

## **Big Creek Flow Restoration Plan (TMDL)**

### **December 2000**

#### **Introduction**

This submittal is to document elements of the flow restoration work completed in the lower reach of Big Creek as the Total Maximum Daily Load (TMDL) Plan for flow regulation/modification and designated uses. The waterbody addressed by this plan is a 3.6 mile long segment of Big Creek (MT43B004\_111), which is found in the Upper Yellowstone hydrologic unit (HUC 10070002) and flows through southern Park County in southwestern Montana about 30 miles south of Livingston (see Figure 1 - Location Map). This reach is described as that portion of Big Creek from the National Forest boundary to the mouth (DEQ 2000a).

The water quality issue addressed by the plan is dewatering caused by flow regulation/modification for the purpose of agricultural irrigation. The original 3.6 mile reach designation (DEQ 2000a) was based on an approximate location for the impairment. Later refinement has shown that the actual flow-related, use impairment exists only in the lower 1.5 miles of Big Creek (below the Mutual Ditch diversion). Accordingly, the information reviewed in the development of this plan indicates that beneficial uses in the upper 2.1 miles of the reach are not impaired due to lack of flow. No flow restoration activities are needed in the upper 2.1 miles of the reach. This plan will, therefore, be sufficient to remove the entire 3.6 mile reach as described on the 2000 303(d). Future 303(d) lists will officially reflect this change in reach length, description, and use support status.

Big Creek, a second order stream, originates on the east slope of the Gallatin Range and flows for about 18 miles before entering the Yellowstone River. For much of its length, Big Creek passes through mountainous timberlands managed by the U.S. Forest Service. Average annual precipitation ranges from 26 to 32 inches in the headwaters dropping to around 12 inches near the mouth. Drainage area is about 82 square miles; average annual discharge is 61 cfs (USGS 1986). Big Creek is primarily fed by snowmelt (USDA-SCS 1992). About one and a half miles above the mouth, Big Creek leaves the mountains and enters the agricultural lands of the Yellowstone Valley.

The impaired reach of Big Creek lies on gently sloping fan and terrace deposits between the Yellowstone River and the Gallatin Mountain Range. The land uses in the area addressed by this TMDL irrigated hay (75%), irrigated small grains in rotation (10%), and native rangeland (15%) (USDA-SCS 1992). The land addressed by this TMDL plan is privately-owned land. (Figure 2, Project Map)

Pertinent resource issues are:

- The successful use of the stream by Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*) for spawning and rearing habitat. The State of Montana has identified the Yellowstone cutthroat trout as a "Fish of Special Concern". Big Creek has been documented as a potentially significant source of Yellowstone cutthroat trout recruitment in the upper Yellowstone River (Clancy 1985).
- Irrigation water use and conveyance system losses. Big Creek is included on the Department of Fish, Wildlife and Parks *De-watered Streams List*.
- Protection of existing water rights in Big Creek and sustained crop production levels on lands irrigated from Big Creek.

No Federally listed Threatened and Endangered (T&E) aquatic or plant species occur in this portion of the Upper Yellowstone River watershed. The Grizzly Bear (*Ursus arctos horribilis*), and Bald Eagle (*Haliaeetus leucocephalus*) are currently listed as Threatened. The status of the Gray Wolf (*Canis lupus*) is Endangered (federal Endangered Species Act, 2000). The grizzly bear and gray wolf are described as transients in the project area, while the bald eagle utilizes tall trees in the riparian zone. Implementation of this plan will have no effect on the former species and no effect to possible long-term improvement for the latter species primarily through improvement in the fishery and associated aquatic life.

Historically, five irrigation diversions in the lower one and one-half miles captured nearly all of the streamflow of lower Big Creek causing the lower reach to go dry in virtually all years (Berg 1975; Clancy 1984, 1985). These ditches were used by nine water users to irrigate about 1300 acres. Assessment and planning efforts over a number of years by landowners, Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, and Montana Fish Wildlife and Parks (FWP) led to the eventual development of a Future Fisheries Project in 1998. The restoration project re-watered the lower mile of Big Creek by creating and then leasing "salvage water" from three privately owned ranches. "Salvage water" is water no longer used for irrigation because of improvements in efficiency (SB 450, 1989 Legislature). Conversion of existing ditch/flood irrigation facilities to more efficient gravity fed pipelines and sprinkler systems on a portion of the lands served by Big Creek created "salvage water". In conjunction with the irrigation management improvements, two voluntary water right leases were implemented between three water right holders and FWP to provide instream flow in the lower mile of Big Creek (FWP 1998a). These agreements were implemented in 1999.

### **Restoration Plan (TMDL) Review Elements**

The following elements were used as review criteria in evaluating the sufficiency of the State submittal as a TMDL and therefore justify removal of this reach of Big Creek from Montana's (Year 2000) 303(d) List under the Clean Water Act (DEQ 2000a).

#### **• Stream Classification and Standards**

Big Creek is a perennial stream classified as B-1 in the Montana Water Quality Standards (ARM 17.30.601 et seq.). The B-1 classification means that the stream must be suitable for growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; agricultural and industrial water supply; drinking, culinary and food processing purposes after conventional treatment; and bathing, swimming and recreation. This reach of Big Creek is 3.6 miles long and extends from the Gallatin National Forest boundary to its confluence with the Yellowstone River. (See Figure 1 Location Map) The waterbody number is MT43B004\_111 and it is found in the Upper Yellowstone hydrologic unit, HUC 10070002.

The beneficial uses of water in Big Creek that are *partially supported* are Aquatic Life, Cold Water Fishery, and Contact Recreation. The probable cause of impairment has been identified as de-watering. The probable source of impairment has been identified as flow regulation/modification. Drinking Water, Agriculture and Industrial designated uses have not been determined due to a lack of

sufficient credible data (DEQ 2000a). The upper reaches of Big Creek (MT43B004\_112 and 113) have been found to be fully supporting of aquatic life and cold water fishery uses (DEQ 2000).

Since there is no numeric standard for the pollutant of concern (dewatering or an absence of flow), this TMDL plan addresses the support and maintenance of associated aquatic life, cold water fishery and contact recreation designated uses. The plan focuses on restoring flow conditions in Big Creek to a level that fully supports the cold water fishery use. Achievement and maintenance of designated uses is implicit in meeting water quality standards. Restoration of year-round flow to provide full support of the cold water fishery will restore and protect the aquatic life and contact recreation uses as well.

#### • **Criteria Used to Judge Achievement of Designated Uses**

The goal for this restoration plan is to support all conditions suitable for the growth and propagation of a native salmonid species (Yellowstone cutthroat trout) and associated aquatic life. The **primary use support target** for full achievement of impaired designated uses in Big Creek requires a year-round flow in the channel. This target has been determined to be a minimum stream flow of 11 cfs in the channel below the upper diversion (see Fig. 2 -Project Map) throughout the critical period (August and September) excepting significant natural events (drought) when that amount is not available at the diversion.

To provide an additional means with which to judge overall success and adequacy of the restoration plan, it is desirable to have more than one target. Full achievement of the associated aquatic life is the **secondary use support target**, expressed as a biotic index score of 75 percent or more of a reference condition (DEQ 2000b). For Big Creek, similar sites above and below the Mutual Ditch diversion will be compared. DEQ staff will collect macroinvertebrate samples and a DEQ contractor will analyze the samples according to DEQ's Rapid Bioassessment Macroinvertebrate Protocols: Sampling and Sample Analysis SOPs (Bukantis 1998).

The primary use support target will be used to judge success of the cold water fishery use in Big Creek. Consistent achievement of the minimum value flow (excepting natural drought) during the irrigation season will constitute full support of the cold water fishery and recreational uses. The secondary target will be used to judge support status of associated aquatic life. Consistent achievement of the minimum biotic index score will constitute full support of the associated aquatic life use. The principal suitable recreational use of Big Creek is fishing given its size and structure. Full support of the fishery and associated aquatic life will provide full opportunity for recreational uses.

#### • **TMDL**

The TMDL for Big Creek is expressed as a **flow-increase target**, in this case a quantified value during a critical period. Point sources of pollutants are non-existent in the watershed, therefore the "wasteload allocation" component of the TMDL is considered to be zero. The TMDL is considered solely in the "load allocation" component of the TMDL. The load allocation is made up of 'natural' and non-point sources. Natural sources in the case of dewatering are considered the normal

hydrologic regime for a particular stream. The probability of natural flows in Big Creek is depicted in Table 2. Natural channel losses throughout the entire Big Creek drainage average about 3 cfs (SCS 1992) and have been considered in setting the flow-increase target of 11 cfs at the Mutual Ditch diversion point. The 'load allocation' therefore is based on increasing flows to a minimum of 11 cfs, considered to be the threshold for full support of the cold water fishery and associated aquatic life.

Montana Fish, Wildlife & Parks has determined that the 11 cfs flow level in this segment is adequate to cover 97.5% of the spawning redds observed (Byorth 1990) and that amount is adequate to fulfill other habitat requirements of salmonids, i.e. temperature, depth, and velocity in the stream channel. The following activities have already been implemented to accomplish the restoration plan:

- Twenty-six cfs of Big Creek water leased to FWP by three water right holders. Eleven cfs of the lease is protectable from junior users downstream to ensure a minimum instream flow.
- More efficient irrigation water management practices and sprinkler irrigation systems applied to approximately 700 acres. A significant portion of these Best Management Practices (BMPs) were installed entirely at the landowners' expense.
- In excess of 15,000 feet of underground pipelines were installed to replace existing open conveyance ditches and thereby further increase efficiency of irrigation water use.
- An effectiveness-monitoring program has been developed and implemented in this reach of Big Creek. Temperature, flow and spawning activity has been monitored during the irrigation season.

#### • Significant Sources

The pollution of concern is seasonal dewatering of the lower one and one-half mile of Big Creek due to state-permitted irrigation water withdrawals. Water rights on Big Creek total 113 cfs, well in excess of late summer flows. The chronic dewatering has created undesirable conditions for the growth and propagation of aquatic life and salmonid fishes. Seasonal dewatering also limits the contact recreation use through lack of opportunity and reduced quality. The source of the impairment is flow modification/regulation in order to attempt to meet the consumptive use of agricultural crops. Dewatering of the lower reaches of tributaries to the Yellowstone adversely impacts the reproductive success of cutthroat trout and consequently limits the production of new recruits for the river fishery (Berg 1975; Byorth 1990; Clancy 1984, 1985). These studies have shown tributary dewatering to be an important, if not the major factor, regulating the numbers of adult Yellowstone cutthroat that reside in the Yellowstone River. Research conducted in Big Creek in 1988 indicated that almost no juvenile outmigrants reached the river because of severe dewatering in July and August (Byorth 1990). Dewatering has also limited the number of resident fish of all species and associated aquatic life in the lower one and one-half mile (FWP 1998b).

A 1992 USDA-SCS study estimated that the lower one and one-half miles of stream is dewatered eight out of ten years from late July to mid-August. The primary reason for dewatering has been determined to be irrigation water conveyance and application system inefficiency. None of the irrigation water diverted from Big Creek returns as surface water to the creek. This is evidenced by the fact that this reach of stream goes dry virtually every year. Surface flow would be visible within

the lower reach if irrigation return flows were a significant contributor of water. Consumption of diverted water is estimated at 100% (FWP 1998c).

Water rights in Montana are guided by the prior appropriation doctrine (DNRC 1999). Under this doctrine, a right established first in time is therefore first in the right to the amount of water that can be put to a beneficial use. Earlier rights are then senior to junior (later) rights for a given water source in terms of priority. The earliest water rights were generally established to provide for consumptive uses, i.e. for irrigation, livestock, culinary, and industrial purposes. In the 1980s and 1990s, the Montana Legislature created laws to allow water that is diverted for consumptive uses to be transferred to an instream or non-consumptive use (85-2-436, MCA; 85-2-408, MCA). The strategy used by water right holders on Big Creek was to lease a portion of the priority water rights to FWP. As a result of this process, the water right holder continues to own the water right, receives financial compensation, and makes a valuable contribution to protecting Montana's natural heritage.

### • **Technical Analysis**

The adequacy and needed term of the minimum required flow was based on a Montana State University study by Patrick Byorth which found that a flow of 11 cfs protected all but one redd in the lower mile of creek from being de-watered (Byorth 1990). The study showed that cutthroat trout prefer the lower one-mile of Big Creek for spawning. The lower one and one-half mile of creek was the reach that was chronically de-watered during August most years preventing fry emergence and return to the Yellowstone River system. Fry emergence is usually completed by mid-August. By late September, most fry have entered the main river. FWP estimated that maintenance of the minimum flow could result in 3,900 additional mature fish in the Yellowstone River (Shepard 1991). FWP also concluded that the minimum flow level would also protect all fish species (resident and migratory) and aquatic life in Big Creek (FWP 1998a,b).

Hydrologic and water rights analyses were conducted to determine the feasibility of the project to meet the target flow. Montana's water leasing program allows that FWP can only protect the amount of leased water that was previously consumed and did not directly return to the source of supply. The primary irrigation canal, the Mutual Ditch, which takes water from Big Creek for irrigation on the north side, was measured for water loss by the Montana Department of Natural Resources and Conservation (Compton, S. 1988). This study measured a cumulative loss of 72 percent of the 26-cfs diverted throughout a length of 4.6 miles. While the south-side ditch (Stewart-Ragsdale Ditch) was not measured, it is reasonable to conclude, due to similarity of soil types and topography and use, that the rate of conveyance losses are similar to that of the Mutual Ditch.

Two south-side irrigators developed a plan to improve irrigation water management and create salvage water available for instream use. The south-side pipeline and sprinkler systems on average use about half of that traditionally used for the flood irrigation systems. As a result, 16 cfs of water was available from these ranches.

At least five, north-side irrigators have independently installed sprinkler irrigation systems at their own expense thereby further cutting water consumption. The second lease makes use of senior water rights from one of these north-side ranches (the 1st priority, 10-cfs lessor). North and south-side areas

improved for irrigation are shown on Figure 2, Big Creek Area Map. The amounts and priorities for leased irrigation rights are shown in Table 1.

Table 1. Summary of irrigation water rights for the three ranches participating in the Big Creek water right lease program.

Claim No.	Priority	Claimed Flow Rate (cfs)	Period of Use	Amount Leased for Instream Flow (cfs)
43B-W-195265	6-30-1873	12.5	5/01-11/01	10.00*
195264	6-30-1882	3.13	5/01-11/01	0
193683	3/12/1883	2.50	4/15-10/15	1.00*
190630	8-17-1900	4.00	4/01-11/15	0
190689	6-30-1901	4.00	4/15-10/15	2.50
193684	5-31-1909	2.50	4/15-10/15	2.50
190268	5-15-1910	5.00	4/15-10/15	5.00
190269	5-15-1910	2.50	4/01-11/15	0
193682	5-15-1910	7.39	5/15-7/01	5.00
<b>Total</b>		<b>43.52</b>		<b>26.00</b>

\* protected flows

FWP compared the water rights with flow probability for Big Creek (FWP 1998c). Table 2 provides monthly percent exceedence flows for lower Big Creek at stream mile 2.7 (USGS 1986). These values, adjusted to the 1934-82 base period, depict the undepleted flows of Big Creek upstream from the diversions and measured water availability.

During the months of August and September, the period when water conflict is greatest, Big Creek averages (Q.50) flows of 35 and 32 cubic-feet per second (cfs), respectively. If the irrigation right holders on Big Creek are simultaneously diverting the full amounts of their claimed rights and adhering to the priority system, there is sufficient streamflow during August and September to only satisfy the first ten rights. Among the first ten are two rights (1<sup>st</sup> and 3<sup>rd</sup> in priority) being leased for instream use (FWP 1998c).

<b>Table 2. Stream Flow Probability for Big Creek (USGS)Site No. 06191800 Big Creek., near Emigrant, MT @ Stream mile 2.7</b>	<b>Month</b>	<b>Q.90 (cfs)</b>	<b>Q.80 (cfs)</b>	<b>Q.50 (cfs)</b>	<b>Q.20 (cfs)</b>	<b>Q<sub>M</sub> (cfs)</b>
1934-1982 Base period	October	23	24	29	34	30
	November	20	22	25	30	25
	December	18	19	23	25	22
	January	16	17	21	22	20
	February	15	17	19	21	19
	March	16	17	19	21	19
	April	22	24	33	64	43
	May	87	93	128	155	126
	June	156	176	249	307	248

	July	54	65	97	135	105
	August	22	27	35	49	37
	September	26	30	32	36	32
	Annual	--	--	--	--	61

The  $Q_n$  values in Table 2 represent the chance of streamflow exceeding the flow ( in cfs) shown. The  $Q_{.90}$  column represents drier conditions with monthly flow exceeding the flow value shown 90% of the time, or 9 out of 10 years. Flow will be equal to or less than the value shown only 1 year out of 10. The  $Q_{.20}$  column represents wetter conditions with flows exceeding the value shown only 2 out of 10 years. Flows will be equal to or less than this value 80% of the time or 8 out of 10 years.  $Q_{.50}$  gives the average or mean flow volume.  $Q_M$  is the calculated median monthly flow.

During drought events represented by ( $Q_{.90}$ ), available flows (22 and 26 cfs, respectively) are sufficient to fully satisfy only the first four to seven rights in August and September. Again, among these rights are two senior priority rights being leased for instream flow (FWP 1998c).

FWP concluded that installing south-side irrigation system improvements and leasing water from the north-side senior water right user who already converted to sprinkler irrigation would achieve the project goals. The combination of actions protects a minimum flow of at least 11cfs in Big Creek below the major diversion. The flow target also insures that adequate water is available to meet the consumptive use requirement of the lessors' crops. Eleven cfs of the 26 cfs leased is protectable in all years from junior users downstream and will be filled by water salvaged through the irrigation efficiency gains.

FWP studies also indicated that habitat requirements such as water temperature, riffle and pool depth and velocity are maintained at acceptable levels by the 11cfs minimum flow value during the chronic dewatering period of August and September. Protection of the minimum flow during the critical period ensures that stream riffles are submerged yearlong providing suitable habitat and growing conditions for benthic aquatic life. It is reasonable to assume, therefore, that if limiting shallow spawning habitats are protected, other in-stream habitat structures (pools, glides and runs) are also maintained at acceptable levels. The minimum flow target also ensures that water is present in sufficient volume to achieve full support of the contact recreation use (FWP 1998a, b).

Streamflow during the non-irrigation demand season of October through mid-April is generally unmodified from natural conditions. Big Creek is primarily a snowmelt fed stream. Flows during runoff in May and June of normal to above-normal years are adequate to meet irrigators needs and still exceed 11 cfs below the Mutual Ditch diversion.

• **Allocation**

Approximately nine water-right holders use Big Creek water to irrigate about 1300 acres. The direct involvement and participation of two of the three senior water right holders on Big Creek provides a sufficient level of treatment to achieve the restoration goal (TMDL). Voluntary application of water conservation practices to more than 50 percent of the irrigated lands served by Big Creek to facilitate the availability of salvage water, also further constitutes reasonable allocation of the TMDL.

## • Margin of Safety & Seasonal Variation

The margin of safety and seasonal variation is provided for in several ways. The average annual discharge in Big Creek is about 61 cfs (USGS 1986). The senior water rights holders control about 43 cfs. The landowners have retained the right to use approximately 17 cfs allowing some flood irrigation during spring runoff if excess flow is available. The leasing of up to 26 cfs and the protection of a minimum flow of 11 cfs through the FWP agreements provides a margin of safety in that during above average water years, available streamflow during the critical portion of the irrigation season (August and September) should be sufficient to provide instream flows in excess of the minimum flow level. Based on the USGS data, at least the minimum flow should be protectable at all times every year. Only a severe drought (less frequent than the Q.90) should cause available flow to be less than the lease target of 11 cfs.

The period and mechanisms within the lease provide additional elements of a margin of safety. More than twice the minimum critical flow of 11 cfs is being leased by FWP. Ten cfs of 1<sup>st</sup> priority right water is leased for a 10-year period (Claim No. 43B-W-195265) at the end of which time, the lease may be renewed. Sixteen cfs of water is leased for a 20-year period (Claim Nos. 43B-W-193683, -193689, -192684, -190629, and -193682). The rights to the latter claims have been donated in perpetuity by the ranches to the Montana Land Reliance (MRL), a non-profit land trust located in Helena, Montana. MRL is leasing this water to FWP, without charge, for instream use providing a further margin of safety in meeting the TMDL goal. The latter claims are lower priority, but serve to provide additional instream flow during the early and late portion of the irrigation season.

The most significant element of the margin of safety is based on Big Creek irrigators' interest and commitment. In addition to the mechanisms undertaken through the leasing program, improvements in irrigation efficiencies made by landowners provide a margin of safety for water demand. Five additional north-side irrigators are voluntarily contributing to the success of the effort by monitoring their water use, improving irrigation efficiencies as much as possible, and collaboratively working to manage water use.

An adaptive approach to the monitoring component of the plan provides another source of margin of safety. The monitoring procedures implemented through the flow restoration plan provide a mechanism with which to adopt needed plan refinements based on evaluations of the effectiveness of the actions and agreements. Effectiveness will be determined by monitoring flow during the irrigation season (fishery use support) and periodic benthic macroinvertebrate sampling (aquatic life use support), by DEQ.

FWP has instituted a monitoring program as a means of evaluating the adequacy of the target flow to achieve the objectives of the restoration plan. Flows are monitored at two points: at the Mutual Ditch diversion and at a USGS installed staff-gage below the diversion. The short-term monitoring program is conducted through an FWP contract consultant (Garcia and Associates, Bozeman, Montana) to measure daily flow, water temperature, and spawning activity through the irrigation season (June through mid-September); to estimate fry production; and to contact FWP if flows fall below the target level. Over the long-term, FWP has proposed to rely on the ranch owners to administer water withdrawals and to monitor Big Creek flows. FWP personnel are available to periodically spot check and measure flow levels. In the event that the initial plan becomes

unworkable, a new flow-monitoring program that could include the annual appointment of a water commissioner will be implemented (FWP 1998c).

Under Montana's Water Quality Act, DEQ is charged with the periodic assessment of beneficial use support in streams for which TMDLs have been implemented (75-5-703(7) and (9) MCA). DEQ will conduct macroinvertebrate sampling in the lower reach of Big Creek no less than every five years following the approval of the TMDL. Benthic macroinvertebrate community indices from a site below the Mutual Ditch diversion will be compared to a reference site upstream of the diversion as a means of judging TMDL target success and aquatic life use support status.

Allowance for seasonal variation is implicit throughout the proceeding analyses: accounting for seasonal hydrologic variation, critical biologic requirements of aquatic life, irrigation demand to meet crop consumptive use during the irrigation season, and the period of use for appropriate water rights.

### ▪ **Plan Implementation**

The components of the Big Creek flow restoration plan and TMDL are presently in place. All proposed actions have taken place. Participants and actions are described below. Figure 2 shows the location of applied BMPs.

#### Landowners

- Implemented BMPs to improve efficiency of irrigation water delivery and application on over 700 acres.
- Install, operate and maintain irrigation system improvements.
- Provided 26 cfs leased water to FWP for instream use.
- Donated 16 cfs in perpetuity to Montana Land Reliance
- All irrigators collaborate to manage withdrawals and bypass flows to achieve minimum target flow.

#### Montana Fish, Wildlife and Parks

- Provide technical and financial assistance to landowners to purchase and install irrigation system improvements on two landowners.
- Provide funds to lease 26 cfs of water rights; 11 cfs of a senior rights.
- Monitor flows and fishery status in Big Creek (cooperatively installed a staff gage with assistance from the U.S. Geological Survey (1999) and GANDA monitoring contract.

#### USDA- Natural Resources Conservation Service

- Conducted irrigation system and hydrologic analyses.
- Provided technical assistance to landowners with irrigation system improvements.

#### Montana Department of Natural Resources

- Provided technical assistance with conveyance efficiency and water rights determinations.

### Montana Land Reliance

- Provide 16 cfs water right lease to stream in perpetuity.

The first full season of the water lease program began in 1999. The major sources of implementation funds were from the Malcolm and Big Creek Ranches and the FWP Future Fisheries Program. An economic analysis of the restoration project conducted by FWP evaluated several scenarios; without the project and with the project (Shepard 1991). The analysis indicated that the annual economic benefits from Big Creek fish ranged from \$283 without the project and up to \$276,120 with the project. The difference is due to the recreational value associated with improved trout reproduction resulting from maintenance of the target flow. Total cost of the project to landowners and the state, including irrigation system components and annual water lease payments, is more than \$600,000 over a twenty-year period (of which FWP has contributed \$325,000). This total amount does not include expenditures by landowners voluntarily installing sprinklers outside of the lease arrangement.

Monitoring protocols and data for the first year of project implementation on Big Creek are included in the Appendix 1 (Roulson 1999). The data indicated that flows in excess of the minimum target level of 11 cfs were achieved. The minimum flow measured during the critical period was 15.4 cfs. Water temperatures did not exceed 59 degrees F. Total annual precipitation at the Gardiner, Montana weather station for the 1998-99 water year was 11.02 inches with mean annual precipitation 10.12 inches (WRCC 2000). Twenty-three actively spawning fish were observed. The number of fry trapped during the sampling period was 3,429. There is no current data with which to compare the trap catch or statistical relationship to total fry production. Flow monitoring will be continued for each year that the leases are active.

Preliminary monitoring data for 2000 indicates that water users were able to maintain the target flow even though the region suffered through a widespread year-long drought. Fry trapping produced significant increases in the total and per day catch from the previous year.

### • **Public Participation**

Landowners made application to the Future Fisheries Program used to complete this project. The proposals and funding arrangements were subject to a competitive application and public review process. The program's advisory board and the FWP Director and Commission made funding decisions. Terms of the agreements were available for public review. An Environmental Assessment was prepared by FWP and circulated for public comment. No adverse comments were received.

The water-leasing program, as authorized by the Montana State Legislature, allows for the voluntary, temporary transfer and use of senior water rights by agreeable parties. A public review process open to objection and formal legal notices of the proposed water right transfers were made. No objections were filed.

This TMDL plan was reviewed with the participants and their comments incorporated into the final document. Notice of a 30-day public comment period for the TMDL was made to interested parties on December 20, 2000. This document was posted on the DEQ website at

<http://www.deq.state.mt.us>. Formal notice of this TMDL submission to EPA was made on December 18, 2000.

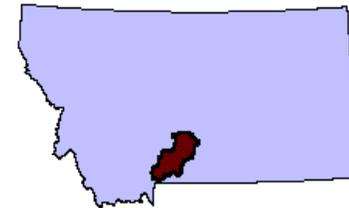
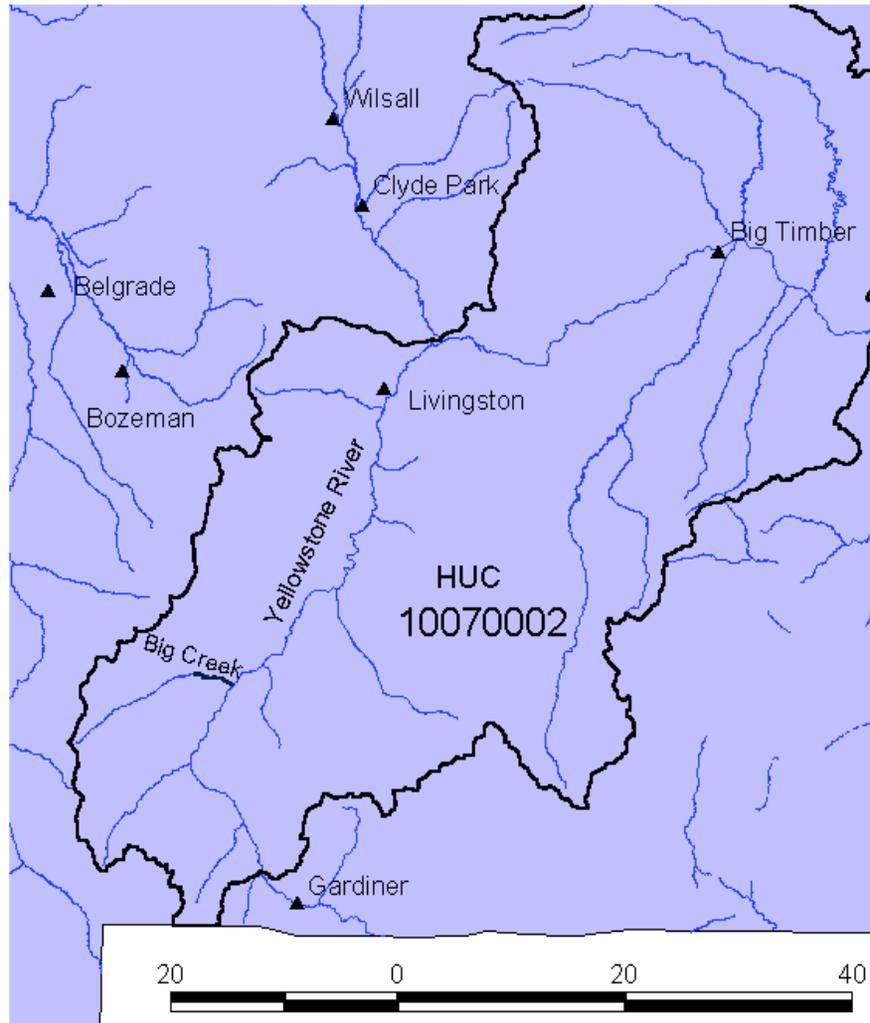
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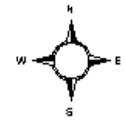
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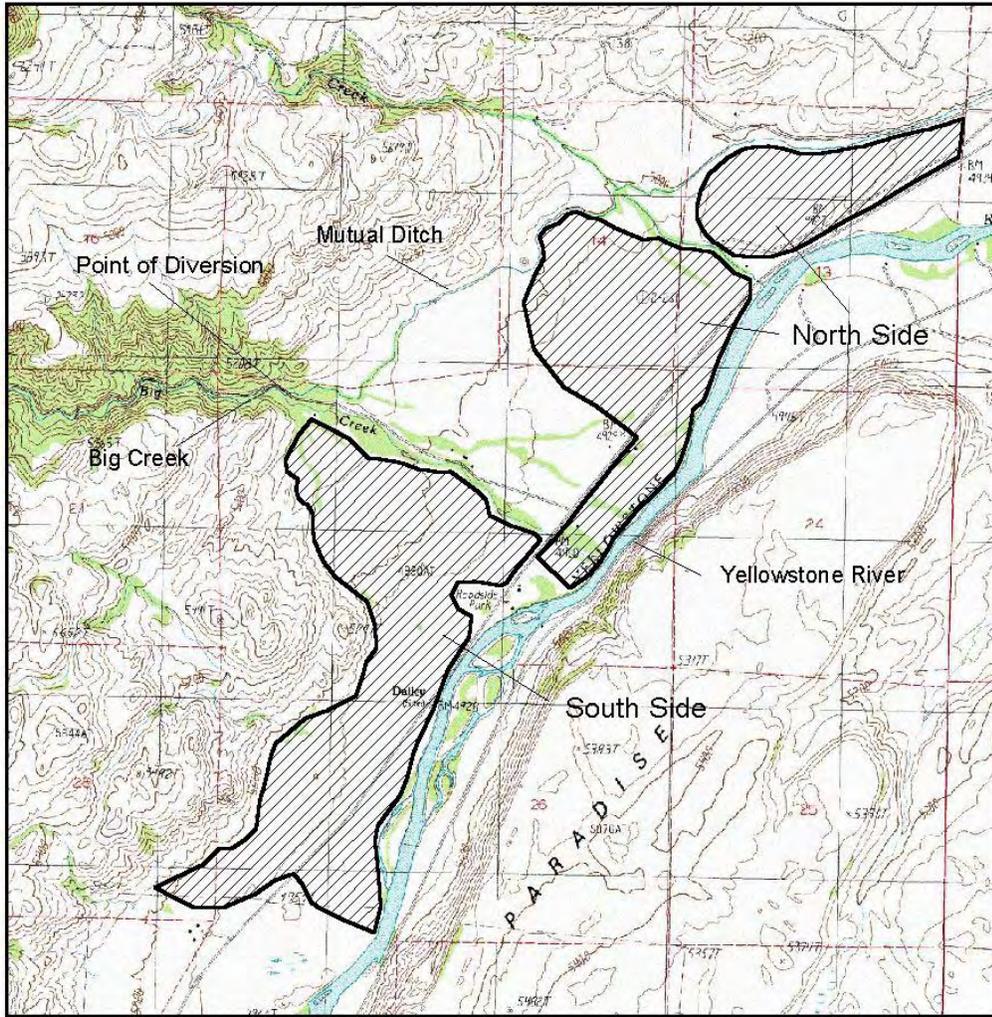
# Figure 1. Location Map



-  Big Creek TMDL Segment
-  Streams
-  Cities
-  Upper Yellowstone HUC



# Figure 2: Big Creek Area Map



Area of Irrigation Improvements 

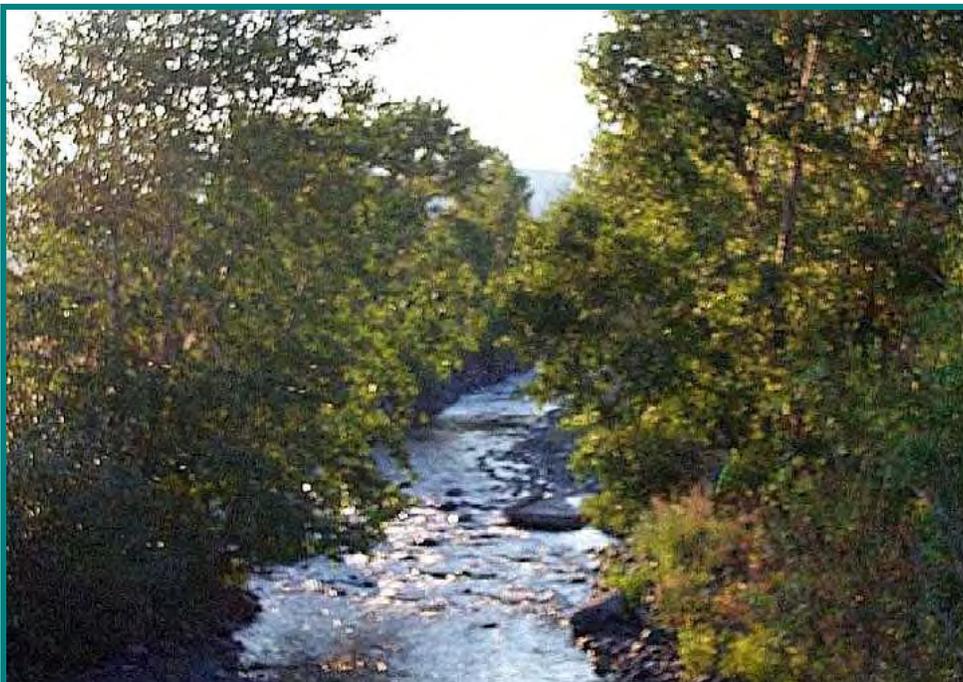


11/24/00

**EXHIBIT 1 BIG CREEK CHANNEL ABOVE HWY 89 SO. BRIDGE**



**BEFORE**  
(Prior to 1998)  
Photo by FWP



**AFTER**  
8/28/00  
12 cfs flow

Photo by Amy Miller,  
Park C.D.



