Ondatra zibethica* |
| River otter | *Lutra canadensis* |

Table 4. Lower Yellowstone River life history periodicity chart.

| Species | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Canada Goose | | | | | | | | | | | | |
| Nest Establishment | | | ******** | ******** | | | | | | | | |
| Incubation | | | | ******** | ***** | | | | | | | |
| Mallard | | | | | | | | | | | | |
| Nest Establishment | | | | * | ******** | * | | | | | | |
| Incubation | | | | | * | ********* | * | | | | | |
| Paddlefish | | | | | | | | | | | | |
| Migration & Spawning | | | | * | ******** | ********* | ****** | | | | | |
| Passage around Intake | | | | | | ****** | | | | | | |
| Shovelnose Sturgeon | | | | | | | | | | | | |
| Migration & Spawning | | | | ****** | ******** | ********* | ********* | *** | | | | |
| Rearing | | ***** | ********* | ********* | ******** | ********* | ********* | ********* | ********* | ******* | ******* | ****** |
| Walleye & Sauger | | | | | | | | | | | | |
| Spawning & Incubation | | | | ******** | ******** | | | | | | | |
| Rearing | | ***** | ********* | ********* | ******** | ********* | ********* | ********* | ********* | ******* | ******* | ****** |
| Ling | | | | | | | | | | | | |
| Spawning | | ***** | ********* | | | | | | | | | *** |
| Rearing | | ***** | ********* | ********* | ******** | ********* | ********* | ********* | ********* | ******* | ******* | ****** |

Table 5. Specifics for lower Yellowstone River periodicity chart.

| Species | Activity | Dates |
|---|---|---|
| Canada goose | Nest Establishment<br>Incubation | March 1 - April 30<br>April 5 - June 1 |
| Mallard | Nest Establishment<br>Incubation | April 21 - June 7<br>May 18 - July 5 |
| Paddlefish | Migration<br>Passage around Intake | April 21 - July 31<br>June 8 - June 30 |
| Shovelnose sturgeon | Migration & Spawning<br>Rearing | April 15 - August 7<br>Year around |
| Walleye & Sauger | Spawning and Incubation<br>Rearing | April 1 - May 30<br>Year around |
| Ling | Spawning<br>Rearing | December 15 - January February<br>Year around |

7. Methods used for flow/level determination.

A variety of methods were used to determine the required flows of the lower Yellowstone on an annual basis. Flows considered essential for certain life history aspects of selected species were used for a portion of the year. Habitat considerations such as channel formation, water quality and rearing flows were used for the remainder of the year. A brief description of the methodologies employed for the various periods of the year are as follows:

March - April Period

The flows for March and April were based on those necessary for successful Canada goose production on the lower river. An optimum flow was determined that would both minimize nest predation and prevent nest flooding.

May - June - July

The paddlefish was selected as the key species for the May through July period. It is believed that if the paddlefish passage requirements are met, then its spawning and incubation requirements would also be met. Since the paddlefish is, by far, the largest fish in the system, the requirements of other species spawning at the same time would also be met. The paddlefish passage flows were used for June 8 - 30.

Increasing flows from May 15 through June 7 were requested toprovide the stimulus for paddlefish migration and partial passage up the Yellowstone. Decreasing flows during July were intended to allow passage of adult and larval paddlefish downstream to Garrison Reservoir.

In addition to meeting the passage and spawning requirements of the paddlefish, a peak discharge during June is requested to maintain sediment and bedload movement and, therefore, maintain the existing habitat types in their present condition. The peak flow was determined according to Leopold, Wolman and Miller (1964).

<u>August - September - October - November</u>

The August through November flows were requested primarily to maintain adequate rearing conditions in the lower river following the method outlined by White (1975). In addition, flows required to meet the existing water quality of this reach of river, as determined by the Montana Department of Health and Environmental Sciences (J. Thomas - personal communication) will also be met.

<u>December - January - February</u>

Aquatic populations commonly suffer the highest natural mortality and are under the greatest stress during the winter period. A discussion of the flows requested for this period is contained later in the report.

8. Why flow (or level) is necessary.

The following is a presentation and discussion of the instream flows requested for maintenance of the existing aquatic and wildlife resources found in the lower Yellowstone River and its immediate riparian areas. The flows are presented for the periods March - April, May - July, August - November, and December - February. The methodology used for each period is described and a summary of the supporting data is given. For a more detailed presentation of the supporting data, reference is made to specific studies, individuals and reports.

Where possible, the latest biological and hydraulic data from current studies on the Yellowstone River were used. The literature is cited to substantiate current data and as a supplement where specific data is incomplete. Those methodologies selected were based on their suitability to the conditions found on the lower Yellowstone in view of the existing data base. In addition to meeting the requirements of fish and wildlife, the recommended flows will also contribute toward partially or completely meeting the needs for other instream values such as: water quality, aesthetics, recreation and adequate stage heights for existing water withdrawal structures.

## MARCH - APRIL

The March and April flows are those required for successful Canada goose reproduction on the lower Yellowstone. An estimated 30 percent of the breeding population of Canada geese in the surveyed areas of the Central Flyway portion of Montana utilize the Yellowstone River mainstem for nesting (T. Hinz - pers. comm., Witt 1975). An additional 15 percent nest on the Powder, Tongue, and Bighorn Rivers. Maintaining conditions favorable for Canada goose production on these rivers is thus highly important.

The date of initiation of the first goose nest in the spring is to some degree dependent on spring weather conditions. In most years, however, the period from March 1 through April 30 will encompass the period of goose nest initiation on the lower river (T. Hinz - pers. comm.). Islands are the most preferred nesting areas for Canada geese on the Yellowstone (Hook 1975, Hinz 1975).

The security of a given island for nesting depends on its isolation from predators. The farther an island is from a large island or mainbank where predators occur and the deeper the water is separating the island from this area, the more secure the nest will be. Island security as related to distance from a predator source and depth of the channel separating the island from that source has been demonstrated by a number of workers (Sherwood 1965, Hammond and Mann 1956, Hook 1973).

The security of islands utilized for nesting on the lower Yellowstone is directly related to river flows. Steady, high flows throughout the nesting period will produce greater depths of channels between islands and the mainland, and therefore greater security, than low flows. Canada goose nesting studies on the lower Yellowstone in 1975 and 1976 indicate that a flow of approximately 11,000 cfs during March and April would prevent excessive nest predation on islands (Hinz 1976). Low flows (around 9,000 cfs) during the early part of the nesting period in the spring of 1976 resulted in an overall predation rate of 28 percent on 96 nests surveyed. Predation rates in individual study sections ranged from 7 percent to 57 percent. The period of low flows in the spring of 1976, (9,000 cfs) was the result of regulation of the Bighorn River by Yellowtail Dam. In 1975, higher flows (11-12,000 cfs) during the early part of the nesting season were associated with an overall predation rate of 11 percent (range 0 percent to 20 percent) (Hinz 1976). Irregular flows with peaks higher than 12,000 cfs may produce substantial nest flooding. For a more complete discussion and presentation of nesting data, refer to Hinz (1976). Using a similar methodology, Merrill and Bizeau (1972) determined that uniform releases of 16,000 cfs from Palisades Dam on the Snake River prevented goose nest predation yet did not produce nest flooding.

## MAY - JUNE - JULY

To maintain the integrity of the lower Yellowstone River and its associated aquatic and wildlife populations, it is necessary for the reservation to reflect the historic flow regimen. The high water period of the Yellowstone occurs during May, June and July with June commonly having the highest flows. The portion of the reservation for these months is designed to preserve a portion of the spring flood flows for maintenance of the channel formation processes and for necessary biological functions.

### Channel Maintenance Flows

The channel configuration of the lower Yellowstone is characterized by channel bars, islands, braided channel areas and an accompanying divided flow pattern in such areas. These channel features indicate the dynamic nature of the system. The diversity of channel, island and channel bar types found in the lower river naturally leads to a diversity of habitat types for both aquatic and terrestrial populations.

The major process in establishing and maintaining the channel form in view of its geology and bed and bank material is the annual flood characteristics of the river (Roy Koch - Pers. Comm.). The Yellowstone has a flow regimen characterized by an annual spring flood which occurs during May, June and

July with June commonly having the highest flows. The low water period normally occurs from late August through February with December, January and February having the lowest monthly flows.

It is the higher spring flood flows that determine the form of the channel rather than the average or low flows. Reducing these flows beyond the point where the major amount of bedload and sediment is transported would interrupt the on going channel processes and change the channel form (Roy Koch - Pers. Comm.). A significantly altered channel configuration would effect both the abundance and species composition of the present aquatic and terrestrial populations by altering the present habitat types.

Impacts of altered streamflows, most notably that of reduced flood flows, on various channel characteristics of the Bighorn River have been amply described by Martin (1976). Even though the Bighorn River flows have been completely regulated for only a comparatively short period of time (10 years), marked channel changes have already occurred. The river below Yellowtail Dam changed from a braided to a meandering channel system. Lost as a result of these changes were 1469 acres of vegetated island area (23.1%) and 1532 acres (69.7%) of gravel bars (Martin 1976). These figures reflect the loss of wildlife habitat largely the result of the construction of Yellowtail Dam and the regulation of the spring floods. Similar losses can be predicted for the Yellowstone with a loss of the spring high water period.

The loss of gravel bars from main stem areas would result in the elimination of resting areas for waterfowl, most notably Canada geese, and render the river considerably less attractive to future waterfowl populations (T. Hinz - Pers. Comm.). In addition, existing exposed gravel bars annually inundated by high water may provide spawning areas similar to those described by Purkett (1961) for paddlefish in the Osage River in Missouri. Loss of these gravel bars could eliminate potential paddlefish spawning areas.

It is generally accepted that the bankfull flow during the spring flood is the most important determining factor in channel formation processes (Leopold, Wolman and Miller 1964, U.S. Bureau of Reclamation 1973).

Actual field determination of the bank full stage is extremely difficult; however the flow of the 1½ year frequency flood is considered by many to approximate the bank full flow (Leopold, Wolman and Miller 1964). Bankfull flow was estimated for the Yellowstone River at Miles City and Sidney by using the 1½ year frequency flood from flood frequency relationships.

The estimated bankfull flow at Miles City and Sidney is 47,000 cfs and 52,000 cfs, respectively (Roy Koch - Pers. Comm.). It is not known how long the bankfull flow must be maintained. Until studies further clarify the necessary duration of the bankfull flow, an arbitrary duration period of 24 hours was chosen.

## Paddlefish Passage Flows

In addition to maintaining the physical integrity of the channel and associated islands, the high water period also functions as a stimulus for spawning of certain important sport fish and provides passage flow necessary for successful migration to traditional spawning areas.

The two notable species which spawn during the high water period are the shovelnose sturgeon and the paddlefish. The paddlefish was selected as the key species for the high water period based on its importance as a sport fish (Elser 1973) its uniqueness as a species (Vasetskiy 1971), its migratory habits (Robinson 1966, Elser 1973, Rehwinkel 1975), and the importance of the lower Yellowstone as a spawning area for the species.

Bovee (1974) also suggests use of the paddlefish as an indicator species for large rivers of the Northern Great Plains. Since the paddlefish is the largest fish in the system, its passage requirements will be the greatest. It follows that if the paddlefish passage requirements are met, then the passage needs of other species will also be met.

The paddlefish is a seasonal inhabitat of the Yellowstone. Spending most of the year in Garrison Reservoir, they ascend the Missouri and Yellowstone Rivers during the spring high water period to spawn. The most commonly reported upstream migration point in the Yellowstone is at Forsyth, Montana (river mile 238). To reach Forsyth, the paddlefish must first negotiate a low head irrigation diversion dam at Intake, Montana (river mile 71.1) which acts as a partial barrier to the upstream migration of the paddlefish (Robinson 1966, Rehwinkel 1975). A side channel bypasses the irrigation diversion, however it only contains water during the high water period.

The importance of paddlefish reaching traditional upstream areas during their spawning migration is obvious. By negotiating the diversion dam at Intake, at least an additional 166 miles of main stem Yellowstone and two major tributaries (Tongue and Powder Rivers) are made available for spawning. Paddlefish have been documented in the Powder River by Jean Smith (Pers. Comm) and in the Tongue by Elser and McFarland (1975). In addition, a popular fishery exists for the paddlefish in areas upstream from the Intake diversion at the Forsyth diversion and at the mouths of the Tongue and Powder Rivers.

The Intake diversion consists of a wood, stone and steel apron over which rocks are periodically dumped to maintain an adequate diversion head (E. Denson - Pers. Comm.). Since the nature of the diversion may change with additional rock, the passage requirements of paddlefish over the diversion may also change. In addition, the possibility exists of a more efficient concrete diversion being installed at some future date. It is not presently known what flows would be required for paddlefish passage over a concrete structure.

A passage flow for paddlefish through the side channel which bypasses the Intake diversion appears to be the best measure of the necessary long term passage flow for paddlefish. Recent studies indicate that the side channel is used for passage by the paddlefish (Peterman 1976a) and the required flows are unlikely to change with alterations in the diversion structure, provided the side channel itself is left unaltered.

For most of the year the Intake side channel is dry, flowing water only during the spring high water period. Water first enters the side channel at a flow of approximately 24,000 cfs (all flows related to the U.S.G.S. gage at Sidney, approximately 40 miles downstream). Intensive sampling (electrofishing) of this side channel during the 1976 paddlefish spawning migration revealed that a flow of approximately 45,000 cfs in the main stem allows sufficient flow in the side channel for adequate passage of the paddlefish (Peterman 1976b). Observation by others (Purkett 1961, Elser 1973) suggest that the duration of the high flows, as well as the magnitude, is significant in determining the extent of upstream migration of the paddlefish during their spawning run. Therefore, a 45,000 cfs flow at Sidney is believed necessary from June 8 through 30.

Paddlefish migrations are believed to be triggered, at least in part, by rising water conditions (Purkett 1961). The May portion of the reservation is designed to preserve the period of rising flows prior to high water. The flows from May 1 through 20 are set at 11,000 cfs (Miles City and Sidney) and are an extension of the goose nesting flows for March and April. By May 20, the period of nest establishment is over and the bulk of the incubation is complete. Flows for May 21 to May 31 are 20,000 cfs at Sidney and 17,000 cfs at Miles City and approximate the 70 percent exceedence level (a flow which is equaled or exceeded 70% of the time) for that period.

Flows requested for June 1 through 7 are 26,000 cfs at Sidney and 25,000 cfs at Miles City and again, are designed to preserve a portion of the rising stage prior to the peak of high water. The flows for the remainder of June (8 through 30) should reflect those required for paddlefish passage plus the bankfull flows for maintenance of the channel forming processes.

The bankfull flow at Sidney (52,000 cfs) is approximately 7,000 cfs higher than those required for paddlefish passage around Intake (45,000 cfs). After June 7, the flow should be allowed to peak at 52,000 for 24 hours. After peaking at bankfull stage, the minimum flow becomes 45,000 cfs for the remainder of June. Corresponding flows for June 8 through 30 at Miles City are 47,000 cfs (peak) and 42,000 cfs (minimum).

The July flows requested represent a gradual dropping of water levels from the high water period of June to the lower water month of August. A gradual drop in water levels is designed to allow downstream migration of both larval and adult paddlefish back to Garrison Reservoir. Using 70 per cent exceedence flows and a two stage drop for July, flows requested at Sidney for July 1-20 are 20,000 cfs and for July 21-31 are 10,000 cfs. Corresponding flows at Miles City are 17,000 and 9,200 for the respective time periods.

## AUGUST - SEPTEMBER - OCTOBER - NOVEMBER

Flows for the August through November period are based on those required for adequate rearing purposes. The successful rearing of stream fishes is dependent upon an adequate food supply, adequate habitat areas and suitable water quality (White 1975).

The principal food of most sub-adult fishes in river systems is aquatic invertebrates (Scott and Crossman 1973, Bjorn 1940, Miller 1970 a and b, Schwehr 1976a). While some game species in the Yellowstone switch to a piscivorous diet as adults (sauger, walleye, burbot and northern pike) others remain almost exclusively aquatic invertebrate feeders throughout their entire life (shovelnose sturgeon). Some fish, such as the channel catfish, are omnivorous as adults, feeding on both fishes and aquatic insects (Schwehr 1976a, Carlander 1969).

The necessity of maintaining suitable aquatic invertebrate production is apparent. Aquatic invertebrate production takes place primarily in riffle areas in most river systems (Hynes 1970). Riffles are also the areas which are most affected by reduced discharges (Bovee 1974). It is generally accepted that the maintenance of suitable riffle conditions (for food production) will also maintain suitable pool conditions (for habitat rearing). With the flows recommended for rearing, water quality deterioration will not be a factor (J. Thomas - Pers. Comm.).

The USGS - Washington Department of Fisheries Method for recommending rearing flows in Washington is based on the assumption that rearing is proportional to food production, which in turn is proportional to the wetted perimeter in riffle areas (Collings 1974). This method has been recommended by White (1975) and is used here to determine rearing flows for the August through November period.

The primary consideration in assuring adequate rearing flows is to maximize the wetted perimeter of the stream bed in the riffle (food production) areas, in view of the flow levels commonly occurring during August through November. In determining the rearing flows, representative riffle areas were located at three sites on the lower Yellowstone (Hysham - river mile 274.3, Kinsey - river mile 177.2, and Intake - river mile 71.1) and a minimum of four cross-sectional profiles surveyed at each site. Standard physical measurements were made and the hydraulic characteristics of the riffles at various flows were computed using the Water Surface Profile program according to Spence (1975) and Dooley and Keys (1975).

In analyzing riffle areas in relation to flow, the wetted perimeter is commonly plotted against discharge. Wetted perimeter generally increases rapidly for small increases in discharge up to the point where the channel nears its maximum width (wetted perimeter extends from bank to bank). Beyond this point, wetted perimeter increases more slowly in relation to discharge. White (1975) suggests that the optimum quantity of water for rearing be selected near this inflection point.

Since the channel configuration of the Yellowstone varies from site to site, a single flow will not produce the same results at each riffle. In some riffle areas, the median flow for August through November will easily cover the riffle from bank to bank. At other riffles, an expanse of gravel separates the actual river channel from the high water bank, or an island gravel bar may be present. Under these circumstances, an abnormally high flow would be required to extend the wetted perimeter from bank to bank. Here, a flow was considered which would cover only the main portion of the river channel.

Cross sections of representative riffle areas were surveyed at the Hysham and Kinsey sites by the Department of Natural Resources and Conservation under Old West Regional Commission funding. The calculated wetted perimeters of the riffle cross sections A and 1 at Hysham were plotted against discharge (figures 1 and 3). The resultant curves reveal a rapidly increasing wetted perimeter in relation to discharge until the channel nears its maximum width.

A change in slope of the curve (indicative of approaching maximum channel width) occurs between 7,000 and 8,000 cfs at Hysham section A (figure 1) and between 6,000 and 7,000 cfs at Hysham section 1 (figure 3). Figures 2 and 4 illustrate the respective stream bottom profiles with the water surface at 7,000 cfs shown. A 7,000 cfs flow will adequately cover the surveyed riffle at the Hysham site. Figure 6 illustrates a riffle at the Kinsey site with an island gravel bar in midstream and the 7,000 cfs flow level plotted. Although the 7,000 cfs flow extends from bank to bank, the wetted perimeter/discharge curve (figure 5) does not change slope as markedly as in figures 1 and 3 and is probably the result of the midstream gravel bar. In this case, a 7,000 cfs flow was judged adequate, even though a portion of the riffle in midstream was exposed. A flow of 10,000 cfs would be necessary to cover the island gravel bar and cannot be justified in view of the previously examined cross sections.

The river immediately below the Intake diversion is believed a rearing area for shovelnose sturgeon and is the only location where sub-adult shovelnose can be consistently taken (Peterman and Haddix 1975). Four cross sections in riffle areas below the Intake diversion were surveyed by the Department of Natural Resources and Conservation under Old West Regional Commission funding.

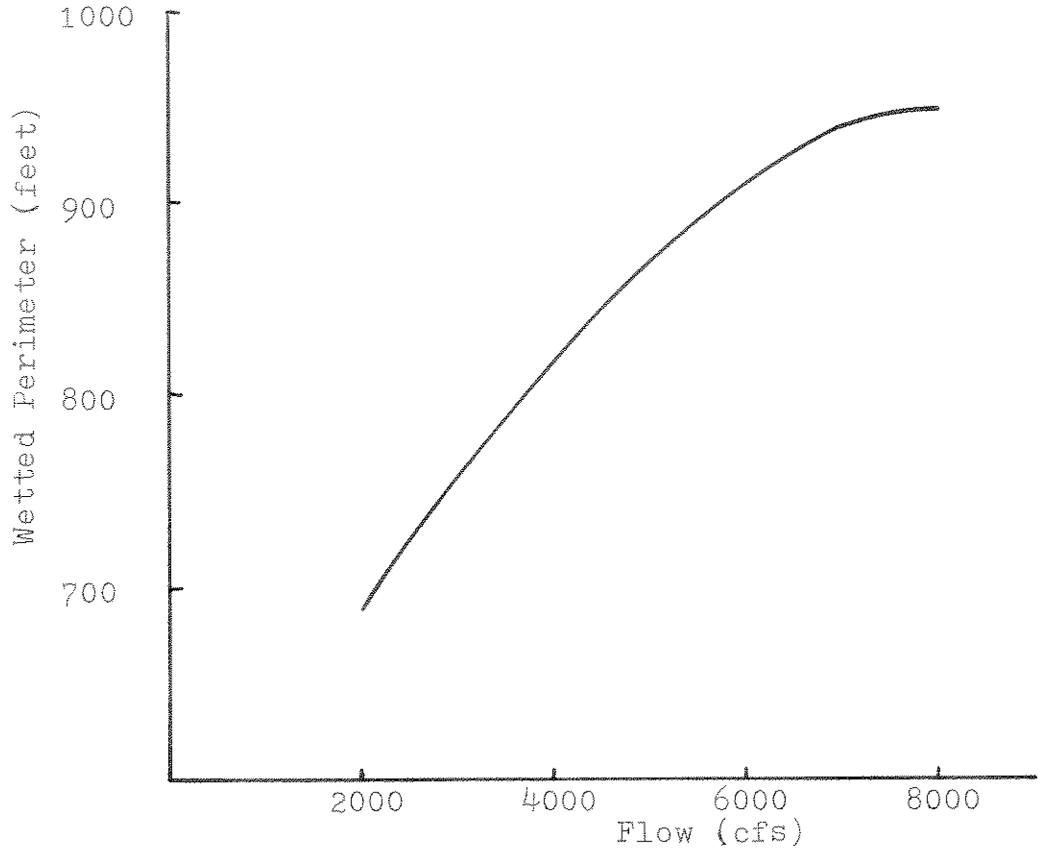



Figure 1. Relationship between wetted perimeter and flow at Hysham cross section A (Yellowstone River).

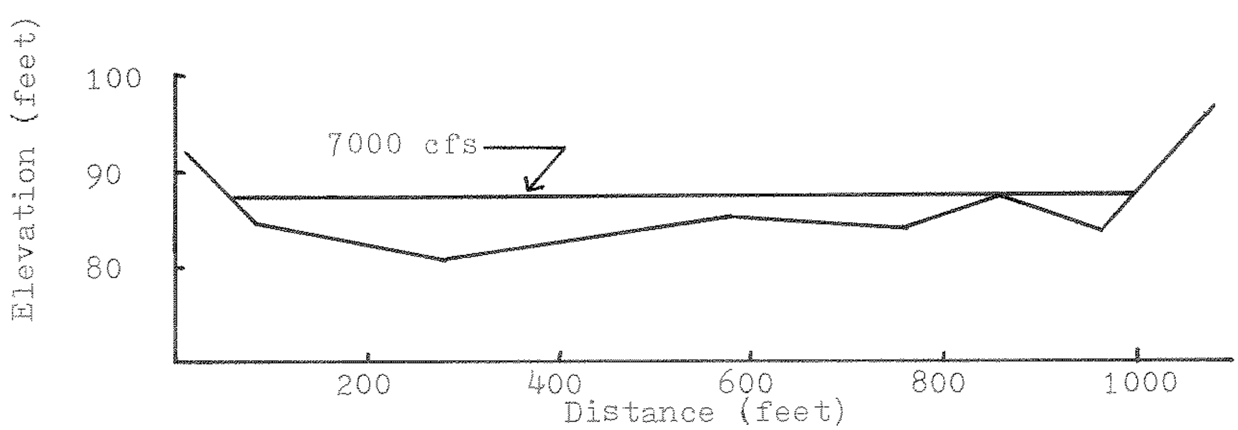



Figure 2. Profile of Hysham cross section A with water surface elevation at 7000 cfs shown.

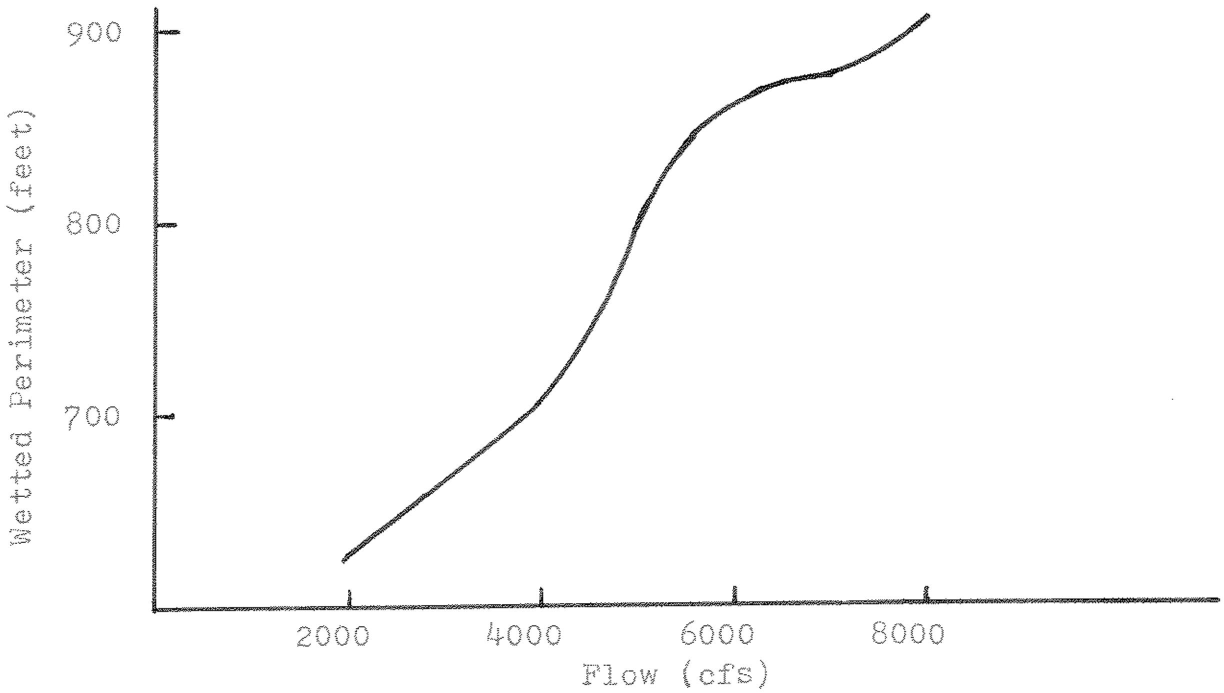



Figure 3. Relationship between wetted perimeter and flow at Hysham cross section 1 (Yellowstone River).

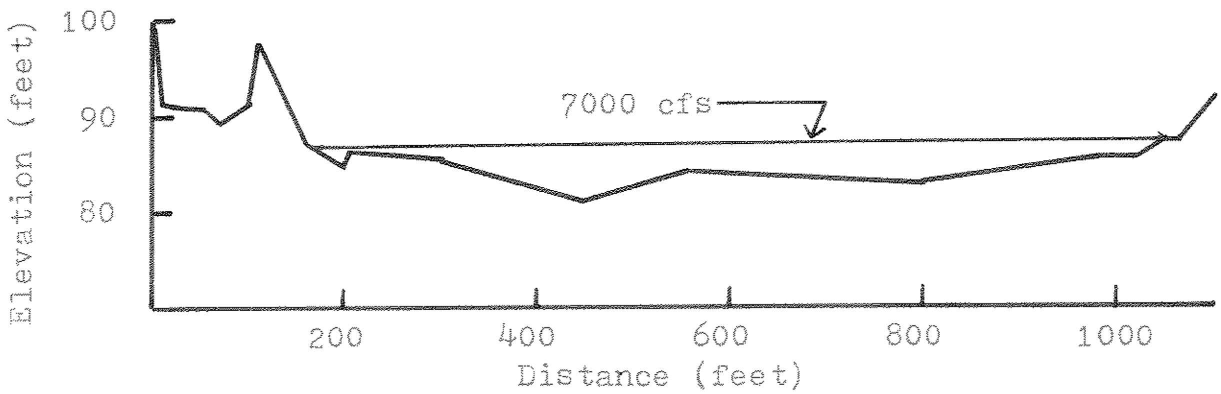



Figure 4. Profile of Hysham cross section 1 with water surface elevation at 7,000 cfs shown.

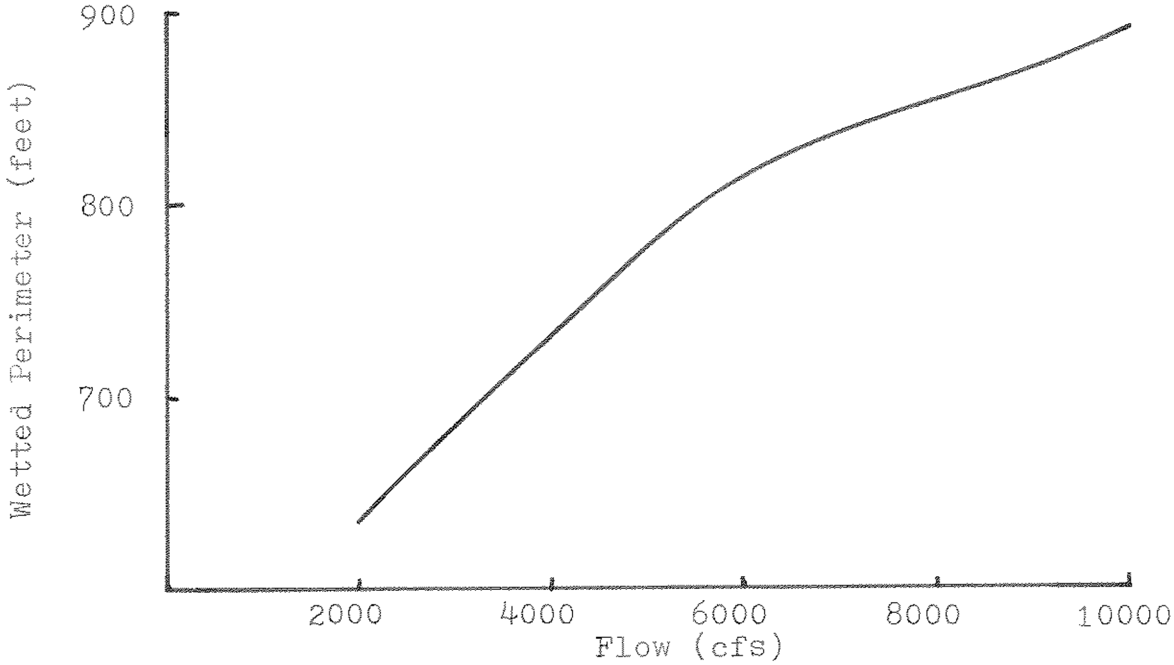



Figure 5. Relationship between wetted perimeter and flow at Kinsey cross section 1 (Yellowstone River).

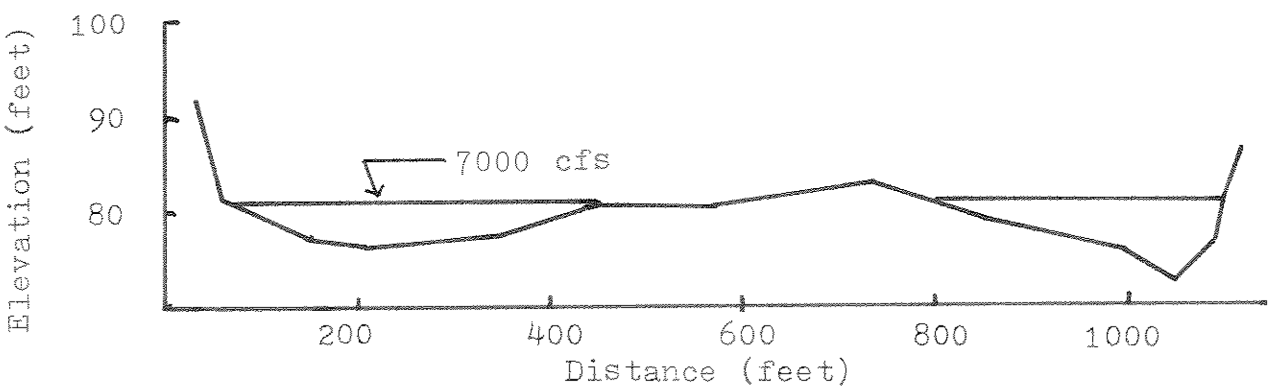



Figure 6. Profile of Kinsey cross section 1 with water surface elevation at 7000 cfs shown.

The river below Intake commonly has large areas of exposed gravel during the August-November period. A graph of the wetted perimeter verses flow relationships for all cross sections is shown in figure 7. A major inflection in the curves are evident between 15,000 to 20,000 cfs. This is the point at which the channel nears its maximum width, however the flows necessary to achieve this are seldom, if ever, encountered during the August through November period.

A closer look at the curves reveals a less evident inflection between approximately 6,000 and 8,000 cfs. The 7,000 cfs flow level was plotted on the stream profiles for cross sections 1, 2, 3 and 4 (figures 8, 9, 10 and 11, respectively). It is apparent that at approximately the 7,000 cfs flow, the stream bed in the main channel area of the profile is adequately covered.

In summary, a 7,000 cfs flow level appears adequate for rearing purposes (food production) at the surveyed riffles. This is only slightly less than the median flow level for August through November and would be expected to be equaled or exceeded approximately half of the time. A rearing flow of 7,000 cfs is recommended both at Miles City and Sidney since flows are very similar at the two gage sites from August through November and flow requirements from the surveyed riffles are also approximately equal.

An additional consideration in requesting adequate flows for August and September is the dissolved oxygen content of the river. If domestic, industrial, or agricultural water consumption were to expand in the Yellowstone River Basin, increases in nutrients would occur through lowered river flows (loss of dilution) and by the return to the river of nutrient "wastes." Knudson (1976), in using algal assays, demonstrated that increases in nutrients (particularly phosphorus) could lead to exponential increases in algal biomass. Diel measurements demonstrated that increases in dissolved oxygen fluctuations can be expected with increases in this algal accumulation. The flow at which near critical dissolved oxygen fluctuations occurred at Custer was approximately 4,000 cfs (measured) and at Miles City near 6,000 cfs (calculated). Diel dissolved oxygen and algal accumulation data indicate that the lower river has a greater potential for reaching harmful dissolved oxygen fluctuations with decreased flows than does the middle river.

Based on the above information, tentative recommendations were made for average late summer flows (August 1 through September 15) necessary to protect the aquatic ecosystem of the Yellowstone River from harmful dissolved oxygen fluctuations:

> The Yellowstone River from the confluence of the Clarks Fork River to the confluence of the Bighorn River - 4,500 cfs
>
> The Yellowstone River from the confluence of the Bighorn River to the North Dakota state boundary - 7,000 cfs.

Although these flows are currently considered tentative, they certainly support the need for a minimum of 7,000 cfs between August 1 and September 15 in this lower reach.

## DECEMBER - JANUARY - FEBRUARY

The winter months (December, January and February) commonly have the lowest flows of the year. This is also the period when the aquatic populations are under the greatest stress. Growth for most species is slowed or halted, largely a result of near 32 F water and reduced production and availability of food organisms. Aquatic populations suffer their greatest natural mortality and biomass reduction during this period. The aquatic habitat available to fish and their food organisms is at its lowest point. The riffles are commonly areas of greatest insect production in streams (Hynes 1970) and are most effected by reduced flow levels in the winter. Riffles are not only affected by reductions in wetted bottom areas, but also by anchor ice formation in winter months.

From a biological standpoint, the winter months have the least quantitative data available. While it is known that this period produces the greatest natural mortality, the exact causes of winter mortalities in a stream are poorly understood. While it is known that the burbot spawn during the winter months, the exact times, locations, and conditions are largely unknown. The habitat, movements and food habits of the important sport and forage fishes are poorly understood for the winter months. The biological effects of ice, both anchor ice and the spectacular ice jams which commonly occur on the lower river, remain a mystery.

In view of the critical nature of the winter period, it is felt that any significant depletion at this time could produce severe impacts on the fishes and related aquatic life and the fur bearers (Martin 1976) of the lower Yellowstone.

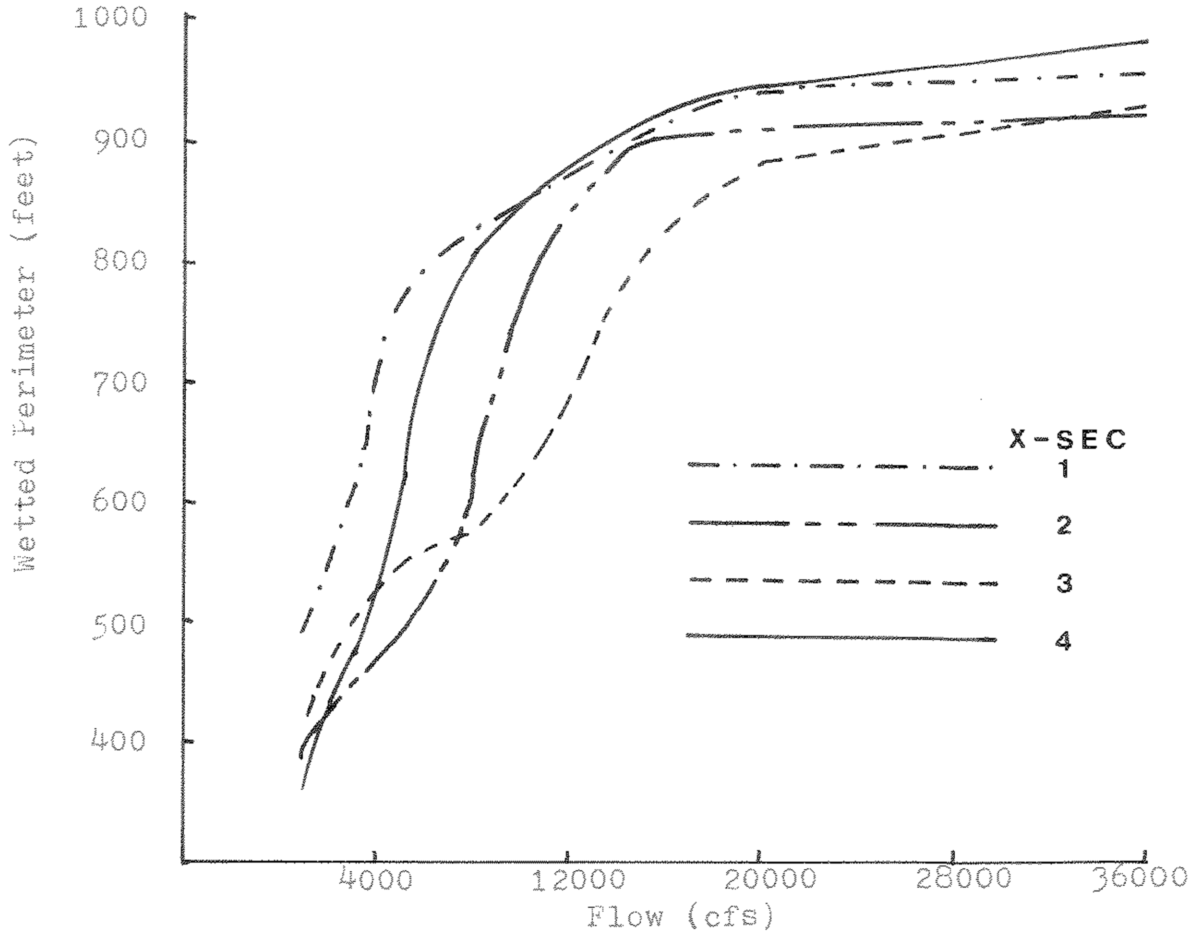



Figure 7. Relationship between wetted perimeter and flow for cross sections 1, 2, 3 and 4, Yellowstone River below Intake.

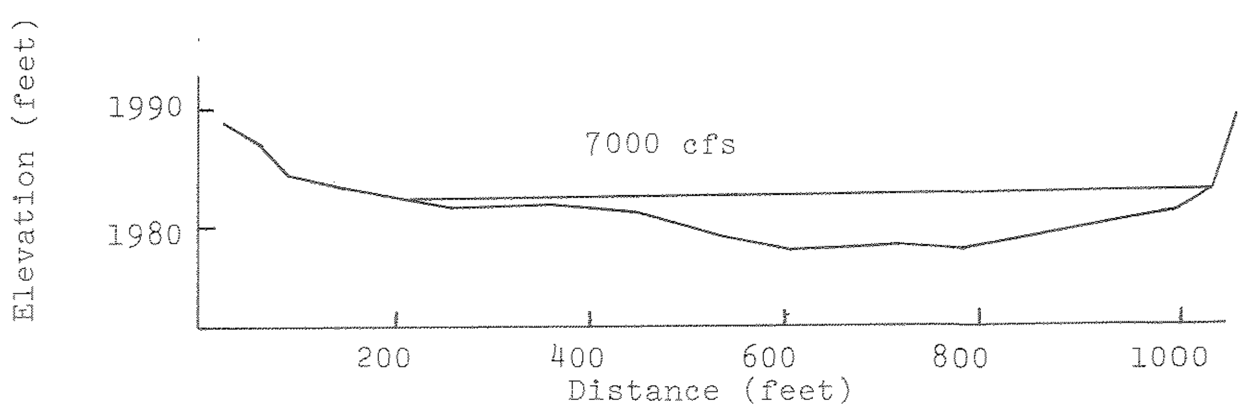



Figure 8. Profile of Intake cross section 1 with water surface elevation at 7,000 cfs shown.

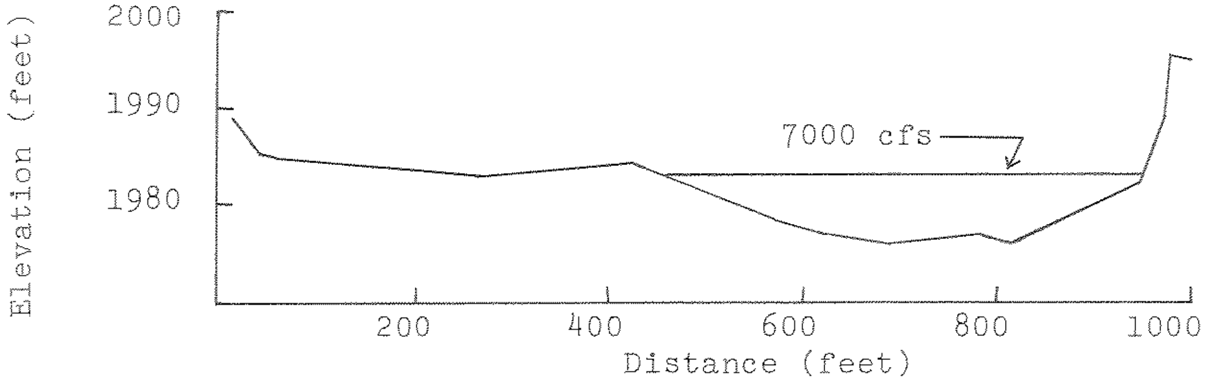



Figure 9. Profile of Intake cross section 2 with water surface elevation at 7,000 cfs shown.

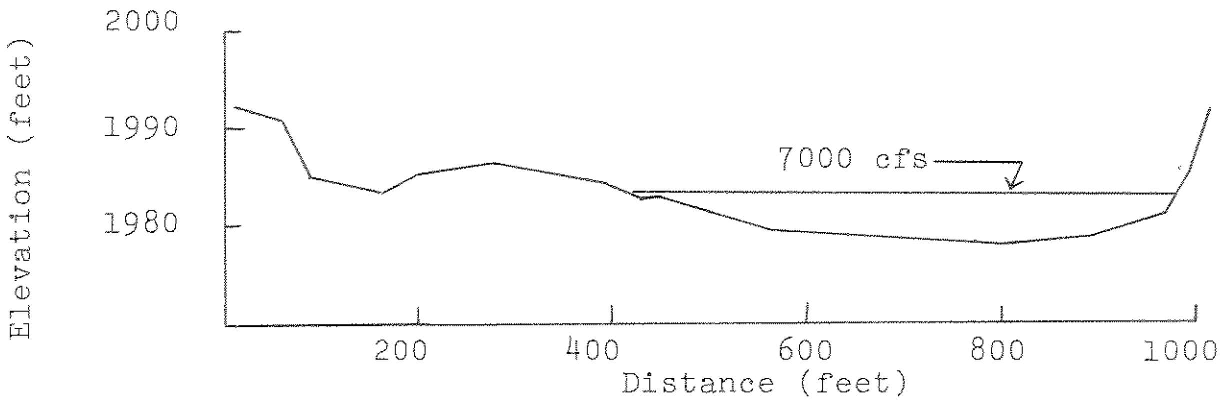



Figure 10. Profile of Intake cross section 3 with water surface elevation at 7,000 cfs shown

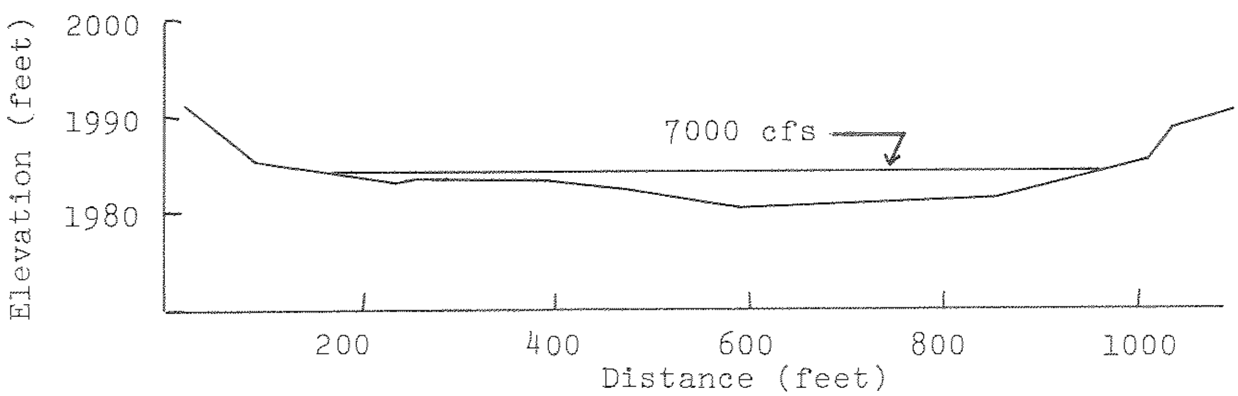



Figure 11. Profile of Intake cross section 4 with water surface elevation at 7,000 cfs shown.

The lack of quantitative data makes a determination of a minimum stream flow for the winter months very difficult. At present, it is felt the best protection to be provided the aquatic and wildlife resources of the lower river during this period would be to reserve the median flow for the winter months.

Median flow values for the Yellowstone River at Sidney and Miles City were computed by the U.S. Geological Survey for the period 1936-1974. Median flow values at Sidney for December, January and February are 5,680, 4,870, and 5,940, respectively. Corresponding median flows at Miles City are 5,600, 4,820, and 5,460. Median flows were rounded to the nearest 100 for the requested flows.

## SUMMARY

The requested flows for the lower Yellowstone (Mouth of Bighorn River to Montana-North Dakota State Line) are summarized in table 6. The lower river was divided into two sections (Section 1 - Mouth Bighorn to Mouth Powder, Section 2 - Mouth Powder to Montana-North Dakota State Line) to accomodate those months where significant variations in flow between the two U.S.G.S. gage sites (Section 1 - Miles City, Section 2 - Sidney) occur.

Requested flows for the March - May 20 period are the same for both sections, even though, in certain years, significant differences in flow between the two gage sites do occur.

Goose nesting studies indicate that the major nest predation problems occur in section one, and the requested flow of 11,000 cfs for goose nesting relates to the Miles City gage (section 1). Correspondingly higher flows during March and April were not requested for section 2, since deeper channels present in section 2 minimize nest predation under lower flow conditions and 11,000 cfs is believed adequate from March to May 20 for section 2 also (T. Hinz - pers. comm.).

Table 6. Flow reservation for the lower Yellowstone River from the mouth of the Bighorn River to the Montana-North Dakota State Line.

| Time | Section 1 - Mouth Bighorn R. to Mouth Powder R. 1/ FLOW | | Section 2 - Mouth Powder R. to Mont-N.D. State Line 2/ FLOW | |
|---|---|---|---|---|
| Period | CFS | Acre-Feet | CFS | Acre-Feet |
| January | 4,800 | 295,200 | 4,900 | 301,350 |
| February | 5,500 | 309,745 | 5,900 | 332,271 |
| March | 11,000 | 676,500 | 11,000 | 676,500 |
| April | 11,000 | 654,500 | 11,000 | 654,500 |
| May 1-20 | 11,000 | 436,260 | 11,000 | 436,260 |
| May 21-31 | 17,000 | 337,110 | 20,000 | 396,600 |
| June 1-7 | 25,000 | 347,025 | 26,000 | 360,906 |
| June 8-30 | 42,000 | 1,925,493 3/ | 45,000 | 2,066,286 4/ |
| July 1-20 | 17,000 | 674,220 | 20,000 | 739,200 |
| July 21-31 | 9,200 | 182,436 | 10,000 | 198,300 |
| August | 7,000 | 430,500 | 7,000 | 430,500 |
| September | 7,000 | 416,500 | 7,000 | 416,500 |
| October | 7,000 | 430,500 | 7,000 | 430,500 |
| November | 7,000 | 416,500 | 7,000 | 416,500 |
| December | 5,600 | 344,400 | 5,700 | 350,550 |
| Total | | 7,876,889 | | 8,206,723 |

1/ All flows in section 1 relate to the U.S.G.S. gage at Miles City.

2/ All flows in section 2 relate to the U.S.G.S. gage at Sidney.

3/ Total acre-foot figure for June 8-30 includes one day of bankfull flow at 47,000 cfs.

4/ Total acre-foot figure for June 8-30 includes one day of bankfull flow at 52,000 cfs.

## Bighorn River Flows at Mouth

The Bighorn River enters the Yellowstone near Custer, Montana and is the largest tributary to the lower river. U.S. Geological Survey records indicate an average annual contribution of approximately 30 percent to the Yellowstone (U.S. Geological Survey 1975). During certain months, the Bighorn may contribute as much as 50 percent of the flow of the Yellowstone at Miles City. The need for maintaining adequate flows in the Bighorn is apparent. A recommended flow for the Bighorn River at its mouth is based on inflow from the Bighorn necessary to maintain the proposed instream flows for the Yellowstone.

Bighorn River flows were derived by comparing the occurence of requested flows at Miles City with the corresponding discharge from the Bighorn considering a two-day lag time. Comparisons were made on a monthly basis and data from post regulation water years 1968 through 1975 were considered. An average percent contribution was calculated and applied to the requested flows at Miles City.

In addition, average monthly discharge figures from Yellowtail dam were calculated and compared to the discharge figures obtained by the above method. The lower of the two figures for the comparison period was used. Requested Bighorn flows at the mouth are shown in table 7.

All calculations for Bighorn River flows were based, for the most part, on better than average flow conditions which occurred during the post impoundment period of record. Alternate methods of arriving at recommended flows for the lower Bighorn are being considered. As such, the lower Bighorn flows should be considered tentative and may be subject to possible revision as the data or methods indicate.

Table 7. Flow reservation for Bighorn River at Bighorn, Montana (mouth).

| | CFS | Acre-Feet | Period | CFS | Acre-Feet |
|---|---|---|---|---|---|
| January | 3,300 | 202,950 | July 1-20 | 3,800 | 150,708 |
| February | 3,200 | 179,263 | July 21-31 | 3,200 | 63,456 |
| March | 4,000 | 264,000 | August | 2,800 | 172,200 |
| April | 3,600 | 214,200 | September | 2,600 | 154,700 |
| May 1-20 | 3,800 | 150,708 | October | 2,700 | 166,050 |
| May 21-31 | 3,800 | 75,354 | November | 3,100 | 184,450 |
| June 1-7 | 5,200 | 72,181 | December | 3,200 | 196,800 |
| June 8-30 | 5,200 | 237,167 | | | |
| | | | Total | | 2,484,187 |

1. Name: Fox Lake - Richland County

2. Reach: NA

3. Location: 1/2 mile west of Lambert, T22N, R55E

4. Fish Species Present: NA

5. Wildlife Species Present:

Resident: White-tailed deer
Sharp-tailed grouse
Ring-necked pheasant
Hungarian partridge
Muskrat
Red fox
Mink
Mule deer
Coyote

Migratory: Snow geese
Canada geese
White-fronted geese
Redheaded duck
Canvasback
Mallard
Pintail
Blue-winged teal
Green-winged teal
Shoveler
Gadwall
Lesser scaup
Sandhill crane
Raptors
Shorebirds
Numerous small birds

6. Life History Periodicity Chart: Attached

7. Methods:

The water volume of Fox Lake was determined according to Welch (1948) by measuring a contour map of the lake constructed in 1956 by G. E. Brennan, Sidney, Montana. The total water volume was determined to be 4900 acre-feet. Water to fill the lake comes from Fox Creek and several unnamed tributaries. This application requests water from each of the important tributaries which supply water to the lake (see below). The amount of water requested from each tributary is based on the size of the drainage area of each tributary, and the percent it comprises of the total drainage area measured (36.8 sq. mi.). The percent each tributary contributed was multiplied by 4900 acre-feet to arrive at the requested flow needed from each tributary. USGS 7.5 minute quadrangle maps were used to determine drainage areas.

8. Why Lake Water Level is Necessary:

The Fox Lake Game Management Area includes 1362 acres, all of which is public land except for a 150-200 foot railroad right-of-way passing through its north side. It was purchased by the Montana Department of Fish and Game primarily to preserve a 1200-acre marsh. Secondary objectives included improvement as a waterfowl production and resting area, and as a public hunting ground. It represents one of the few places where sportsmen may pursue marsh-type waterfowl hunting in eastern Montana.

During dry years, the marsh is usually devoid of water, but during wet years, many ducks breed there and thousands of ducks and geese use it for a resting and feeding area in spring and fall. In order to improve water conditions, a privately financed dike was built in 1930. The dike increased the water depth but caused erosion problems on the railroad bed so the Great Northern Railroad destroyed it in the early 1940's.

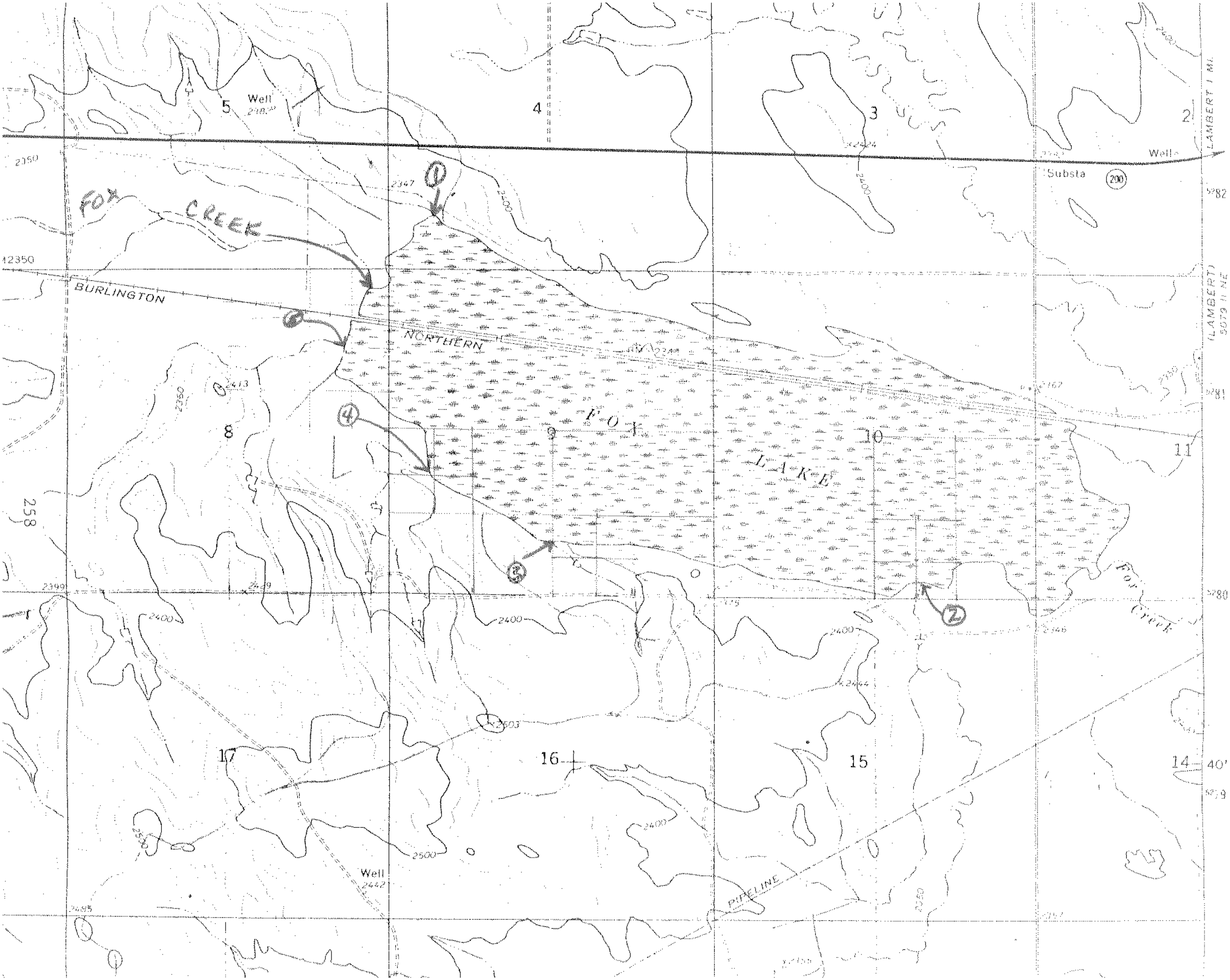
The Department of Fish and Game made its initial land purchase (264 acres) in the area in 1952 and acquired all of the Fox Lake land now under its control by 1962. Communications with the Great Northern Railroad relative to stabilizing the water level were started in 1965 and have continued until recently. To date, no agreement has been reached with what is now the Burlington Northern Railroad. Because of this, the Department of Fish and Game will approach the 1977 Montana Legislature with a proposal to construct a system of permanent dikes and gates using funds from the Renewable Resources Act.

This water reservation request is necessary to guarantee that water will be available for the water control project in the marsh (Fox Lake). The resulting stabilization of water levels will allow use of Fox Lake by breeding and migrating waterfowl every year rather than intermittently. Waterfowl production, recreational hunting and birdwatching will thus be greatly enhanced.

9. Flow (or Level) Request:

Fox Lake requires a water reservation in the amount of 4900 acre-feet. This amount is to be obtained from Fox Creek and tributaries draining into Fox Lake in the amounts shown below from January 1 to December 31, inclusive, each year. All waters are to be reserved at the confluence of the respective streams with Fox Lake.

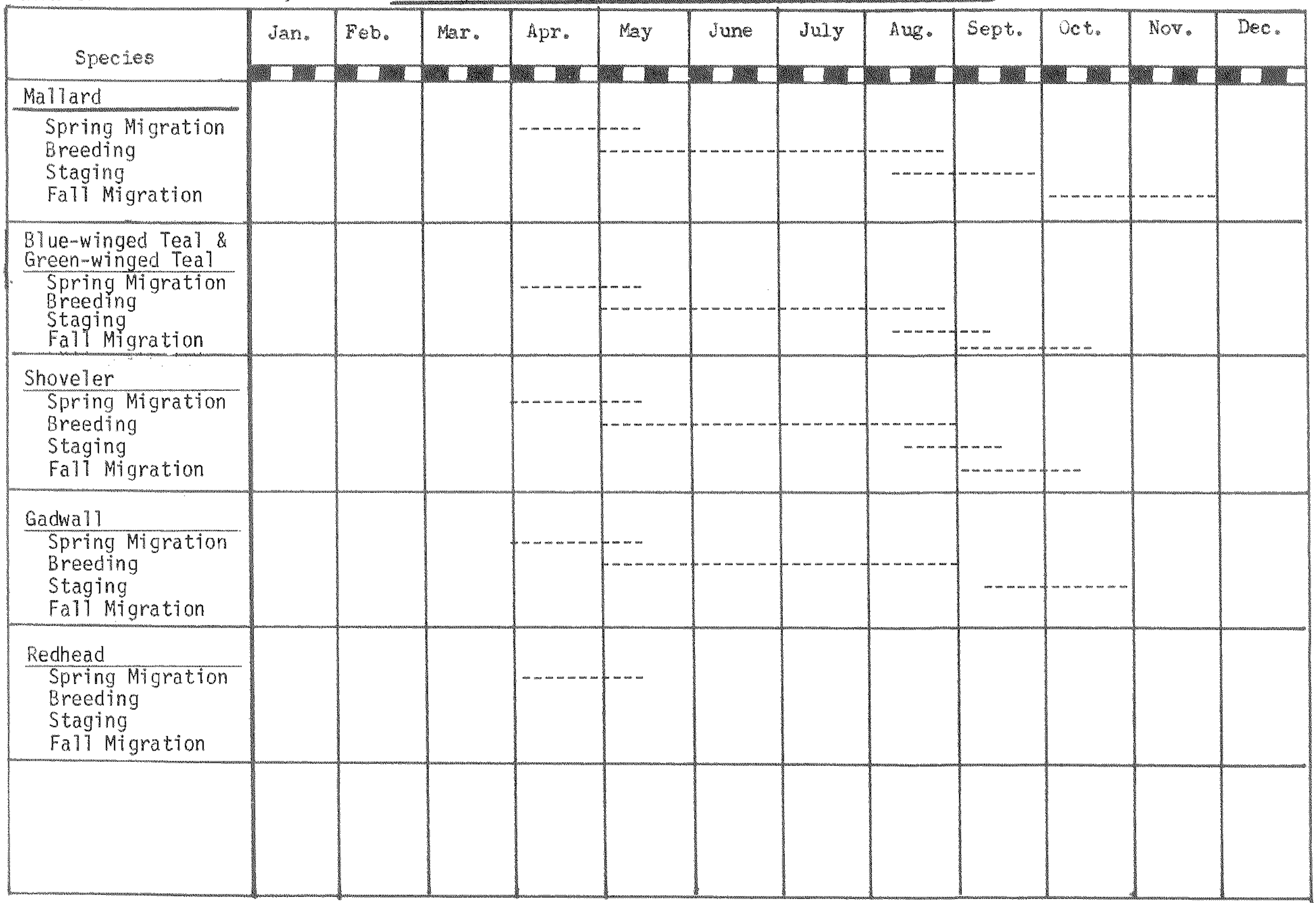
| Stream | Location of Confluence with Fox Lake (see attached map) | Amount of Water Necessary for Purpose of Reservation (Acre-Feet) |
|---|---|---|
| Fox Creek | NE¼NE¼NE¼ Sec. 8, T22N, R55E | 2167 |
| Unnamed Tributary (1) | NE¼SW¼SW¼ Sec. 4, T22N, R55E | 43 |
| Unnamed Tributary (2) | SE¼SW¼SE¼ Sec. 10, T22N, R55E | 1984 |
| Unnamed Tributary (3) | NW¼SW¼SE¼ Sec. 9, T22N, R55E | 19 |
| Unnamed Tributary (4) | NW¼NW¼SW¼ Sec. 9, T22N, R55E | 64 |
| Unnamed Tributary (5) | SW¼NE¼NE¼ Sec. 8, T22N, R55E | 623 |
| | Total | 4900 |



FOX LAKE
Fox Creek
FOX CREEK
BURLINGTON
NORTHERN
LAMBERT 1 MI.
(LAMBERT) 5079 II NE
Substa
200
Well
PIPELINE
2400
2500
258

LIFE CYCLE PERIODICITY CHART

Name of lake: Fox Lake, Richland County



## STATEMENT THAT THE RESERVATION IS IN THE PUBLIC INTEREST

The applied-for reservation is in the public interest. Strong evidence that this request is in the public interest is found in the overwhelming executive, legislative and public support given to Senate Bill 728 (the Yellowstone moratorium) during the 1974 legislative session. Granting of the reservation here requested would strengthen and augment that support and interest.

The public benefits which will occur from the reservation include the following:

(1) continued perpetuation of the fish and wildlife resources as currently found in the Yellowstone basin, whose existence is in the public interest;
(2) continued perpetuation of the existing fish and wildlife resources found in the Yellowstone basin for current and future utilization by the public;
(3) prevention of the gradual depletion of streamflows currently enjoyed by the public for recreational uses;
(4) maintenance of water quality which contributes to a clean, healthful environment for the citizens of Montana and the nation;
(5) a contribution to the protection and continued utilization of existing water rights in the basin.

This application is not a request for flow augmentation through storage. It is an application that there be established a base that perpetuates the historical and natural flow pattern of the Yellowstone River and that this base be supported by the Board of Natural Resources.

Fish and wildlife have always been a part of Montana. For many centuries they have been a source of support of human life and continue to be a part of the way of life in Montana. They have been, and are, a continual source of public recreation. Fish and wildlife are environmental indicators as to what we are doing with the public's land and water. Impact on the land is reflected in fish and wildlife populations long before we can precisely measure or predict the total environmental impact of our activities. After gaining acceptance of this concept, rapidly evolving environmental law is providing a remarkable array of real opportunities for fish and wildlife managers to defend fish and wildlife habitat. Montana is a good case in point. The real challenge now lies in implementation.

In discussing the adverse and beneficial environmental and economic effects of the reservation as required in the MAC rules, it became evident that any discussion must include alternative actions if these effects were to be determined. Thus we have discussed these alternatives in narrative form and summarized the impacts in an environmental-economic matrix.

The alternative actions chosen for discussion and the matrix include four possible actions which could be taken by the Board of Natural Resources on this reservation application. These include (1) no reservations of any kind are granted; (2) Fish and Game reservation is granted in the full amount requested; (3) Fish and Game reservation is not granted at all, but reservation requests by conservation districts, cities and towns are granted in full and the remaining water allocated on a piecemeal basis; (4) Fish and Game reservation is granted in some lesser amount.

There are an infinite number of possibilities and combinations in this latter category and it is impossible to analyze even a portion of them. It is assumed the adverse impacts would be greatest the less water is granted.

The discussion and matrix assume the conditions of the alternatives would apply to each stream in the same amounts and do not show the infinite possibilities which could occur in water reservation allocations. It is our contention that although the dewatering of a single stream <u>may</u> not produce <u>significant</u> adverse environmental or economic consequences, the cumulative effects of such individual dewaterings will produce these adverse consequences in the long run. Not granting a reservation on any given stream may not show adverse economic impacts. However, the cumulative effects might have adverse impacts. The matrix thus shows only the <u>net</u> primary effects of alternative actions, even though secondary impacts might occur. Examples of these effects are discussed below.

## A

## Environmental Impacts

Possible, and available, alternatives to the reservations herein requested are as follows:

(1) <u>No reservations of any kind are granted</u>.

Acceptance of this alternative by the Board of Natural Resources would maintain the status quo as far as water allocations are concerned. Water use permits would continue to be issued on a first-come, first-served, piecemeal basis as they currently are being issued. Water rights for instream uses would not be available and these resources would continue to suffer from gradual dewatering of streams. Fish and wildlife resources would continue to receive no recognition in the issuance of water use permits and would thus continue to be degraded by the diversion of water for other uses.

Water use permits requested by industry would eventually be issued following expiration of the Yellowstone moratorium and agriculture and instream uses would not receive the "preference" in use over other use permits as is authorized in the Yellowstone moratorium (Section 89-9-105(2) R.C.M. 1947.

Another significant long-term detriment to be derived from this alternative would be the continued issuance of water use permits for diversionary purposes without the benefit of knowing water availability and current usage. Only through the process of determining existing rights as authorized in Montana's Water Use Act can future water allocations be accomplished in a rational manner. This adjudication process by the state of Montana is necessarily slow and complicated and it will likely be many years before the process is completed in the entire Yellowstone basin. Thus this would not be an immediate solution to water allocation problems and would assume the risks of making proper long-term solutions even more unavailable.

Existing water rights in the river basin will at all times be honored. If the reservations here requested are not granted and approved, any waters available over and above such existing rights will be vulnerable to future appropriations by permit. If these future appropriations are allowed to be executed in advance of, or without, the reservations here requested being established, the fish and wildlife resources will be permanently deprived of the waters so necessary for their healthy survival. It is readily apparent that when realistically considered, under our current water laws and regulations, waters once allowed to be appropriated might well never again be available for reservation for fish, wildlife and recreational purposes. The need for an adequate reservation now is thus dictated.

The principal detriment in the use of this alternative would be toward instream water uses for fish and wildlife. Other beneficial water users such as agriculture, industry, domestic, power, mining etc. would continue to obtain water as they needed it while fish and wildlife resources would do with less amounts as the years went by. The losses to the public could, thereby, become irretrievable.

(2) Fish and Game reservation granted in full.

Such action would have two types of environmental consequences: (a) In the upper Yellowstone basin (from Gardiner to Big Timber) applicant asks for reservation of the "instantaneous streamflow subject to existing, lawfully appropriated water rights in the stream reach," except during the spring high water months. Specific flows have been requested for those months or portions thereof. In this situation the environmental benefits derived will very much favor proper instream uses for fish and wildlife and recreation. In those streams currently not suffering from dewatering, existing levels of aquatic populations will be maintained because there will be no change in the natural streamflow regime. Streamflows will continue to include highs and lows, and those flows in between to which existing populations have evolved. On those tributary streams where water levels are already low due to summer irrigation withdrawals, and where the aquatic resources are perhaps currently not at optimum levels, granting of the reservation will help ensure that those populations are not further degraded by reduction in flow, and will, perhaps, allow them to increase in numbers in the long run.

In this upper portion of the basin, water for agricultural and industrial uses will be available during the spring high flow period when streamflows exceed our request for that period. During other months, existing water rights will be protected, but new rights will not be possible unless alternative water sources are found, suitable offstream storage facilities are developed, or water use efficiencies are increased.

(b) In the middle and lower portions of the basin, specific streamflow quantities ("numbers") have been requested. By assigning these numbers, we have ourselves ultimately altered the natural flow regime of the streams, assuming that all water in excess of our requests will be withdrawn for other beneficial uses. Thus we have created conditions which will alter the status of existing fish and wildlife populations through changes in aquatic and riparian habitat of the streams. This will be a future environmental detriment to these instream uses.

Conversely, granting of the full request will be an environmental benefit from the standpoint that fish and wildlife will have access to streamflows which could otherwise be withdrawn for other future beneficial uses, to the detriment of those populations. In those instances where streams have been low at times due to water withdrawals, establishment of flow numbers will protect the aquatic resource from further degradation.

Thus in weighing the beneficial against the detrimental effects of this alternative on fish and wildlife, the net effect will be to benefit the aquatic resource. Although it is not logical from a fish and wildlife standpoint, to request flow "numbers" on natural, unregulated streams, we are forced into this position by the recognition of the needs of other water users.

Water will be available above our flow requests for other uses throughout the year, making new water sources of offstream storage projects less likely requirements than in the upper basin.

In all cases existing rights will be honored and existing irrigation facilities will be protected from excessive lowering of water levels.

(3) Fish and Game reservation not granted at all while reservations for future diversionary use are granted.

This alternative will have a completely detrimental effect on aquatic resources. Water will be allocated to other uses, particularly future diversionary uses, with no consideration for instream resource values. Water will be available for both agricultural, domestic and industrial uses in more or less unlimited amounts since no quantities for instream uses are provided for. This will be beneficial to those other users but will ultimately destroy existing fish and wildlife values of the river system.

Existing water rights in the river basin will at all times be honored. If the reservations here requested are not granted and approved, any waters available over and above such existing rights will be vulnerable to future appropriations by permit. If these future appropriations are allowed to be executed in advance of, or without, the reservations here requested being established, the fish and wildlife resources will be permanently deprived of the waters so necessary for their healthy survival. It is readily apparent that when realistically considered, under our current laws and regulations, waters once allowed to be appropriated might well never again be available for reservation for fish and wildlife purposes. The need for an adequate reservation now is thus dictated.

This alternative is probably the most detrimental of the four presented. It is more detrimental than alternative (1) since it would allocate water for a number of years in the future, leaving little or no chance for possible future fish and wildlife uses. Alternative (1) does not grant rights for the future and thus allows us the chance to eventually obtain water for instream fish and wildlife uses from unallocated water sources. (Adoption of this alternative would completely ignore constitutional and statutory directives and concerns.)

(4) Fish and Game reservation granted in some lesser amount.

There are an infinite number of possibilities and combinations in this alternative and it is not possible to address even a portion of them.

Under this alternative, it can generally be stated that the more the requested reservations are discounted, the more detrimental the impacts will be on fish and wildlife and public recreation. Also, it might fairly be stated that the more such reservations are discounted, the more the risk of irretrievable loss to the fish and wildlife resource in years to come - especially if such discounting would be effected in order to accommodate applications for water applications not now in existence or for uses not now being exercised.

In assessing the net environmental and economic impacts of the reservation, certain conditions must be assumed. For example, to say that a reduction in streamflow will have a negative effect on aquatic populations in a given stream, we make the assumption (properly, it is believed) that we are all attempting to maintain the existing ecological situation as closely as possible. To assume otherwise would open a Pandora's box of speculative potential positive effects which could occur with a reduction in flow. For example, a reduction in flow might increase the frequency of excessive algal amounts in the stream on an annual basis. This could be proclaimed as a benefit to the algae and, consequently, to fish which depend upon algae for food. At the same time, biological oxygen demand (BOD) could be increased on the greater amounts of decomposing algae, causing lowered oxygen content in the stream. Lowered flows which allow access to fishing areas currently flooded by high water would benefit public access, but might not allow channel forming processes to occur which would produce detrimental effects on aquatic habitat. An increase in summer water temperatures might benefit swimmers who previously made only limited use of the stream reach, but could adversely affect aquatic populations and water quality. Low water levels which allow raccoons, skunks and other predators more frequent access to Canada goose nests on river islands would obviously benefit the raccoons, but would be detrimental to the geese.

Environmental conditions in the river system have historically favored one species and then another, depending on environmental conditions, including quantity of water available. Goose nest predation, for example, has always occured; however, it has been higher in some years than in others. Thus geese are benefited during optimum river flows for nesting while predators have benefited in other years. By this request we do not wish to preclude natural predation, we simply do not want it to become a more frequent and permanent part of the ecosystem.

Thus any final analysis of adverse and beneficial effects of being granted or not being granted the reservation request cannot separate any part or function of the ecosystem from the whole ecosystem as it currently exists. Our philosophy then in assigning positive or negative values to environmental parameters is that a detrimental effect would be one which might alter the current structure of the ecosystem as a whole even though some portion of that system might be benefited.

## B

## Economic Impacts

Economic analysis of the impacts from our reservation is difficult to accomplish due to inadequacies in available information. What is necessary is to be able to quantify the dollar value of impacts occurring from a water reservation. (For example, the expenditures of anglers in the upper Yellowstone - Paradise Valley - is $X per person per day.) Then, through quantification, the impact of losing these expenditures can be addressed. Similarly, boating, camping, rafting, swimming, etc. could be analyzed as to their impacts. Unfortunately, this information or the value of the amenity resource is not available for the Yellowstone basin.

What does exist, are studies identifying and measuring the economic value of tourism and recreation. Polzin and Schweitzer (1975) estimated the expenditures of nonresident anglers in 1971, and the direct income to Montana residents for each dollar spent. Although based upon nonresident expenditures, the analysis can be used as a base to estimate changes in the economy occurring from resident expenditures (recreation) as well.

A study conducted for the Montana Fish and Game Department in 1960 indicated significant average expenditures by resident and nonresident anglers (McConnen 1960). Again the precision of the data does not allow specific analysis in the Yellowstone basin, but will adequately assist assessment of changes in the local and basin economy (Gum et al 1973).

One problem area which exists with analysis of the economic impacts of our water reservation is assessment of foregone opportunities. Agriculture could be adversely impacted with marginal units going out of production due to lack of ability to irrigate new lands. Where our full reservation precludes water development by agriculture, then potential increased revenues will be lost to the farmers and ranchers and to the local economies (it is not clear, however, that conflicts will exist over available supplies). However, there are no numbers available to allow for analysis of these potential changes.

While the resulting agricultural economic impacts from our reservation (if granted in full) will be in all probability minimal, as will be discussed later, foregone industrial development could have substantial short-term impacts.1/ Quantification of the income and employment derived

1/ Short-run impacts of the expected lifetime of possible industrial uses would be approximately 40-50 years (for example, the expected life of Colstrip 3 & 4 is 37 years). Conversely, instream values will be for an infinite time.

from a coal generation or coal gasification plant is possible, whereas the instream value of a river is not possible to quantify at this time. Hence, there is no ability to quantify benefits vs. costs under the various alternatives.

Likewise, no quantification is available for the "consumer surplus" of the instream values. By "consumer surplus" the economist means the value of fishing over actual out-of-pocket expenses such as food, lodging, transportation, equipment costs, etc. Or put another way, it is what a blue ribbon fishery is worth to its users including anglers, viewers, floaters, etc.

We do not believe dollar values can currently be assigned to the intangible instream water uses. A recent paper by Copeland and Stroup (1976), economists at Montana State University, confirms the problems to be overcome in the estimation of the economic value of these amenities, particularly on a stream system like the Yellowstone River with its great expanse and variety of recreational uses. An abstract of the paper is presented in Appendix C. Therefore, this department does not choose to relate the economic beneficial and adverse effects of the reservation in dollar values.

What can be done to show the economic effects of our reservation is a qualitative analysis of the economic impacts directly (and indirectly through income and employment multipliers) resulting from recreational amentities of the Yellowstone basin.

The form of the analysis will be a matrix using positive, negative and negligible impacts. Assuming recreation expenditures to be positive for recreational use (see previously mentioned studies) and looking at recreation values of various reservation alternatives, then analysis can be done. (See Economic Background, Appendix D.)

Several points should be given about the assumptions of the matrix. First it assumes that there will be no water quality problems in the lower stretches of the river such as increased salinity, BOD, solids, temperature, etc. with increased diversions. If these problems do occur, then the impacts from the full water reservation on agriculture would be negligible or positive in Sections 3, 4 and 5 because with poor water quality the Yellowstone will be unsuitable for irrigation, with those using the water doing harm to the productive capabilities of their land and hence their economic position.

Secondly, it assumes that irrigation uses will remain the same. For example, in Sections 1 and 2, which are predominantly ditch systems, the conversion to sprinkler irrigation would conserve considerable water, which would be available for future use.

Similarly, the matrix assumes no offstream storage of spring runoff. If captured, this water could be used for additional irrigation.

At this time it is difficult to understand the total economic ramifications of this application. The worst picture is presented here, although it could change considerably when more information is known.

## C. State and Federal Legislation and Policies Which Support the Reservation

In accordance with the MAC Rules governing water reservation applications, the following state and federal legislation and policies are submitted in support of this application. All of these laws or policies relate to the concern for preservation of the environment through the wise use of natural resources, including an extremely important use - WATER. These laws and policies reflect the concern of Montana citizens as well as citizens of the United States in protecting the unique natural resources which have provided this country with a way of life second to none on this earth. Streams have always been closely associated with our way of life. They have nourished our growth, irrigated our farms, provided electric power, and served as avenues of commerce. But in the course of time and through development, many of our streams and rivers have become so degraded from pollution, physical destruction and dewatering that they are no longer fit for human contact. This trend has recently been reversed through passage of legislation which has altered the old way of doing business. When the Wild and Scenic Rivers Act (Public Law 90-542) was recommended to congress for passage, the secretaries of interior and agriculture made the following declaration:

"America's rivers flow deep through our national consciousness. Their courses beckoned us to explore a new continent and build a nation, and we have come to know, depend upon and love the rivers that water our land.

"We have harnessed many of our rivers, dedicating some to navigation, others to power, water supply, and disposal of wastes. But we have not yet made adequate provision to keep at least a small stock of our rivers as we first knew them: wild and free-flowing. In a nation as bountifully endowed with rivers as ours, it is time to do so." (From Wild and Scenic Rivers information pamphlet by Bureau of Outdoor Recreation and U.S. Forest Service, June 1965.)

Recognition of the fish and game resource is present in the Montana Constitution and in Montana statutes. While this recognition was implicitly recognized before the early 1970's, it has been directly stated since that time.

In all this legislation, the importance of the fish and game and recreational resource is acknowledged as a legal contender for the land and water that now sustains it. This recognition is gained through constant emphasis on its right to exist and its ability to indicate the quality of our own existence.

The following is a summary and discussion of state and federal legislation and policies relating to this reservation application.

### State of Montana Legislation and Policies

(1) Constitution of the state of Montana adopted March 22, 1972 and ratified June 6, 1972.

Article IX deals with the environment and natural resources. Section 1(1) states that the state and each person shall maintain and improve a clean and healthful environment in Montana for present and future generations. Section 1(2) states that the legislature shall provide for the administration and enforcement of this duty; Section 1(3) states the legislature shall provide adequate remedies for the protection of the environmental life support system from degradation and provide adequate remedies to prevent unreasonable depletion and degradation of natural resources.

Section 3(3) states that surface waters are the property of the state for the use of its people and are subject to appropriation for beneficial uses as provided by law.

This constitutional mandate and declaration directly support the instream beneficial use applied for because instream uses of water as requested in this reservation application are beneficial water uses as defined in the 1973 Montana Water Use Act. Granting of the water quantities requested in this application will contribute to maintenance of a clean and healthful environment and will help prevent unreasonable depletion and degradation of natural resources.

(2) The Montana Water Use Act
(Sections 89-865 through 89-8-111 R.C.M. 1947)

This 1973 law is the authority under which this reservation application is submitted. Section 89-866 (2) declares that the purpose of the Act is to implement Article IX, Section 3(4) of the 1972 Montana Constitution. Section 89-866(3) declares that it is the policy of the state to "encourage the wise use of the state's water resources by making them available for appropriation consistent with this act, and to provide for the wise utilization, development, and conservation of the waters of the state for the maximum benefit of its people <u>with the least possible degradation of the national aquatic ecosystems.</u>" (Emphasis added.) Section 89-867 defines "beneficial" water use to include fish and wildlife and recreational uses. "Appropriate" is defined to include reservation of water by a public agency. Section 89-890 states that a state agency can reserve water "for existing or future beneficial uses, or to maintain a minimum flow, level or quality of water throughout the year, or at such periods, or for such length of time as the board (Board of Natural Resources) designates."

Since this state law is the authority for this reservation, it directly relates to and supports the beneficial use applied for.

(3) Yellowstone Moratorium
(Sections 89-8-103 through 89-8-111, R.C.M. 1947)

A three year moratorium on issuance of water use permits for flows greater than 20 cfs or storage of 14,000 acre feet or more was passed by the 1974 legislature. The moratorium applied only to the Yellowstone basin. The legislature, in adopting the moratorium, noted the following findings and policy:

"The legislature, noting that appropriations have been claimed, that applications have been filed for, and that there is further widespread interest in making substantial appropriations of water in the Yellowstone River basin, finds that these appropriations threaten the depletion of Montana's water resources to the significant detriment of existing and projected agricultural, municipal, recreational and other uses, and of wildlife and aquatic habitat. The legislature further finds that these appropriations foreclose the options to the people of this state to utilize water for other future beneficial purposes, including municipal water supplies, irrigation systems, and minimum flows for the protection of existing rights and aquatic life. The legislature pursuant to its mandate and authority under article IX of the Montana Constitution, declares that it is the policy of this state that before these proposed appropriations are acted upon existing rights to water in the Yellowstone basin must be accurately determined for their protection, and that reservations of water within the basin must be established as rapidly as possible for the preservation and protection of existing and future beneficial uses."

Reservations established before applications for permits are granted are preferred uses over the right to appropriate water and permits issued are subject to that preferred use.

Evidence that this reservation request is in the public interest can certainly be derived from the overwhelming executive, legislative and public support given this legislation (as Senate Bill 728). This reservation request strongly relates to this legislation since it strengthens state government's position in meeting the intent of that act.

(4) Montana Environmental Policy Act
(Sections 69-6501 through 69-6518 R.C.M. 1947)

In section 2 of the Act, the purpose is cited:

"The purpose of this Act, is to declare a state policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the state; and to establish an environmental quality council."

The manner in which this policy will be implemented is stated later in the act. Sections 3(a) and 3(b) state:

"(a) In order to carry out the policy set forth in this act, it is the continuing responsibility of the state of Montana to use all practicable means, consistent with other essential considerations of state policy, to improve and coordinate state plans, functions, programs, and resources to the end that the state may --

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Montanans safe, healthful, productive, and esthetically and culturally pleasing surroundsing;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our unique heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(b) The legislative assembly recognizes that each person shall be entitled to a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment."

Further, Section 4 states in part:

"The legislative assembly authorizes and directs that, to the fullest extent possible:

(a) The policies, regulations, and laws of the state shall be interpreted and administered in accordance with the policies set forth in this act, and. . ."

Thus it would appear that water allocation is a significant action which falls within the requirements of this act. This legislation directly supports this reservation request which is intended to preserve the integrity of the Yellowstone River and its tributaries and which will contribute to the health and welfare of man and promote harmony between man and his environment.

(5) Montana Stream Protection Act of 1965
(Sections 26-1501 through 26-1509 R.C.M. 1947)

Section 26-1501, R.C.M. 1947 states it is "the policy of the state of Montana that its fish and wildlife resources and particularly the fishing waters within the state are to be protected and preserved to the end that they are available for all time, without change, in their natural existing state except as may be necessary and appropriate after due consideration of all factors involved."

Although this Act speaks specifically to physical changes in stream channels due to construction or hydraulic projects which alter the existing state of those stream channels, it is obvious that the intent of the act was to protect Montana streams and the resources they support from degradation. Water quantity is a necessary factor in maintenance of these streams and cannot be separated from the total habitat requirements which support the fishery resource. Thus this legislation relates to and supports the purpose of this reservation application for beneficial water use.

(6) The Natural Streambed and Land Preservation Act of 1975 (Sections 26-1510 through 26-1523 R.C.M. 1947)

Section 26-1511 states "It is the policy of the state of Montana that its natural rivers and streams and the lands and property immediately adjacent to them within the state are to be protected and preserved to be available in their natural, or existing state, and to. . ." and "further it is the policy of this state. . .to protect the use of water for any useful or beneficial purpose as guaranteed by the Constitution of the state of Montana."

Instream water uses for fish and wildlife and recreation are beneficial water uses according to the 1973 Montana Water Use Act and are thus subject to appropriation under terms of the 1972 Constitution. Thus this act supports the purpose of this reservation application for beneficial instream water use.

(7) Chapter 345, Laws of 1969 Amending Section 89-801

This act amended Section 89-801 to allow the Department of Fish and Game to appropriate the unappropriated waters on 12 designated streams or stream sections "in such amounts only as may be necessary to maintain streamflows necessary for the preservation of fish and wildlife habitat." These rights have priority over other water uses in the stream until the district court in the area should decide another beneficial use to be more appropriate. The 12 streams designated included 7 which are designated "blue ribbon" plus 5 others which are important trout fisheries in Montana.

The fact that the legislature so acted before fish and wildlife, and recreation use were statutorily identified as "beneficial uses" is indicative of the importance placed on instream water uses even before the 1973 Montana Water Use Act was passed. Although Section 89-801 was repealed by the current act, the water filings on the 12 streams are still valid since "existing rights" are recognized by the current water law. This legislation supports the beneficial water use requested in this application.

(8) Section 69-4801 R.C.M. 1947 - Public Policy of the State of Montana (Regarding Water Pollution)

This section of the public Health and Safety Codes states the public policy of Montana is to "conserve water by protecting, maintaining, and improving the quality and potability of water for public water supplies, wildlife, fish and aquatic life, agriculture, industry, recreation, and other beneficial uses," and to provide a comprehensive program for the prevention, abatement, and control of water pollution." (Emphasis added.)

The public interest will be served by granting this reservation request in that the water quantity requested will contribute to the prevention of water pollution which could harm fish and aquatic life, wildlife and recreational uses of the streams in the Yellowstone basin.

The following legislative acts contain similar language relating to preservation of the environment and its life support systems (summary statement is at end of this listing):

(9) Renewable Resource Development Act (Sections 89-3601 through 89-3609 R.C.M. 1947)

Section 89-3601, policy, states that natural resource development in the state will be conducted to "preserve for the citizens the benefit of the state's natural heritage and to ensure that the quality of existing public resources such as land, air, water, fish, wildlife and recreational opportunities are not significantly diminished by developments supported by this act."

(10) Montana Major Facility Siting Act, Chapter 327, Laws of 1973

The policy of this act is found in Section 70-802 and states as follows:

"It is the constitutionally declared policy of this state to maintain and improve a clean and healthful environment for present and future generations; to protect the environmental life support system from depradation and prevent unreasonable depletion and degradation of natural resources; and to provide for administration and enforcement to attain these objectives."

(11) The Montana Resources Indemnity Trust Act (Sections 84-7001 through 84-7013 R.C.M. 1947)

"It is the policy of this state to provide security against loss of damage to our environment from the extraction of nonrenewable natural resources. Recognizing that the total environment consists of our air, water, soil, flora, fauna, and also those social, economic, and cultural conditions that influence our communities and the lives of our individual citizens, it is necessary that this state be indemnified for the extraction of those resources. Therefore, it is the purpose of this chapter to provide for the creation of a resource indemnity trust in order that the people and resources of Montana may long endure."

(12) The Montana Pesticides Act
(Sections 27-213 through 27-245 R.C.M. 1947)

Section 27-214, declares that "The control of pesticides and their use is essential for the protection of man and his environment. Pesticides are currently considered valuable and necessary to provide sufficient quantity of quality foods and for the protection of humans from vector-borne diseases. However, the protection of man and his essential needs - water, air, food, animals, vegetation, pollinating insects, and shelter from pesticides which are potentially dangerous - is in the public interest now and in the future. Therefore, it is deemed necessary to provide for the control of pesticides."

(13) The Montana Strip and Underground Mine Reclamation Act
(Sections 50-1034 through 50-1057 R.C.M. 1947)

The policy of this act states in part in Section 50-1035 R.C.M. 1947, that it is the declared policy of this state and its people

"- to maintain and improve the state's clean and healthful environment for present and future generations,

- to protect its environmental life-support system from degradation,

- to prevent unreasonable degradation of its natural resources,

- to restore, enhance, and preserve its scenic, historic, archaeologic, scientific, cultural, and recreational sites,"

by proper control and planning of strip mining activities in Montana, and also preventing certain unique lands from being mined if the land has been defined as having such unique characteristics as (1) "biological productivity, the loss of which would jeopardize certain species of wildlife". . . (2)"ecological fragility in the sense that the land, once adversely affected could not return to its former ecological role in the foreseeable future," (3) "ecological importance" such that the land is of such importance to the total ecosystem that even temporary disturbances could precipitate a systemwide reaction of unpredictable nature, (4) "scenic, historic, archaeologic, topographic, geologic. . .or recreational significance."

(14) The Open Cut Mining Act
(Sections 50-1501 through 50-1517 R.C.M. 1947)

Section 50-1502, R.C.M. 1947, states "Policy of state. It is the policy of this state to provide for the reclamation and conservation of land subjected to open cut bentonite, clay, scoria, phosphate rock, sand or gravel mining. Therefore, it is the purpose of this act to preserve natural resources, to aid in the protection of wildlife and aquatic resources, to safeguard and reclaim through effective means and methods all agricultural, recreational, home and industrial sites subjected to or which may be affected by open cut bentonite, clay, scoria, phosphate rock, sand or gravel mining to protect and perpetuate the taxable value of property, to protect scenic, scientific, historic or other unique areas, and to promote the health, safety and general welfare of the people of this state."

(15) The Strip and Underground Mine Siting Act
(Sections 50-1601 through 50-1617 R.C.M. 1947)

The act provides in Section 50-1602 a policy of the state which will "provide adequate remedies for the protection of the environmental life support system from degradation and provide adequate remedies to prevent unreasonable depletion and degradation of natural resources" and exercise general police power to provide for the health and welfare of the people."

(16) Mined Land Reclamation Act
(Sections 50-1201 through 50-1226 R.C.M. 1947)

The act controls reclamation of mined lands and gives as one of the purposes of the act (Section 50-1202) to provide for (1) "the recognition of the recreational and aesthetic values of land as a benefit to the state of Montana" and (2) "that the usefulness, productivity and scenic values of all lands and surface waters involved in mining and mining exploration within the boundaries and lawful jurisdiction of the state will receive the greatest reasonable degree of protection and reclamation to beneficial use."

(17) The Nongame and Endangered Species Conservation Act
(Sections 26-1801 through 26-1809 R.C.M. 1947)

The policy stated in this act declares in part:

"(1) That it is the policy of this state to manage certain nongame wildlife for human enjoyment, for scientific purposes, and to ensure their perpetuation as members of ecosystems."

The policy of this act further supports the proposed beneficial use, as water is necessary for the perpetuation of these species.

It is clear that all the above acts intended to protect the natural resources of Montana from unwanted degradation. Thus each of these acts in its own way provides for the concern of Montana citizens to protect natural values of their environment for the preservation of their health and welfare. We believe these acts to represent a desire by the people of Montana to preserve these natural values and that these acts support our application for reservation of water to sustain the fish, wildlife, and recreational values of the Yellowstone River basin.

# Montana Fish and Game Commission Policy Statements Related to Instream Uses of Water for Fish, Wildlife and Recreation

The following excerpts from Montana Fish and Game Commission meeting minutes relate directly to and support this department's request for instream beneficial water uses in the Yellowstone basin.

(1) Item 51, April 20, 1965, Yellowstone State Waterway

Mr. Dunkle advised the commission of a proposal from District Five that the Yellowstone River be dedicated as a state waterway. It is considered one of the 100-top trout streams in the USA and is popular for float trips. The department has several fishing access sites on the river which can be developed as campgrounds and boat launching areas. Sportsmen and civic groups that have been contacted in regard to the proposal are very enthusiastic. The director recommended to the commission the dedication of the river as a state waterway and said that a detailed plan for the development of areas along the river would be forthcoming. Mr. Leipheimer indicated that additional importance should be attached to this area in that part of the Lewis and Clark Expedition followed this route on the return trip.

Motion, Mr. Leipheimer: "I move to dedicate the Yellowstone River from the Yellowstone Park line to Pompeys Pillar as the Yellowstone State Waterway." Seconded by Mr. Weintz. Carried.

(2) Item 24, June 5, 1961, Water Development Policy

The following motion was made to adopt a water development policy which has been under consideration for some time.

Motion, Mr. Staves: "I move to adopt a Water Development Policy as follows:

"Fishing and hunting are major recreational activities in Montana. They are activities that contribute highly to the economy of the state. Above all, they are activities that owe their existence to adequate supplies of suitable waters.

"The water needs of a rapidly expanding human population and the increasing demands for water for industry and agriculture will seriously reduce the amount of water available to fish and wildlife. If the fish and wildlife resource is to survive and continue to be of prime importance, not only to the state of Montana but to the nation, then consideration commensurate with this importance should be a part of the planning in all proposed water development projects.

"The use of water for fish and wildlife is difficult to evaluate on a dollar basis. For this reason fish and wildlife often receive only minor recognition at the bargaining table when competing with other established water uses. By Montana law, the use of water for fish and wildlife is not considered one of the prime beneficial uses. Trout streams can be, and often are, completely dried up when the water is diverted for irrigation. Irrigation practices that, in many instances, may do more damage than good to the land. Studies of irrigation practices in Montana have shown that from 10 to 60 percent of the water diverted never reaches its destination. Of the water that does reach the field, 30 to 50 percent is lost by deep percolation and surface run-off caused by over-irrigation. Since the use of water by fish and wildlife constitutes a nonconsumptive use, many Montana trout streams could be saved by improved irrigation practices alone.

"Montana is one of the last strongholds in the nation of natural trout stream fishing. The work of the Montana Stream Fishery Classification Committee emphasizes very graphically that top quality fishing streams in the state are limited. The committee composed of representatives from the Montana Fish and Game Department, Montana State College, and the Missouri River Basin Studies of the Bureau of Sport Fisheries and Wildlife, spent more than five years in the preparation of a stream classification map. Briefly, streams were rated on the basis of access, esthetics, use, and productivity. Based on these criteria, streams were placed into four classes, ranging from steams important nationally as well as statewide, to streams of relatively local importance. In the top two classes there are only 1500 miles of streams. The popular conception of unlimited miles of fine natural trout streams in Montana is both misleading and dangerous, in that it gives a false sense of security and complacency.

"The Montana Fish and Game Commission feels that unspoiled recreation areas must be retained for the future, and encroachment upon irreplaceable, wild and semi-wild rivers and their watersheds must be resisted. The Commission feels that unspoiled wilderness areas are inextricably interwoven with fish and wildlife considerations. There is a very definite value in being able to hunt and fish in areas where native fish and wildlife populations remain unchanged in a primitive setting. It is recognized that increasing amounts of electric power will be needed by the expanding human population. These future populations will also need increased outdoor recreational opportunities that are essential to human well being. These recreational opportunities will be lost if the natural stream habitat continues to be exploited at the present rate. The Commission feels that when water development projects are presented to the people and to Congress for approval, the gains to irrigation, power, and flood control must stand on their own merits, and losses to other resources including fish and wildlife must be clearly stated.

"The Commission opposes the granting of water development permits to private companies or the allocation of funds for government water resource developments until essential studies of the effects on fish and wildlife are completed. Of the huge sums expended on the planning of water development projects, adequate funds should be provided for pertinent fish and wildlife studies. Provision should also be made whereby revenue from a water development project would help defray the increased costs of fish and/or game management resulting from the project.

"The Montana Fish and Game Commission, in reviewing proposed water development projects, will consider and base recommendations on the following points.

1. Needs for natural outdoor recreational areas will increase as human populations expand.

2. The use of water by fish and wildlife should be considered one of the prime beneficial uses.

3. More efficient use of water taken for irrigation could be made with the result that more water would be available for fish and wildlife.

4. Water pollution of any type is considered objectionable because of the detrimental effects on fish and wildlife.

5. Public access should be guaranteed where any water development project is involved.

6. Stream channel changes by highway, road, and railroad construction should be kept to a minimum. Where channel changes are proven necessary, they should be meandered.

7. Adequate funds for essential fish and wildlife studies should be provided by the agency concerned with a water development project, and provisions should be made whereby revenue from the water development project would help defray increased fish and/or game management costs resulting from such water development project.

8. Esthetic values should be recognized in terms other than those of economic values alone."

Seconded by Mr. Skibby. Carried.

(3) Item 16, March 7, 1974, Reservation of Flows - Yellowstone River

Mr. James Posewitz, administrator of the Environment and Information Division, reported on the department's responsibilities under the Water Use Act. He said that adequate reservation of Yellowstone River flows is probably the No. 1 environmental problem in the state today as the Yellowstone is under severe threat of total dewatering by the energy industry. The department filed for a water right on the Upper Yellowstone River after the 1969 legislature gave authority for this section and on certain other streams. Application can now be made under the Montana Water Use Act of 1973 to reserve sufficient flow in any river to protect fishing, wildlife habitat and recreational opportunities. A draft of this proposal was presented for the commission consideration.

Mr. Allen Elser, Region 7 fisheries manager, explained technicalities involved in ascertaining adequate flows. It was found that a 30% flow would be adequate to maintain fish populations during the low water period.

Although Senate Bill 728, if it passes, would place a moratorium on water use permits on the Yellowstone River for a 3-year period, Mr. Posewitz recommended that the commission approve an application to reserve flows in the Yellowstone River to support the purpose and philosophy of the bill and provide a record of the need for a reservation of flows. Our application would ask that no new users be allowed who would not be willing to cease diversions when the river reaches that level.

Motion, Mr. Hagenston: "I move to apply for a reservation of flows in the Yellowstone River." Seconded by Dr. Pengelly. Carried.

(4) Item 19, June 24, 1976, Yellowstone River Studies

Administrator of the Environment and Information Division, Jim Posewitz, said that since the inception of the Water Use Act the department has been conducting studies of the Yellowstone River in order to support a reservation of flows in the river for the use of wildlife. The legislature also placed a 3-year moratorium on major use of water from the Yellowstone River which will expire in March 1977. The Bureau of Reclamation has financed the present study which is about to expire. They have offered to extend the fisheries investigations for 15 months. This portion of the study would place emphasis on fish populations and movements around major diversions in the Yellowstone River. No additional personnel and no state funds would be required. Mr. Posewitz recommended that the commission approve the contract and authorize submission of a budget amendment if it should be required.

Motion, Mr. Klabunde: "I move to approve Contract No. 6-07-01-10810 with the Bureau of Reclamation to contribute $43,375.00 for continuation of the fisheries investigations on the Yellowstone River for 15 months, to authorize the director to sign the document, and approve a request for a budget amendment if necessary to spend the funds." Seconded by Mr. Hegstad. Carried.

## Federal Legislation

(1) The National Environmental Policy Act of 1969
(Public Law 91-190; 83 Stat. 852)

This Act has been called a national environmental "Bill of Rights."

Section 2 of the Act states the purpose is "to declare a national policy which will encourage productive and enjoyable harmony between man and his environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and national resources important to the nation; and to establish a Council on Environmental Quality."

The Yellowstone River is a blue ribbon stream in its upper reaches and having been declared such is of great importance to both the state and the nation. Thus the preservation of this important ecological system through the granting of this reservation request will allow productive and enjoyable harmony between man and the Yellowstone River, will help eliminate damage to this environment and will stimulate the health and welfare of man. This reservation request for beneficial water use is supported by this legislation.

(2) Federal Aid in Fish Restoration Act (Dingell-Johnson Act)
(64 Stat. 430, as amended; 16 U.S.C. 777-777k)

An Act "to provide that the United States shall aid the states in fish restoration and management projects and for other purposes."

This act provides an excise tax on sport fishing equipment and supplies purchased by fishermen in each state. The money collected is apportioned back to each state under terms of a formula based on area of state and number of fishing licenses sold. These funds are available annually and are used by state fish and game departments for fish restoration and management projects for all fish species which have material value in connection with sport or recreation in fresh (and marine where applicable) waters of the United States. This act enables the sportsmen who utilize fish resources to pay their own way toward fisheries preservation and management. Since this act became effective on August 9, 1950, sportsmen have realized the importance of maintaining fish habitat and have funded this program through their purchase of sport fishing equipment. The maintenance of this fish habitat is directly related to water quantity and thus this reservation request is directly related to continuation of this important wildlife conservation program.

(3) Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act)
(50 Stat. 917), as amended (16 U.S.C. 669-669b, 669c-669i)

This act, passed on September 2, 1937 authorized the collection of an excise tax on sport hunting equipment, such as firearms and ammunition, portions of which are returned to the states for programs on the research and management of wildlife species, including big game, small game, waterfowl and furbearers. The funds are returned to state fish and game departments under terms of a formula based on area of the state and number of hunting licenses sold. This act enables the sportsmen who utilize wildlife resources to pay their own way toward wildlife preservation and management. Since this act became effective, sportsmen have realized the importance of maintaining wildlife habitat in producing huntable wildlife populations and have funded this program through their purchase of sport hunting equipment and supplies. The maintenance of riparian wildlife habitat is directly related to water quantity and thus this reservation request is directly related to continuation of this important wildlife conservation program.

(4) Fish and Wildlife Coordination Act (48 Stat. 401 as amended; 16 U.S.C. 661 et seq.)

This act was passed on March 10, 1934 and last amended in 1958. The purpose of the act is to recognize "the vital contribution of our wildlife resources to the nation, the increasing public interest and significance thereof due to expansion of our national economy and other factors, and to provide that wildlife conservation shall receive equal consideration and be coordinated with other features of water resource-development programs through the effectual and harmonious planning, development, maintenance, and coordination of wildlife conservation and rehabilitation. . ." One of the provisions of the act authorized the Secretary of Interior to "provide assistance to, and cooperate with, federal, state and public or private agencies and organizations in the development, protection, rearing, and stocking of all species of wildlife, resources thereof, and their habitat. . ." (Emphasis added.) The Act has been important in water development projects and proposals by inclusion of fish and wildlife needs and values in any of these projects authorized for construction. Many acres of wildlife habitat have been acquired for inclusion in irrigation and hydropower projects which otherwise would not have been available for wildlife management today.

The act points out the need for orderly water resource development which specifically includes preservation of fish and wildlife habitat, such habitat being, in many cases, directly related to adequate water quantity such as is requested in this reservation application.

(5) Federal Water Pollution Control Act of 1956 (Public Law 84-660) with amendments of 1961, 1965, 1966; the Water Quality Improvement Act of 1970 and the Water Pollution Control Act Amendments of 1972 (Public Law 92-500)

Through this series of acts, water pollution control laws were strengthened. Public Law 92-500, the latest act, has the objective "to restore and maintain the chemical, physical and biological integrity of the nation's waters." By July 1983, whenever possible, water quality is to be suitable for recreational contact and for protection and propagation of fish and wildlife. The 1965 amendment to the act was termed the "Water Quality Act of 1965" which gave the states the opportunity to hold public hearings, establish water quality standards for interstate and coastal waters within their borders and to say what waters they wanted and how clean their local waters should be.

Subsequent to Public Law 92-500 federal regulations were published to implement the law. Federal regulation CFR 40 E 130.17 required revisions to state water quality standards which would protect water quality for a number of uses, including propagation of fish, shellfish, and wildlife and for recreation purposes. The regulations also directed the states to develop and adopt a statewide antidegradation policy which provides that existing instream water uses shall be maintained and protected. No further water quality degradation which would interfere with or become injurious to existing instream water uses is allowed. Also in high quality waters which exceed those levels necessary to support propagation of fish, shellfish and wildlife, and recreation shall be maintained and protected unless the public should decide otherwise.

Thus, this legislation directly relates to this reservation application in that water quality will be protected from degradation by granting of the requested streamflows, allowing propagation of fish and wildlife and public use of the waters for recreational purposes.

(6) Water Resources Planning Act of 1965 (Public Law 89-80, 42 U.S.C. 1962, as amended)

The state of Montana participates in this act through the Resources and Planning Bureau, Water Resources Division, Department of Natural Resources and Conservation. Montana receives federal grants to fund research in comprehensive water planning. The policy of the Act encourages the conservation, development and utilization of water and related land resources of the United States on a comprehensive and coordinated basis between federal, state and local agencies and private enterprises. Section 103 of the Act establishes the principles, standards and procedures for river basin planning. The Principles and Standards subsequently established require river basin planning to consider fish, wildlife, recreation and other environmental values in an environmental quality account to properly treat the needs of these resources in water development planning processes. According to Principles and Standards, the objective of environmental quality is "to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems." Instream flow requirements are an important component of the environmental quality account and thus this act supports our reservation application for beneficial water use.

In summary, it seems quite clear that state and federal policy-making bodies have great concern for the preservation of the environment and have mandated that such natural resources as in water and fish and wildlife be protected for continued health and enjoyment. These laws and policies are submitted support of this reservation request to help in the preservation of fish and wildlife resources themselves as well as the recreational values these resources bring to the people of Montana and the nation.

## CONCLUDING STATEMENT

An additional point to be made in this reservation request is that should other qualified agencies or government entities also submit reservation applications for instream beneficial water uses (such as for water quality maintenance or for adequate use of existing irrigation diversion facilities) on streams listed in this application, our requests could be reduced accordingly where similar time periods are involved. Our intent in submitting this application is to protect the fish and wildlife resource. Fish and wildlife have no knowledge of ownership of an instream resource maintenance flow. It is only important to provide them an adequate water supply for their continued existence.

Finally, it seems evident that a sophisticated streamflow and water use monitoring system must be established in the Yellowstone River basin if adequate water management is to be accomplished for the benefit of all water users.

## LITERATURE CITED

Ballou, R. M. 1954. Nesting, distribution and mortality studies of Canada geese on the Green River. Fed. Aid Rept. W-50-R-3, Wyoming Game and Fish Comm., Cheyenne. pp. 68-82.

Benson, N. G. 1955. Observations on anchor ice in a Michigan trout stream. Ecology, 36(3):529-530.

Berg, R. K. 1975. Fish and Game planning, upper Yellowstone and Shields river drainages. Fisheries inventory and plan, fed. aid in fish & wildl. rest. acts. Mont. proj. No. FW-3-R, Job I-a. pp. 1-125.

Bjorn, E. E. 1940. Preliminary observations and experimental study of the ling, Lota maculosa (Lesueur) in Wyoming. Trans. Am. Fish. Soc. 69:192-196.

Bovee, K. D. 1974. The determination, assessment and design of "instream value" studies for the Northern Great Plains region. Univ. of Mont. Final report, Contr. No. 68-01-2413, Env. Prot. Agency. 204 p.

__________. 1975. Assessment and implementation of "instream value studies" for the Northern Great Plains. In: Proc. Ft. Union Coal Symp. Vol. 2:112-123.

Brown, C. J. D. 1971. Fishes of Montana. Big Sky Books, Bozeman. 207 pp.

Carlander, K. D. 1969. Handbook of freshwater fishery biology. Vol. 1. Iowa St. Univ. Press. 752 pp.

Chapman, D. W. 1966. Food and space as regulators of salmonid populations in streams. The American Naturalist, 100(913):345-357.

Childress, D. A. 1971. Canada goose production and water level relationships on Madison River, Montana. M. S. Thesis, Mont. St. Univ., Bozeman. 35 pp.

Coble, D. W. 1975. Smallmouth bass. In: Black bass biology and management: 21-33; ed. R. H. Stroud and H. Clipper. Sport Fishing Inst., Washington, D.C.

Collins, M. R. 1974. Generalization of spawning and rearing discharges for several Pacific salmon species in western Washington. USGS in coop. with the st. of Wash., Dept. of Fisheries. Open file rept. Tacoma. 39 pp.

Constan, K. J. 1975. Fish and Game planning, upper Yellowstone and Shields river drainages. Big game inventory and plan, fed. aid in fish and wildl. rest. acts. Mont. proj. No. FW-3-R, Job I-b. pp. 126-183.

Copeland, M. and R. Stroup. 1976. Problems in estimating the fish, wildlife and recreation value of the Yellowstone river. Dept. Agric. Econ. and Econ., Mont. St. Univ., Bozeman. (In press.)

Denson, E. 1976. Personal communication. U. S. Dept. of Interior, Bureau of Reclamation, Billings, Montana.

Dimmick, R. W. 1968. Canada geese of Jackson Hole. Wyo. Game and Fish Comm., Cheyenne. Bull. 11. 86 pp.

Dooley, J. M. 1975. Application of U. S. Bureau of Reclamation Water Surface Profile Program (WSP). In: Proceedings of the Ft. Union Coal Field Symp., Vol. 2, Aquatic Ecosystems Section. Mont. Acad. Sci. and Eastern Mont. College, Billings, Apr. 25-26, 1975. 232 pp.

__________, and J. Keys. 1975. Use of the Water Surface Profile Program. Workshop conducted for Montana Fish and Game biologists, Jan. 22, 1975, Billings, Mont. 12 pp.

__________. 1976. U. S. Bureau of Reclamation, Billings, Mont. Personal communication.

Elser, A. A. and R. G. Marcoux. 1971. Inventory of the waters of the project area. Job prog. rept. Fed. aid in fish rest. act., Mont. proj. No. F-9-R-18, Job I-a. 20 pp.

__________. 1973. Southeast Montana fisheries investigations. Mont. Dept. of Fish and Game, job prog. rept., fed. aid in fish and wildl. rest. proj. No. F-30-R-9, Job I-b. 18 pp.

__________ and J. C. Schreiber. 1975. Impact of coal development on aquatic biota of Rosebud Creek, Montana. Quarterly prog. rept. EPA-WQO res. grant No. R 803950: 13-23.

__________. 1976a. Fish management surveys. Job prog. rept. F-30-R-12, Job I-b, Mont. Dept. Fish and Game, 42 pp.

__________. 1976b. Use and reliability of Water Surface Profile Program data on a Montana prairie stream. In: Proceedings Instream Flow Needs Workshop, Boise, Idaho. In press.

__________ and R. C. McFarland. 1975. Task 1: Investigation of aquatic communities - Tongue River. In: A study to evaluate the potential physical, biological and water use impacts of water withdrawals and water development on the middle and lower portions of the Yellowstone River drainage in Montana. Annual report (June 25, 1974 to June 30, 1975) to Old West Regional Commission. Mont. Dept. of Nat. Res. and Cons., Helena. p. 24-46.

__________ and __________. 1976. Investigation of aquatic communities (Tongue River fish studies). Old West Regional Commission quarterly rept. (April 1, 1976-June 30, 1976). Proj. No. 10470022, August 1, 1976: 2-5.

Gum, R. L., W. Martin, A. Smith and C. Depping. 1973. Participation and expenditures for hunting, fishing and general rural outdoor recreation in Arizona. Res. rept. 270. Agric. Exp. Stat., Univ. Arizona, Tucson. 27 pp.

Hammond, M. C. and G. E. Mann. 1956. Waterfowl nesting islands. J. Wildl. Mgmt. 20(4): 345-352.

Hinz, T. C. 1975. Task 2: Assessment of the impact of altered streamflows on selected migratory birds, p. 47-64. In: A study to evaluate potential physical, biological and water use impacts of water withdrawals and water development on the middle and lower portions of the Yellowstone River drainage in Montana. Annual rept. (June 25, 1974 to June 30, 1975) to Old West Regional Commission. Mont. Dept. of Nat. Res. and Cons., Helena.

__________. 1976. Task 2: Assessment of the impact of altered streamflows on selected migratory birds. In: A study to evaluate potential physical, biological and water use impacts of water withdrawals and water development on the middle and lower portions of the Yellowstone River drainage in Montana. Final rept. to Old West Regional Commission. Mont. Dept. of Nat. Res. and Cons., Helena. (In progress.)

__________. 1976. Personal communication, Mont. Dept. of Fish and Game, Miles City.

Hook, D. C. 1973. Production and habitat use by Canada geese at Freezout Lake, Montana. Mont. Dept. of Fish and Game job prog. rept. Fed. aid in fish and wildl. rest., proj. No. W-120-R-3, Job GB-9.02, 53 pp.

__________. 1975. Upland game bird inventory and plan. P. 184-230. In: Fish and Game planning, upper Yellowstone and Shields river drainages. Mont. Dept. of Fish and Game. Fed. aid to fish and wildl. rest. Proj. FW-3-R, Job I-c.

Hynes, H. B. N. 1970. The ecology of running waters. Univ. of Toronto Press, Toronto, Canada. 555 pp.

Knudson, K. and D. Swanson. 1976. Effects of decreased water quantity and increased nutrient addition on algal biomass accumulation, and subsequently, the dissolved oxygen balance of the Yellowstone River. Mont. Dept. Fish and Game. Env. & Inf. Div., Helena. (In press.)

Koch, R. 1976. Personal communication. Mont. Dept. Nat. Res and Cons., Helena.

Leopold, L. B., G. M. Wolman and J. P. Miller. 1964. Fluvial processes in geomorphology. W. H. Freeman and Co., San Francisco. 522 pp.

Marcuson, P. 1973. Southcentral Montana fisheries study. Fed. aid in fish rest. Proj. F-20-R-16, Job I-a, Mont. 11 pp.

Martin, P. R. 1976. Task 3: Assessment of the impact of altered streamflows on selected furbearing mammals. In: A study to evaluate potential physical, biological and water use impacts of water withdrawals and water development on the middle and lower portions of the Yellowstone River drainage in Montana. Final rept. to Old West Regional Commission. Mont. Dept. of Nat. Res. and Cons., Helena. (In progress.)

Martinka, C. J. 1974. Personal communication, Glacier Nat. Park.

McClelland, B. R. 1973. Autumn concentrations of bald eagles in Glacier Nat. Park. Condor 75(1):121-123.

McConnen, R. J. 1960. Economic importance of hunting and fishing in Montana. Mont. Dept. Fish and Game, Helena. Two reports, mimeo.

Merrill, L. B. and E. L. Bizeau. 1972. Canada goose production as related to streamflow on the South Fork of the Snake River in Idaho: a preliminary survey. Idaho Coop. Wildl. Res. Unit, Moscow. 38 pp.

Miller, D. D. 1970a. Life history study of the burbot. Coop. res. proj. 5, part I, Wyo. Game and Fish Commission and Univ. of Wyo. 90 pp.

__________. 1970b. Life history study of the burbot in Boysen Reservoir, Ring Lake and Trail Lake. Coop. res. proj. 5. part II, Wyo. Game and Fish Commission and Univ. of Wyo. 56 pp.

Newell, R. E. 1976. Yellowstone River study. Final rept. Mont. Dept. Fish and Game and Tenneco Inc. Helena, Mont. 97 p. + appendix (259 pp.).

NGPRP. 1974. Northern great plains resource program, water work group report. Denver, Colorado. 74 p. + appendices.

Peterman, L. G. 1976a. The ecological implications of Yellowstone River flow reservations. Quarterly prog. rept. Period April 1 through June 30, 1976. Mont. Dept. Fish and Game, Env. and Inf. Div., Helena. 8 pp.

__________. 1976b. The ecological implications of Yellowstone River flow reservations. Annual prog. rept., Mont. Dept. Fish and Game, Env. and Inf. Div., Helena. (In progress.)

__________ and M. H. Haddix. 1975. Preliminary fishery investigations on the lower Yellowstone River. Prog. rept. No. I, Mont. Dept. Fish and Game, Env. and Inf. Div., Helena. 56 pp.

Pflieger, W. L. 1975a. The fishes of Missouri. Missouri Dept. of Cons. 343 pp.

__________. 1975b. Reproduction and survival of the smallmouth bass in Couror's Creek. In: Black bass biology and management, 231-239; ed. R. H. Stroud and H. Clepper, Sport Fishing Inst., Washington, D.C.

Polzin, P. and D. Schweitzer. 1975. Tourism or timber. Montana Business Quarterly, Autumn, 1975. pp. 5-20.

Purkett, C. A. 1961. Reproduction and early development of paddlefish. Trans. Amer. Fish Soc. 90(2):125-129.

Rehwinkel, B. J. 1975. The fishery for paddlefish at Intake, Montana during 1973 and 1974. Unpubl. thesis (M.S.) Mont. St. Univ., Bozeman. 37 pp.

__________, M. Gorges and J. Wells. 1976. Powder River aquatic ecology project. Annual rept. Oct. 1, 1975-June 30, 1976. Utah Internat., Inc., 35 pp.

Reynolds, J. B. 1965. Life history of smallmouth bass, Micropterus dolomieui Lacipide, in the Des Moines River, Boone County, Iowa. Iowa St. Jour. Sci., 39(4):417-436.

Robinson, J. W. 1966. Observations on the life history, movement and harvest of the paddlefish, Polyodon spathula, in Montana. Proc. Mont. Acad. Sci., 26:33-44.

Schoenthal, N. D. 1975. Colstrip plume fallout area: stream biology sampling stations. Quarterly prog. rept. (July 1, 1975-September 30, 1975) EPA-WQD res. grant No. R 803950: 141-149.

Schwehr, D. J. 1976a. Task 1: Investigation of aquatic communities - aquatic insects and forage fish. In: A study to evaluate the potential physical, biological and water use impacts of water withdrawals and water development on the middle and lower portions of the Yellowstone River drainage in Montana. Final rept. to Old West Regional Commission. Mont. Dept. of Nat. Res. and Cons., Helena. (In progress.)

__________. 1976b. Distribution and diversity of aquatic macroinvertebrates in the middle Yellowstone River. Unpubl. M. S. thesis, Univ. Mont., Missoula. 136 pp.

Scott, W. B. and E. S. Crossman. 1973. Freshwater fishes of Canada. J. Fish. Res. Bd. Canada. Bull. 184, 996 pp.

Sherwood, G. A. 1965. Factors limiting production and expansion of local populations of Canada geese. Canada Goose Management. p. 73-85.

Skaar, P. D. 1975. Montana bird distribution. Preliminary mapping by latilong. Pub. by P. D. Skaar, Bozeman. 56 pp.

__________. 1976. Montana bird distribution, one year supplement. Pub. by P. D. Skaar 8 May, 1976. Bozeman. 8 pp.

Smith, J. 1974. Personal communication.

Spence, L. 1975. Guidelines for using Water Surface Profile Program to determine instream flow needs for aquatic life. Prelim. draft. Mont. Dept. Fish and Game, Env. and Inf. Div., Helena. 33 pp.

Stalnaker, C. B. and J. L. Arnette. 1976. Methodologies for the determination of stream resource flow requirements: an assessment. USF&WS West. Water Allocation. 199 pp.

Stevenson, H. R. 1975. The trout fishery of the Bighorn River below Yellowtail dam, Montana. Unpubl. thesis (M.S.) Mont. St. Univ., Bozeman. 67 pp.

Swedberg, S. E. 1975. Bighorn Lake and Bighorn River post-impoundment study. D. J. Comp. rept., proj. F-20-R-19, Job IV-a. 15 pp. (Mimeo)

Thomas, J. 1976. Water quality bureau, Mont. Dept. Nat. Res. & Cons., Billings. Personal communication.

Thompson, K. 1972. Determining streamflows for fish life. In: Proceedings of the instream flow requirement workshop, Portland, Oregon, March 15-16, 1972. pp. 31-46.

U. S. Bureau of Reclamation. 1973. Appendix H-sedimentation. In: Design of small dams. U. S. Govt. Print. Off., Washington. pp. 789-795.

U. S. Department of Interior, Bureau of Reclamation. 1968. The Bureau of Reclamation's Water Surface Profile Computation Method B. Engineering Res. Center, Denver, Colo. 17 pp.

U. S. Geological Survey. 1975. Water resources data for Montana - water year 1975. USGS water data rept. MT-75-1, Water Res. Div. of USGS, Helena. 604 pp.

Vincent, E. R. 1971. River electrofishing and fish population estimates. Prog. Fish Cult. 33(3):163-167.

__________. 1974. Addendum to river electrofishing and fish population estimates. Prog. Fish Cult. 36(3):182.

Vasetskiy, S. G. 1971. Fishes of the family Polyodontidae. J. of Ichthyology, 11(1):18-31.

Welch, P. S. 1948. Limnological methods. The Blakiston Company, Philadelphia, Penn. 381 pp.

White, R. G. 1975. A proposed methodology for recommending stream resource maintenance flows for large rivers. In: Stream resource maintenance flow studies. Coop. proj., Idaho Dept. Fish and Game and Idaho Coop. Fish. Res. Unit., Moscow. pp. 3-20.

Witt, D. 1975. Waterfowl breeding ground and production survey. Statewide wildlife survey and inventory. Mont. Dept. Fish and Game, fed. aid to fish and wildl. rest. proj. W-130-R-6, Job II-8.3. 26 pp.

Workman, D. L. 1972. Inventory of the waters of the project area. Job prog. rept. Fed. aid in fish rest. act., Mont. proj. No. F-9-R-20, Job I-c. 10 pp.

__________. 1973. Inventory of the waters of the project area. Job prog. rept., fed. aid in fish and wildl. rest. acts. Mont. proj. No. F-9-R-21, Job I-c. 6 pp.

__________. 1976a. Mont. Dept. Fish and Game, Great Falls. Personal communication.

__________. 1976b. Southwestern Montana fisheries investigation. Fed. aid in fish rest. proj. F-9-R-24, Job I-c, Montana. Mont. Dept. Fish and Game, Helena. 21 pp.

## APPENDIX A

### Methods and Procedures used to Determine Instream Flow Needs

This section briefly summarizes certain methods or procedures used to determine instream flows necessary for the protection of aquatic habitat. The purpose of this section is to explain procedures in one location in the application rather than repeat them each time they were used in the text. Complete information can be obtained from the documented reference, where applicable. Additional methods are explained in the text for certain streams.

### Water Surface Profile Program (WSP)

WSP is a computer adaptation of the Bureau of Reclamation's Water Surface Profile Computation Method B (U. S. Dept. of Interior, Bureau of Reclamation 1968). The program was written to computerize computations necessary to determine tailwater and backwater elevations below dams and control structures and above reservoirs. WSP is adaptable to instream applications (Dooley 1975). The program allows the user, after sufficient field work, to predict and/or study various changes in stream characteristics at many different flows without having to make numerous field observations at these same flows. The program is calibrated to a specific stream section using one or two observed flows, the corresponding water surface elevations, and cross-sectional data at various locations (transects) in this stream section. Among the parameters which are predicted by the program are width, depth, velocity and wetted perimeter. These parameters can be used in conjunction with known aquatic biological data to estimate possible changes in aquatic habitat under various flow conditions.

### Dominant Discharge Concept

The "dominant discharge" (also known as"bank-full discharge") is that stream discharge which has a recurrence interval of about 1.5 years (Leopold, Wolman and Miller 1964). It is the peak discharge which occurs 2 out of 3 years on the average, or 67 percent of the time (Koch 1976 pers. comm.). This discharge is believed to be the flow which determines the channel form and allows channel processes such as sediment transport and bedload movement to occur (Leopold et al. 1964). Our intent in requesting streamflow during the spring high water periods is to maintain channel integrity; i.e., retain existing channel form and allow existing channel processes to occur so that habitat characteristics will be retained. The dominant discharge was used as the upper limit in our flow requests.

The dominant discharge quantity was requested only in those stream reaches where USGS streamflow records were available and of sufficient length to allow calculation of this quantity. Dominant discharges were provided by Koch (1976 pers. comm.).

Attempts to reliably estimate the dominant discharge on ungaged streams were unsuccessful; however, the concept is used in our flow requests in streams of the upper Yellowstone drainage. (Estimates could be made of the dominant discharge at ungaged sites with additional field work.)

On the ungaged streams we have requested the dominant discharge, once determined, to occur for one continuous 24-hour period. This is probably a conservative estimate of the time needed for this flow to accomplish the necessary channel-forming processes. It is believed the longer the dominant discharge occurs the more channel work is accomplished; however, quantification of this time-work relationship is difficult. Since the timing of peak flows may vary from year to year, it is feasible only to request the dominant discharge within some broad time period, based on actual streamflow hydrographs for gaged streams in the drainage. Thus the dominant discharge may occur between May 15 and May 31 on some streams, while occurring between June 15-June 30 on others. Our requests reflect this variation by stating a broad time period in which the flows can occur.

Shields River hydrographs at gaged sites were used to determine the time interval for dominant discharges to occur on tributaries to the Shields. Yellowstone River mainstem hydrographs were used for tributaries to that stream. There is some variation between the runoff patterns of the two drainages.

Peak flows requested for the Yellowstone mainstem between the Boulder River and the Clarks Fork River are estimates derived from known dominant discharges at the USGS gages "Yellowstone River at Livingston," "Boulder River at Big Timber," and "Stillwater River at Absarokee." Dominant discharges at these sites were provided by Koch (1976 pers. comm.).

## Blue Ribbon Concept

The Yellowstone River from Gardiner to the Boulder River at Big Timber was classified as a blue ribbon fishing stream in 1958 and again in 1965 by the Stream Classification Committee (1965). This classification indicates the stream has national as well as statewide importance as a fishing stream. A total of 452 miles is presently classified as "blue ribbon" in Montana. The Yellowstone from Gardiner to Big Timber comprises the longest single reach of blue ribbon stream (103 miles) and contains 23 percent of the state's blue ribbon waters. Recreational fishing does not readily lend itself to the traditional methods of measuring its worth, and as a result has often been sold short in water resource planning. The stream classification was an attempt to provide a base for calculating the material worth of a fishery and shows quite clearly that Montana fishing streams are limited both in quantity and quality.

Thus in view of the importance of this famous river, it was felt the establishment of streamflow "numbers" as flow recommendations during the low water months, would be the first step in degrading this high quality fishery. Fish populations exist there now due to a wide range of flow conditions. Assigning flow "numbers" to this part of the river would eventually place limitations on the fishery which do not exist today, and ultimately alter the existing status of those aquatic resources. Thus we elected to request the "instantaneous streamflow, subject to existing, lawfully appropriated water rights in the stream reach" to protect the fishery resources of the reach of the river during the months of January through April (or portions thereof) and August (or portions thereof) through December. We have assigned flow numbers for the high flow periods in some instances.

Additionally, we cannot separate the tributary streams from the main river in this portion of the basin, since they influence water quantity, water quality and are biologically connected in many cases. (See "The Need for the Reservation" portion of the application.) Thus "the instantaneous streamflow..." was also requested for these streams.

In utilizing this existing blue ribbon concept here, it must be recognized that further examination of Montana's fishery resources may warrant changes in this type of classification, particularly as future water and land uses alter the status of these fishery resources. Streams not currently rated highly on the current classification may become eligible in the future.

## Flow Duration Hydrographs

Streamflow frequency data obtained at USGS gaging stations were used to determine streamflows on certain streams and stream reaches. Flow duration data and hydrographs derived from the data were provided by the USGS, Helena, MT. Example of the data and hydrographs are attached.

The data show the percent of time a given flow was equaled or exceeded daily or by month during the given period of record. The data are useful in determining how frequent a given flow would be expected to occur. The data are available for the Yellowstone River gages at Livingston, Billings, Miles City and Sidney, as well as on a number of tributaries.

## Physical, Chemical, Biological Data Collection

Sampling of aquatic populations was done in several ways. Fish population estimates were made according to Vincent (1974). Electrofishing was used in making trout population estimates as well as in routine stream surveys and in the study of the migratory habits of both trout and nonsalmonids. Electrofishing was also employed to sample sauger, walleye, shovelnose sturgeon, paddlefish and other species in the lower Yellowstone River and tributaries. Gill nets and fish traps were used where electrofishing was not feasible or where habits of fish dictated use of other methods.

Aquatic invertebrates were collected with kick nets, Waters and Hester-Dendy samplers (Newell 1976, Schwehr 1976).

Water temperatures were collected with recording thermographs and pocket thermometers. Water quality data were collected and analyzed by accepted techniques. Laboratory analyses were made by other agencies such as the Department of Health and Environmental Sciences and Bureau of Mines and Geology.

Streamflow data were compiled from U. S. Geological Survey records and/or by direct measurement using standard streamflow measuring techniques.

Depth-velocity requirements were obtained by use of current meters in certain areas where aquatic invertebrates were collected and where fish were observed spawning. Studies by other workers and contacts with persons familiar with a given stream reach were used to verify and/or supplement field data when necessary. Investigations on specific aquatic and riparian species were conducted to determine their life history requirements. These studies are referenced in this application.

UNITED STATES DEPARTMENT OF INTERIOR
GEOLOGICAL SURVEY - WATER RESOURCES DIVISION

STATION 12/3031/00 DATE PROCESSED--03/01/75

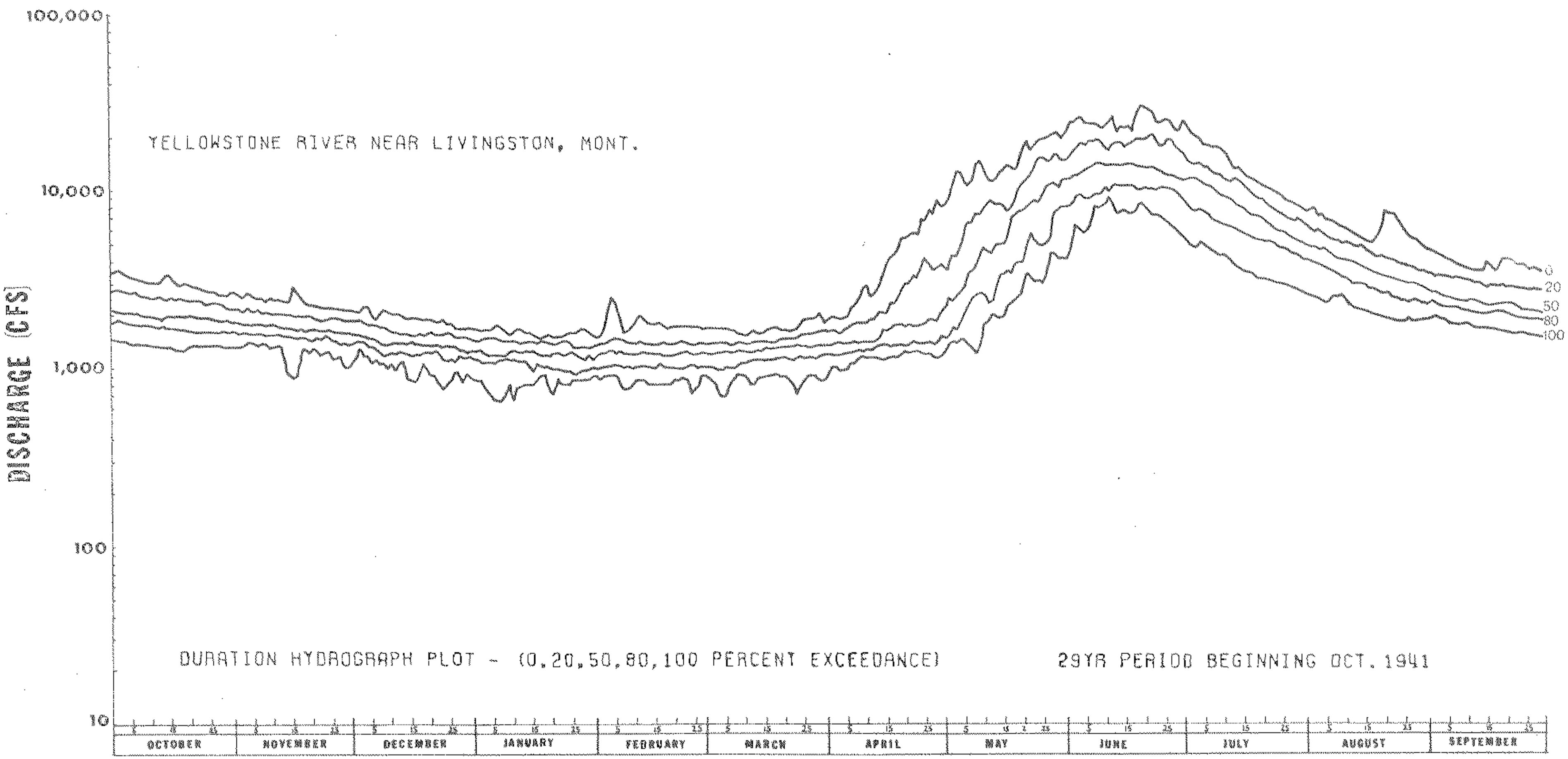
PLOTTING POINTS FOR DURATION HYDROGRAPH FOR 9-YEAR PERIOD BETWEEN WATER YEARS 1965 AND 1973

| DATE | HIGH | .10 | .20 | .30 | .50 | .70 | .80 | .90 | LOW — EXCEEDANCE LEVEL |
|---|---|---|---|---|---|---|---|---|---|
| 1-01 | 12.00 | 12.00 | 9.30 | 8.40 | 8.00 | 6.30 | 5.60 | 5.00 | 5.00 |
| 1-02 | 12.00 | 12.00 | 9.30 | 9.00 | 7.40 | 6.00 | 5.60 | 5.00 | 5.00 |
| 1-03 | 12.00 | 12.00 | 10.00 | 9.30 | 7.00 | 6.10 | 5.60 | 4.90 | 4.90 |
| 1-04 | 11.00 | 11.00 | 11.00 | 9.00 | 7.40 | 6.00 | 5.20 | 4.90 | 4.90 |
| 1-05 | 12.00 | 12.00 | 11.00 | 8.50 | 7.00 | 5.50 | 5.20 | 4.90 | 4.90 |
| 1-06 | 13.00 | 13.00 | 11.00 | 10.00 | 6.80 | 6.00 | 5.60 | 4.90 | 4.90 |
| 1-07 | 12.00 | 12.00 | 11.00 | 11.00 | 6.60 | 5.80 | 5.00 | 4.50 | 4.50 |
| 1-08 | 11.00 | 11.00 | 11.00 | 11.00 | 6.60 | 6.10 | 5.00 | 4.50 | 4.50 |
| 1-09 | 11.00 | 11.00 | 10.00 | 10.00 | 6.80 | 6.30 | 5.00 | 4.80 | 4.80 |
| 1-10 | 11.00 | 11.00 | 9.80 | 9.30 | 6.80 | 6.30 | 5.20 | 4.60 | 4.60 |
| 1-11 | 11.00 | 11.00 | 9.50 | 8.90 | 6.80 | 6.30 | 5.40 | 4.60 | 4.60 |
| 1-12 | 11.00 | 11.00 | 9.30 | 8.60 | 7.00 | 6.10 | 5.00 | 4.60 | 4.60 |
| 1-13 | 11.00 | 11.00 | 9.50 | 9.10 | 8.20 | 5.80 | 4.80 | 4.50 | 4.50 |
| 1-14 | 16.00 | 16.00 | 11.00 | 8.90 | 8.40 | 6.50 | 5.00 | 4.80 | 4.80 |
| 1-15 | 11.00 | 11.00 | 11.00 | 9.10 | 8.40 | 7.00 | 5.50 | 5.40 | 5.40 |
| 1-16 | 11.00 | 11.00 | 10.00 | 9.00 | 8.60 | 7.10 | 5.40 | 5.10 | 5.10 |
| 1-17 | 12.00 | 12.00 | 10.00 | 10.00 | 8.20 | 6.70 | 5.00 | 4.80 | 4.80 |
| 1-18 | 10.00 | 10.00 | 10.00 | 9.00 | 7.90 | 6.70 | 5.00 | 4.60 | 4.60 |
| 1-19 | 30.00 | 30.00 | 9.90 | 9.50 | 7.70 | 6.70 | 5.40 | 5.10 | 5.10 |
| 1-20 | 50.00 | 50.00 | 9.70 | 8.80 | 8.20 | 6.50 | 6.50 | 6.30 | 6.30 |
| 1-21 | 24.00 | 24.00 | 13.00 | 12.00 | 8.60 | 6.60 | 6.50 | 6.50 | 6.50 |
| 1-22 | 19.00 | 19.00 | 14.00 | 9.40 | 8.40 | 6.80 | 6.50 | 6.30 | 6.30 |
| 1-23 | 18.00 | 18.00 | 13.00 | 8.80 | 8.10 | 7.10 | 6.90 | 6.00 | 6.00 |
| 1-24 | 18.00 | 18.00 | 13.00 | 8.80 | 8.20 | 6.70 | 6.70 | 5.00 | 5.00 |
| 1-25 | 17.00 | 17.00 | 14.00 | 8.80 | 7.60 | 6.50 | 6.50 | 4.50 | 4.50 |
| 1-26 | 16.00 | 16.00 | 13.00 | 8.80 | 7.40 | 6.50 | 6.00 | 5.50 | 5.50 |
| 1-27 | 15.00 | 15.00 | 10.00 | 8.80 | 7.20 | 6.50 | 6.50 | 5.00 | 5.00 |
| 1-28 | 12.00 | 12.00 | 8.80 | 8.50 | 7.90 | 7.00 | 6.30 | 4.00 | 4.00 |
| 1-29 | 11.00 | 11.00 | 9.00 | 8.90 | 8.60 | 6.70 | 6.30 | 4.50 | 4.50 |
| 1-30 | 26.00 | 26.00 | 9.80 | 9.50 | 8.60 | 6.30 | 6.10 | 5.00 | 5.00 |
| 1-31 | 73.00 | 73.00 | 10.00 | 9.80 | 8.60 | 6.10 | 6.10 | 5.50 | 5.50 |
| MEAN | 14.70 | 14.70 | 9.98 | 9.50 | 8.21 | 6.43 | 5.84 | 5.77 | 5.77 — Monthly Flows EQUALLED OR EXCEEDED |

Daily Flows EQUALLED OR EXCEEDED

Example of flow duration data for the month of January. All figures are the mean value for the given day or for the entire month.

Flow duration hydrograph of the Yellowstone River at Livingston with 0, 20, 50, 80 and 100 percent exceedance levels shown.



# APPENDIX B

## FISH SPECIES - ABBREVIATIONS - CODE NUMBERS

SPECIES DESIGNATION

Example: A012 - Arlee brood, westslope cutthroat

Brood stock code — Species code from below

| SPECIES | ABBREV. | CODE | SPECIES | ABBREV. | CODE |
|---|---|---|---|---|---|
| Rainbow trout | Rb | 01 | Fathead minnow | | 52 |
| Cutthroat trout* | Ct | 02 | Golden shiner | | 53 |
| Brook trout | Eb | 03 | | | 54 |
| Brown trout | LL | 04 | River carpsucker | Carp Su | 55 |
| Dolly Varden | DV | 05 | Longnose sucker | LN Su | 56 |
| Lake Trout | Lt | 06 | White sucker | W Su | 57 |
| Golden trout | Gt | 07 | Largescale sucker | C Su | 58 |
| Kokanee | KOK | 08 | Blue sucker | B Su | 59 |
| Cobo (Silver salmon) | SS | 09 | Bigmouth buffalo | | 60 |
| Arctic grayling | Gr | 10 | Smallmouth buffalo | | 61 |
| Rainbow X cutthroat hybrid | RbXCt | 11 | Shorthead redhorse | | 62 |
| Cutthroat trout, Westslope | W Ct | 12 | Mountain sucker | J Su | 63 |
| Cutthroat trout, Yellowstone | Y Ct | 13 | Stonecat | | 64 |
| Whitefish* | Wf | 14 | Black bullhead | | 65 |
| Lake whitefish | L Wf | 15 | Yellow bullhead | | 66 |
| Sculpin* | Cot. | 16 | | | 67 |
| Largemouth bass | LMB | 17 | | | 68 |
| Bass* | | 18 | | | 69 |
| Sunfish* | | 19 | | | 70 |
| Yellow perch | YP | 20 | Brook stickleback | | 71 |
| Crappie* | CR | 21 | | | 72 |
| Sauger/walleye* | | 22 | Smallmouth bass | SMB | 73 |
| Northern pike | N Pike | 23 | Bluegill | B GILL | 74 |
| Channel catfish | C Cat | 24 | Pumpkinseed | PS | 75 |
| Bullhead* | | 25 | Green sunfish | | 76 |
| Burbot | Ling | 26 | Black crappie | | 77 |
| Sturgeon* | | 27 | White crappie | | 78 |
| Paddlefish | PF | 28 | Rock bass | | 79 |
| Peamouth | PM | 29 | | | 80 |
| Goldfish | | 30 | Sauger | | 81 |
| Sucker* | Su | 31 | Walleye | | 82 |
| Carp | Carp | 32 | Iowa darter | | 83 |
| Northern squawfish | N SQ | 33 | | | 84 |
| Goldeye | GE | 34 | Mountain whitefish | | 85 |
| Utah chub | Gila | 35 | Pygmy whitefish | | 86 |
| Freshwater drum | | 36 | Chinook salmon | | 87 |
| Minnow* | | 37 | Splake | | 88 |
| Shortnose gar | Gar | 38 | Salmon* | | 89 |
| Longnose dace | | 39 | White sturgeon | | 90 |
| Buffalo* | Buff | 40 | Pallid sturgeon | | 91 |
| Finescale/Nor. redbelly dace | | 41 | Shovelnose sturgeon | | 92 |
| Brassy minnow | | 42 | | | |
| Silvery/Plains minnow | | 43 | | | |
| Flathead chub | | 44 | Trout perch | | 100 |
| Lake chub | | 45 | Plains killifish | | 103 |
| Sturgeon chub | | 46 | Mosquitofish | | 106 |
| Emerald shiner | | 47 | Shortfin molly | | 109 |
| Sand shiner | | 48 | Variable platyfish | | 112 |
| Redside shiner | | 49 | Green swordtail | | 115 |
| Creek chub | | 50 | Trout* | | 118 |
| Pearl dace | | 51 | Trout/salmon* | | 119 |

* Undesignated

APPENDIX C

## Abstract[1/]

Demands for the land and water resources which support fish, wild life, and recreational activities are growing. Good information on which to base sound resource allocation decisions is thus increasing in importance. The non-market character of the resources, however, makes quite difficult the evaluation of economic benefits derived from these resources. This paper presents a history of methods used to estimate such values, including the travel cost method, now the most accepted among those used. The difficulties associated with use of the methods are discussed. Particular attention is paid to the problem of using existing methods to evaluate the economic value of fishing on the free-flowing Yellowstone River. An alternative method is suggested. It is concluded that in the judgment of the authors only after a three-to-four year study, not yet authorized, could sound estimates of fishing values on the Yellowstone be made. Attempts to estimate other recreation values on the Yellowstone face similar problems. Despite the difficulties, these values quite possibly will be quantifiable subject to time and money limitations placed on researchers. Quite clearly, however, the lack of current quantification should not exclude such values from consideration by decisionmakers.

1/ from: Copeland and Stroup (1976).

## Appendix D

## ECONOMIC BACKGROUND

The background information used for the economic analysis came from a fishing pressure survey conducted from May 1, 1975-April 30, 1976 by the Montana Department of Fish and Game. This survey is sent out bi-weekly April through September to 1,000 anglers, asking about their fishing in the last two weeks. For the remainder of the year, questionnaires are mailed out monthly. Some estimates involving small returns of questionnaires are more variable than larger ones, although on the whole these figures are quite adequate for this analysis. This is not attempting to use the figures for analytical purposes, but rather to indicate the magnitude of angling use in the Yellowstone basin (Table 1).

Similarly, boating with motor, river floating and swimming figures are available for 1975 (Table 2), indicating use of the mainstem Yellowstone River.

The magnitude of use of the river and its tributaries is significant, even given difficulties in counting this use. If reduced flows affect the quality of the fishery and the individual's ability to use the river, then negative impacts will likely occur to recreational use and the economy.

For example, if fishing were decreased by one-half in Section 1, 3 and 5, not only would there be lost income and employment to fly shops, sporting goods stores, gas stations and guides, but there would also be losses to workers in other industries as well (secondary or "multiplier" effects). Also, there would occur a loss of value to those who could not participate in excellent brown trout fishing or paddlefish fishing. These persons would turn to other recreation they clearly like less. Of course, there is no value to this loss at this time, but it is a legitimate cost incurred; the point being that the above figures only indicate a use but cannot explain its value.

Table 1. Angler days, May 1, 1975-April 30, 1976, combination residents and nonresidents.

| | |
|---|---|
| Section #1 | |
| Mainstem | 68,667 |
| Tributaries | 16,431 |
| Section #2 | |
| Mainstem | 15,931 |
| Tributaries | 32,742 |
| Section #3 | |
| Mainstem | 10,222 |
| Tributaries | 24,906 |
| Section #4 | |
| Mainstem | 14,997 |
| Tributaries | 17,574 |
| Section #5 | |
| Mainstem | 35,051 |
| Tributaries | 1,459 |
| Basin Total | 237,980 Angler Visits |

Note:

Section 1 is Gardiner to Reed Point mainstem,
plus Shields and Boulder river tributaries
Section 2 is Reed Point to Laurel mainstem,
plus Stillwater and Clarks Fork river tributaries
Section 3 is Laurel to Bighorn River mainstem
plus Bighorn River tributaries
Section 4 is Bighorn River to Powder River mainstem
plus Tongue tributaries
Section 5 is Powder River mainstem to North Dakota border
plus Powder River tributaries

Source: Unpublished information, Montana Department of Fish and Game, Helena, Montana.

Table 2. Boating with motor, river floating and swimming recreation days, 1975, residents and nonresidents, mainstem Yellowstone.

| | Boating with Motor | River Floating | Swimming |
|---|---|---|---|
| Section #1 | 3,657 | 1,836 | 6,948 |
| Section #2 | 154 | 77 | 154 |
| Section #3 | 24,263 | 1,945 | 25,413 |
| Section #4 | 8,006 | 673 | 8,348 |
| Section #5 | 5,833 | 72 | 4,207 |
| Yellowstone Total | 41,913 | 4,603 | 45,070 |

Source: Montana Department of Fish and Game, "Montana Outdoor Recreation Plan,"(SCORP), Vol. 2, 1971 Statewide Recreation Survey. 1975 Updated figures.

NET ENVIRONMENTAL - WATER AVAILABILITY PRIMARY IMPACT MATRIX 1/

| Alternative Actions | Environmental | | | | | Water Available for: | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Agriculture | | Industry | | Municipal |
| | Fisheries/ Aquatic Life | Wildlife | Water 2/ Quality | Air Quality | Recreation 3/ | Development of New Lands 4/ | Protection of Existing Diversion Rights | New or 5/ Expanded Facilities | Water Pollution Control 6/ | Domestic Supply/ Pollution Control 7/ |
| 1. No reservations granted | - | - | - | 0 | - | + | - | + | - | - |
| 2. Fish & Game reservations granted in full | + | + | + | 0 | + | - | + | - | + | + |
| 3. Fish & Game reservations not granted, others are granted | - | - | - | 0 | - | + | - | + | - | - |
| 4. Fish & Game reservations granted in lesser amount 8/ | + or - | + or - | + or - | + or - | + or - | + or - | + or - | + or - | + or - | + or - |

1/ + = positive impact (beneficial)
- = negative impact (adverse)
0 = negligible impact

2/ Water quality factors considered are: Temperature, dissolved solids, nutrients, dissolved oxygen

3/ Recreation uses considered are: Fishing, hunting, trapping, bird watching, boating/floating, sightseeing.

4/ It is not clear that conflicts will exist over available supplies. This analysis assumes a conflict will exist.

5/ It is not clear that conflicts will exist over available supplies. This analysis assumes a conflict will exist.

6/ Assumes greater degree of industrial effluent treatment will be required if water quantity of receiving streams is inadequate to assimilate wastes.

7/ Assumes need for suitable water quality for domestic consumption and use, and that a greater degree of treatment of domestic wastes would be required if water quantity of receiving streams is inadequate to assimilate wastes.

8/ Impact could be + or - depending on the degree to which the reservation was not granted.

NET ECONOMIC PRIMARY IMPACT MATRIX [1/]

| Alternative Actions | Economic | | | | | |
|---|---|---|---|---|---|---|
| | Recreation | | Agriculture | | Industry | |
| | Employ. | Income | Employ. | Income | Employ. | Income |
| 1. No reservations granted River Section [2/] | | | | | | |
| 1 | - | - | + | + | + | + |
| 2 | - | - | + | + | + | + |
| 3 | - | - | + | + | + | + |
| 4 | - | - | + | + | + | + |
| 5 | - | - | + | + | + | + |
| 2. Fish & Game reservations granted in full River Section | | | | | | |
| 1 | + | + | - | - | - | - |
| 2 | + | + | - | - | - | - |
| 3 | + | + | - | - | - | - |
| 4 | + | + | - | - | - | - |
| 5 | + | + | - | - | - | - |
| 3. Fish & Game reservations not granted, others are granted River Section | | | | | | |
| 1 | - | - | + | + | + | + |
| 2 | - | - | + | + | + | + |
| 3 | - | - | + | + | + | + |
| 4 | - | - | + | + | + | + |
| 5 | - | - | + | + | + | + |
| 4. Fish & Game reservations granted in lesser amount River Section | | | | | | |
| 1 | - | - | + | + | + | + |
| 2 | - | - | + | + | + | + |
| 3 | - | - | + | + | + | + |
| 4 | - | - | + | + | + | + |
| 5 | - | - | + | + | + | + |

1/ + = positive impact (beneficial) - = negative impact (adverse)

2/ Section 1 = Yellowstone River and tributaries from Gardner to Reed Point.
Section 2 = Yellowstone River and tributaries from Reed Point to Laurel.
Section 3 = Yellowstone River and tributaries from Laurel to Big Horn River.
Section 4 = Yellowstone River and tributaries from Big Horn River to Powder River.
Section 5 = Yellowstone River and tributaries from Powder River to North Dakota State line.