# BIOLOGICAL ASSESSMENT

FOR

# OPERATIONS AND MAINTENANCE OF BIG FLAT UNIT, MISSOULA VALLEY PROJECT, AND FRENCHTOWN PROJECT, MONTANA

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# TABLE OF CONTENTS

## Attachments

*Attachment*



## Tables

*Table* *Page*



## Figures

*Figure* *Page*

# CHAPTER 1
# INTRODUCTION

## 1.1 PURPOSE

This biological assessment describes the proposed continued routine operation and maintenance of the Big Flat Unit of the Missoula Valley Project and the Frenchtown Project, both located about 7 miles west from Missoula, Montana. The action area for this assessment includes those lands within the projects' boundaries and reaches of the Bitterroot River and Clark Fork (also known locally as the Missoula River) that are adjacent to project lands and facilities. This document also describes and analyzes the effects of the proposed action to Federally-listed and candidate species in the action area.

The U.S. Bureau of Reclamation (Reclamation) is submitting this biological assessment to the U.S. Fish and Wildlife Service (FWS) pursuant to Section 7(a)2 of the Endangered Species Act to initiate formal consultation.

Reclamation requested a list of Federally-listed species in the action area from the U.S. Fish and Wildlife Service's Montana State Office, Helena, on January 31, 2002, and received the official list for Missoula County dated February 6, 2002, on February 11, 2002 (see Attachment A). Six animal and one plant species are listed in Missoula County, including a bird species that is currently a candidate for listing. Though not all species listed in Missoula County occur in the action area, this biological assessment considers and discusses all seven species.

## 1.2 AUTHORITIES

This biological assessment focuses on two Reclamation projects near Missoula, Montana:

### 1.2.1 THE MISSOULA VALLEY PROJECT, BIG FLAT UNIT

President Franklin D. Roosevelt approved construction for the project on May 10, 1944, under authority of the Water Conservation and Utilization Act of August 11, 1939, (53 Stat. 1418, Public Law 76-398) as amended. The authorized project purpose is irrigation.

Reclamation owns the diversion structures and facilities, conveyance systems, and canals for the Big Flat Unit. In 1955, Reclamation transferred the responsibilities to operate and maintain the Big Flat Unit facilities to the Big Flat Irrigation District. Current contracts with the irrigation district stipulate that the district must operate the transferred works consistent with Reclamation standards. The surface water rights for the Big Flat Unit of the Missoula Valley Project has a priority date of December 4, 1944, and is held by the United States (Department of Interior, Bureau of Reclamation).

### 1.2.2 THE FRENCHTOWN PROJECT

President Franklin D. Roosevelt approved the project on September 21, 1935, pursuant to section 4 of the Act of June 25, 1910, (36 Stat. 836), and subsection B of Section 4 of the Act of December 5, 1924, (43 Stat. 702). Project construction began in 1936 and was completed in 1937. The authorized project purpose is irrigation. Stockwatering is also authorized under the state water right.

Reclamation owns the diversion structures and facilities, conveyance systems, and canals for the Frenchtown Project. In 1939, Reclamation transferred the responsibilities to operate and maintain Frenchtown Project facilities to the Frenchtown Irrigation District. Current contracts with the irrigation district stipulate that the district must operate the transferred works consistent with Reclamation standards. The surface water right for the Frenchtown Project has a priority date of September 14, 1933, and is held by the Frenchtown Irrigation District.

## 1.3 PROPOSED ACTION

The proposed action is the continued routine operation and maintenance of Reclamation facilities that are contained within the action area. The action area includes these lands and waterways:

- about 500 acres of irrigated lands that are part of the Big Flat Unit of the Missoula Valley Project on the south side of the Clark Fork a few miles west from Missoula.
- about 5,000 acres of irrigated lands that are part of the Frenchtown Project on the north side of the Clark Fork a few miles west from Missoula.
- the lower Bitterroot River from the Big Flat Unit point of diversion downstream about 4 miles to the river’s confluence with the Clark Fork.
- the middle Clark Fork from the confluence with the Bitterroot River downstream about 21 miles to the lowermost Frenchtown Project lands near Huson.

Figure 1-1 shows the Big Flat Unit’s location. Attachment B contains a more detailed project map. Irrigation water for the Big Flat Unit is withdrawn from the Bitterroot River. The Big Flat Unit is operated to meet its specific authorized purpose of irrigation. It does not include water storage facilities or flood control features.

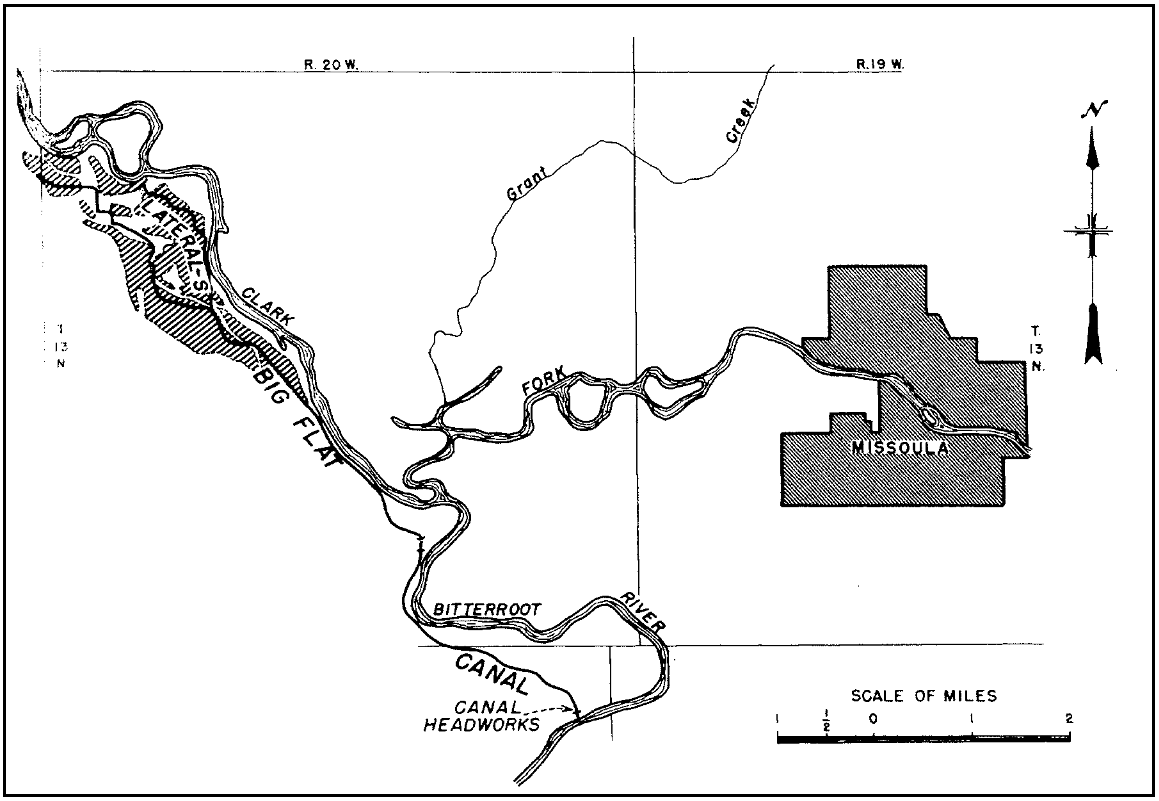


**Figure 1-1.** Big Flat Unit of the Missoula Valley Project location map.

Figure 1-2 illustrates the Frenchtown Project's location. Attachment B contains a more detailed project map. The Frenchtown Project uses the Frenchtown Diversion Dam on a side channel of the Clark Fork to divert water to the headworks of the Frenchtown Canal. The Frenchtown Project is operated to meet its specific authorized purpose of irrigation with some water intermittently used for stockwatering as permitted under the state water right. It does not include water storage facilities or flood control features.

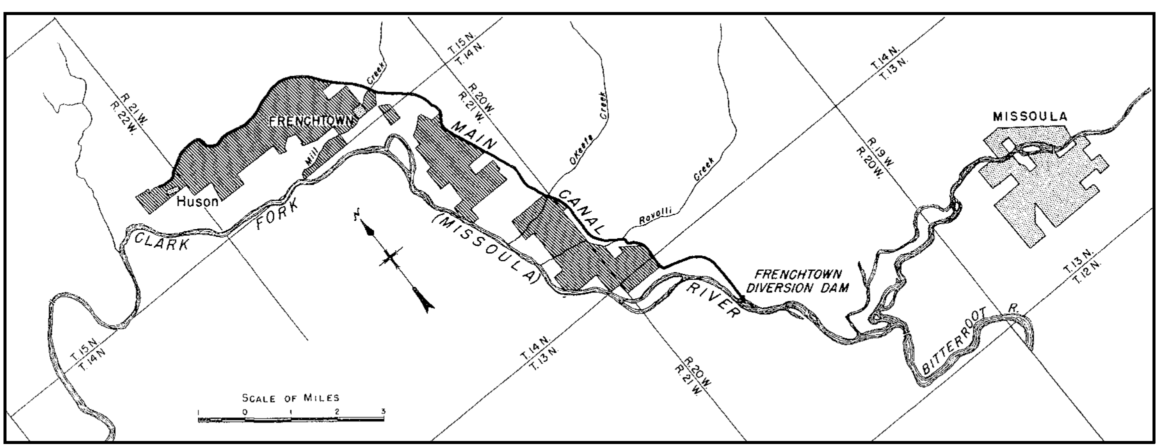


**Figure 1-2.** Frenchtown Project location map.

## 1.4 SUMMARY OF RELEVANT WATER RIGHTS

The state of Montana is in the process of adjudicating existing water rights. In 1979, the Montana Legislature passed Senate Bill 76 amending the adjudication procedures originally established by the Montana Water Use Act of 1973. The legislature opted for a comprehensive general adjudication of the entire state.

The Reclamation Act of 1902 requires Reclamation to comply with state laws in carrying out any authorized project purpose.

The Bitterroot subbasin is currently in the investigatory phase of the adjudication process. Completion of a Temporary Preliminary Decree is estimated to be completed in three or four years. The surface water right for the Big Flat Unit of the Missoula Valley Project has a priority date of December 4, 1944, and is held by the United States (Department of Interior, Bureau of Reclamation). The water right is for 35.80 cfs from the Bitterroot River, with an annual volume of 7,880.00 acre-feet, to irrigate a maximum of 944.60 acres. Though the original project anticipated irrigating 944 acres of land, generally less than 500 acres are currently irrigated. The flow rate for this water right is limited to the historic capacity of the diversion structure and the conveyance system, which is about 25.0 cfs. The period of use is from April 15 to October 31 (State of Montana, Department of Natural Resources and Conservation, 31 May 2002, pers. comm.).

The Clark Fork subbasin has been preliminarily decreed. The surface water right for the Frenchtown Project has a priority date of September 14, 1933, and is held by the Frenchtown Irrigation District. The water right is for 172.00 cfs from the Clark Fork, with no annual volume specified, to irrigate a maximum of 4,676.10 acres. The period of use is from April 15 to October 19. The Frenchtown Irrigation District water right authorizes water for stockwatering purposes at the rate of 30 gallons per day per animal unit. The period of use for stockwatering is from April 15 to December 19. The use of this right for several purposes does not increase the extent of the water right; instead, it decrees the right to alternate and exchange the use or purpose of the water in accord with historic practices (State of Montana, Department of Natural Resources and Conservation, 31 May 2002, pers. comm.).

## 1.5 RELATIONSHIP TO OTHER BIOLOGICAL OPINIONS AND FEDERAL ACTIVITIES

Neither of these two irrigation projects have fish screens at its point of diversion. In October 2000, Reclamation completed an appraisal level study that explored the possibility of installing fish screens at the two projects (Reclamation 2000). Because these installations are currently subject to budget constraints and a several-year planning cycle, this activity is not a subject of this consultation. Reclamation will initiate consultation if these installations receive approval and funding.

## 1.6 LITERATURE CITED

U.S. Bureau of Reclamation (Reclamation). 2000. *Assessment of Fish Passage Needs and Potential Improvements at Frenchtown Main Canal and Big Flat Canal*. Western Montana Fish Passage Program, U.S. Bureau of Reclamation, Pacific Northwest Regional Office, Boise, Idaho. 13pp.

# CHAPTER 2
# DESCRIPTION OF THE PROPOSED ACTION

## 2.1 INTRODUCTION

The proposed action is the continued routine operation and maintenance of Reclamation facilities that are contained within the action area. The action area includes these lands and waterways:

- about 500 acres of irrigated lands that are part of the Big Flat Unit of the Missoula Valley Project on the south side of the Clark Fork a few miles west from Missoula.
- about 5,000 acres of irrigated lands that are part of the Frenchtown Project on the north side of the Clark Fork a few miles west from Missoula.
- the lower Bitterroot River from the Big Flat Unit point of diversion downstream about 4 miles to the river's confluence with the Clark Fork.
- the middle Clark Fork from the confluence with the Bitterroot River downstream about 21 miles to the lowermost Frenchtown Project lands near Huson.

Irrigation water for the Big Flat Unit is withdrawn directly from the Bitterroot River. The Big Flat Unit is operated to meet its specific authorized purpose of irrigation. It does not include water storage facilities or flood control features.

The Frenchtown Project uses the Frenchtown Diversion Dam on a side channel of the Clark Fork to divert water to the headworks of the Frenchtown Canal. The Frenchtown Project is operated to meet its specific authorized purposes of irrigation with some water intermittently used for stockwatering as permitted under the state water right. It does not include water storage facilities or flood control features.

These two projects are relatively small compared to most Reclamation projects. They do not store water and only divert a very small percentage of the rivers' natural flows (usually less than 3 percent), as described in Chapter 5.

### 2.1.1 PROJECT OPERATION RESPONSIBILITIES

This biological assessment covers Federally-owned diversion structures and facilities, conveyance systems, and canals for the Big Flat Unit and the Frenchtown Project and the potential effects of the facility operations on Federally-listed and candidate species. Reclamation has transferred the responsibilities to operate and maintain the Big Flat Unit facilities to the Big Flat Irrigation District. Reclamation has transferred the responsibilities to operate and maintain the Frenchtown Project facilities to the Frenchtown Irrigation District.

Although Reclamation is considerably less involved in the routine day-to-day operations of transferred works, the facilities remain under Federal ownership. Contracts with the irrigation districts stipulate that the irrigation districts must operate transferred works consistent with Reclamation standards. To ensure compliance, Reclamation conducts routine inspections under its Review of Operation and Maintenance program. These reviews typically occur every three to six years.

### 2.1.2 PROJECT MAINTENANCE RESPONSIBILITIES

This biological assessment covers Federally-owned diversion structures and facilities, conveyance systems, and canals for the Big Flat Unit and the Frenchtown Project and the potential effects of facility maintenance on Federally-listed and candidate species.

The Big Flat Unit and the Frenchtown Project facilities, as transferred works that remain under Federal ownership, are routinely inspected by Reclamation and the operating entity under the Review of Operation and Maintenance program. Contracts with the irrigation districts stipulate that the districts must make necessary repairs when identified in these periodic operation and maintenance reviews, which typically occur every three to six years. If major maintenance is required, the operating entity must prepare the specifications and submit them to Reclamation for review and approval prior to repairs being accomplished. Reclamation also conducts periodic Environmental and Hazardous Material Inspections.

The maintenance programs keep facilities in good operating condition and identify potential problems and areas requiring repairs before failures occur. When damage is identified or appears likely to occur, the risks are evaluated and a decision made to either make repairs immediately (emergency or unscheduled repairs) or to delay repairs until the next regularly scheduled maintenance period.

Reclamation conducted a Review of Operation and Maintenance for the Big Flat Unit of the Missoula Valley Project while the facilities were in operation on September 9, 2001. The Big Flat Unit was engaged in routine maintenance of the facilities. Reclamation also conducted an Environmental and Hazardous Material Inspection on April 15 and 16, 2002. No deleterious materials were noted or found along the Federally-owned facilities. These reviews' reports are available at Reclamation's Ephrata, Washington, Field Office.

Reclamation conducted pre-seasonal Review of Operation and Maintenance for the Frenchtown Project on April 15 and 16, 2002. The canals were not operating at the time of the review (the districts typically begin delivering water around May 1). The

Frenchtown Irrigation District was improving facilities at the project's headgate and conducting other routine maintenance. Reclamation also conducted an Environmental and Hazardous Material Inspection on April 15 and 16, 2002. No deleterious materials were noted or found along the Federally-owned facilities. These review and inspection reports are available at Reclamation's Ephrata, Washington, Field Office.

## 2.2 BIG FLAT UNIT, MISSOULA VALLEY PROJECT, FACILITIES, OPERATION, AND MAINTENANCE

Construction of the Big Flat Unit was completed in 1949. Reclamation operated the system for five years before transferring operation and maintenance to Big Flat Irrigation District (BFID) in 1955. BFID currently operates and maintains the project. Though the original project anticipated irrigating 944 acres of land, generally less than 500 acres are currently irrigated. There are 20 main users within the Big Flat Unit boundaries. About one half of the water is used for farming (hay, grain, and pasture are the principal crops within the irrigated areas) and the other half for irrigation of small 5-acre plots. The Irrigation District's Commissioner estimated that 99 percent of the assessed acres use sprinkler irrigation, with approximately 7 acres still using flood irrigation.

### 2.2.1 BIG FLAT UNIT FACILITIES

The principal project features of the Big Flat Unit of the Missoula Valley Project are the 9.3-mile-long Big Flat Canal and headworks. The canal headworks are located on the canal about 488 feet below the point of diversion from the Bitterroot River. Water from the Bitterroot River flows directly into the inlet channel without the need for an intake diversion structure or berm. Although there are upstream dams that store and partially regulate water flows on the Bitterroot River, these activities do not affect the ability for BFID to obtain their water.

The intake channel to the headworks has a design capacity of 39 cfs and the Big Flat Canal has a capacity of approximately 25 cfs below the headworks. The canal and lateral easements vary in width from 120 feet at Sta. 0+00 to 30 feet at some downstream canal and lateral areas. The canal was designed for a maximum flow of approximately 25 cfs. District personnel indicate that the earthen portion of the canal does not experience measurable seepage loss.

The Big Flat Canal travels through the U.S. Forest Service McClay Flats refuge and nature path approximately two miles downstream from the point of diversion. The Forest Service nature path parallels the canal for approximately ½ mile.

Approximately five miles downstream on the canal, it closely parallels the Clark Fork. In this area, three concrete flume sections were constructed between 1945 and 1949. The flume is very close to the river, with an adjacent narrow roadway. The lands served by the district are located just downstream from the third flume section. Two miles of laterals complete the distribution system. The diversion facility for the S-Lateral near Sta. 372+67.72 is primarily a stop-log structure.

Several wasteways are used to dewater the canal at the end of the irrigation season and for emergency dewatering.

### 2.2.2 BIG FLAT UNIT OPERATION

The irrigation season generally runs from May 1 to October 1. At start-up of the irrigation season, low flows are sent down the canal for about 48 hours before the full canal flow is delivered. The district does little in the way of water management. BFID does not maintain flow records, but they do have adjudicated rights records. They essentially turn water into the canals and allow landowners to use water as they deem necessary. The district employs a ditchrider to patrol the system on a daily basis, but there are no systems to measure or determine the amounts used by each irrigator. The district advises its constituents of the canal and lateral conditions by using strategically-placed signs. These signs also advise the water users of the irrigation season schedule of turn on and shut off dates. BFID does occasionally dewater the canal mid-season to suppress algae growth. The district does not use chemicals for weed control.

### 2.2.3 BIG FLAT UNIT MAINTENANCE

Gravity flow from the Bitterroot River is sufficient to provide water into the intake channel; no berm or structure is needed in the river to ensure an adequate water supply. Every few years, the district removes a gravel bedload bar that accumulates at the point of diversion. BFID obtains a permit for this in-water work through the coordination of the Missoula Conservation District. When required, the district removes large floating debris from the inlet channel. In the past, some large debris has damaged the trashrack.

BFID mechanically removes vegetative material growing in the canal, and each spring, they may find assorted debris in the canal. They also find cottonwood leaves in the canal each fall. No large debris enters the canal from the inlet channel. Siltation is not a problem within the canal system. Occasional floating moss will occur in the canal but is kept moving by a strong current.

The canal is dewatered during winter, and there are no problems with ice causing any structural damage to the facilities.

The district conducts very little maintenance where the canal travels inside the U.S. Forest Service McClay Flats boundary. In an effort to preserve natural habitat in this limited area, there is local opposition to the district using chemical weed control or livestock grazing. Because water travels very well through this reach of canal, very little canal maintenance is required; however, trees are well established in the canal prism and on the maintenance easement.

Livestock grazing on adjacent U.S. Forest Service lands near McClay Flats has caused debris and rock to slide into the canal bottom. The district has unsuccessfully attempted fencing off the canal. The use of the area has created unstable conditions on the bank.

The district maintains a maintenance road adjacent to the concrete flumes that closely parallels the Clark Fork from about Sta. 217+00 to Sta. 287+51. District personnel patrol the flume sections regularly. The flume is in fair condition with some concrete deterioration and damage from falling and rolling rocks. The ongoing maintenance of concrete repair and rock fall removal is a major concern for BFID. The district has been repairing the concrete sections as needed. The district reports that the flume does have some leakage problems, but they are of minor concern and do not hamper the district's ability to monitor the flume sections.

### 2.2.4 POTENTIAL FUTURE OPERATION AND MAINTENANCE CHANGES

A fish screen may be installed near the headworks of the main canal at some time in the future to reduce or eliminate entrainment of fish into the canal. Montana Fish, Wildlife and Parks (MFWP) is encouraging the screening of irrigation diversions to protect Montana fishery resources.

There is also a proposal to relocate the point of diversion. Relocating the point of diversion from the Bitterroot River to the Clark Fork would eliminate maintenance requirements for approximately 5 miles of canal that currently cross non-users land. The concrete bench flume, which needs repair and is a major maintenance item, would be removed from service and eliminated.

Any future screening of the diversion or relocation of the point of diversion would require separate consultation. Neither of these potential future changes are part of this consultation.

At this time, BFID does not anticipate any future changes to operations or maintenance other than the possible installation of fish screens.

## 2.3 FRENCHTOWN PROJECT FACILITIES, OPERATION, AND MAINTENANCE

The Frenchtown Irrigation District was formed in 1934. Reclamation completed project construction in 1936. In 1939, Reclamation transferred the responsibility of operating and maintaining the project to the Frenchtown Irrigation District.

The project irrigates approximately 5,000 acres of land between the towns of Grass Valley and Huson, Montana. Principal crops irrigated are hay, grain, and pasture. The district has very few full-time farmers. Twelve main users operate farms in the project. Most landowners use revenue derived from project lands to supplement other income. Of the about 5,000 acres under irrigation, 3,000 acres are fairly large farms. The remaining water is used for irrigating smaller-scale farms, gardening, and stockwater.

### 2.3.1 FRENCHTOWN PROJECT FACILITIES

The Frenchtown Project has an intake channel (a side channel of the Clark Fork near River Mile 346), dikes, a diversion dam with a radial gate for sluicing water and debris, canal headworks, and a gravity-flow distribution system that includes 17 miles of main canal and approximately 21 miles of laterals.

The Frenchtown Diversion Dam, an earth and rockfill structure, is located on a side channel of the Clark Fork about 7 miles downstream from Missoula, Montana. The dam is 16 feet high, has a crest length of 489 feet, and contains 12,000 cubic yards of material. The dam also has a 12-foot-wide concrete rectangular sluiceway that is controlled by a single 12.5-foot-high radial gate. Two manually-operated 4-foot-square slide gates control diversions at the canal headworks. During normal and above normal water years, sufficient water travels down the side channel and through the canal headworks. Although there are upstream dams that store and partially regulate water flows on the Clark Fork, these activities do not affect the ability for Frenchtown Irrigation District to obtain their water.

The canal originates at the Frenchtown Diversion Dam and extends 17 miles along the northeast side of the Clark Fork to a point near the town of Huson. The unlined earthen Frenchtown Canal has an approximate 12-foot bottom width with 1.5:1 side slopes and a design capacity of 172 cfs in the upper reaches of the canal. Typical diversions from the Clark Fork are under 115 cfs.

A landslide occurred sometime prior to 1985 where the Grass Valley Canal parallels the Frenchtown Canal. This area has stabilized. The district has chosen not to disturb this area because they believe tampering with the existing condition could jeopardize the integrity of this canal section.

There are ten major laterals off the main canal numbered sequentially from M1 to M10.

### 2.3.2 FRENCHTOWN PROJECT OPERATION

The irrigation season generally runs from May 1 to October 1. Canal flows are measured at a broad-crested weir about 2 miles downstream from the canal headworks. At the start-up of the irrigation season, approximately 50 to 70 cfs is sent down the canal, and it reaches the end of the canal within 24 hours. It takes 3 to 5 days to increase canal flows up to 100 cfs. Information collected over the past 10 years indicates that 115 cfs has been the maximum flow recorded, with most flows ranging from 90 to 100 cfs. The canal does not experience much seepage loss. A study to determine volume of return flows is underway in summer 2002 to aid in the design of a ramp flume on the terminal wasteway of the canal. In addition, some water measurements are being taken on other wasteways.

About 99 percent of the lands are sprinkler irrigated; only one 50-acre tract is gravity (flood) irrigated. Stockwater, as authorized under the water right, can be sent down the canal from September to late November, but this does not occur every year. Upstream water storage is not necessary since the Clark Fork provides an ample supply of water.

### 2.3.3 FRENCHTOWN PROJECT MAINTENANCE

The Frenchtown Irrigation District maintains the inlet channel by opening the radial gate during the non-irrigation season to sluice sediment from the inlet channel. In addition to sluicing, some channel maintenance is occasionally required. The amount of channel work is directly related to the amount of spring runoff. In low runoff years, no channel maintenance has been required. The district must also routinely remove river bedload of aggregate size 4 to 12 inches that migrates into the upper 1/4-mile of canal downstream from the headworks.

When river flows infrequently drop to lower levels, it is difficult to get water to the headworks. When the river flows drop below the level needed to deliver water, district personnel obtain a 310 permit from the state for this in-water work through the coordination of the Missoula Conservation District to use a bulldozer to build up a gravel berm in the upstream river channel. This directs the flow of water over to the side channel. The berm does not extend all the way across the river. The Clark Fork thalweg is on the side of the river channel opposite the headworks. At the end of the irrigation season, the district removes and redistributes the material that formed the berm. The construction of a gravel berm in the Clark Fork is done solely at the discretion of the Frenchtown Irrigation District.

The district uses the approved herbicide Magnicide-H (chemical name: Acrolein) to control aquatic weed growth in the Frenchtown Canal. Weed control is generally required at least once per season, but it is sometimes used twice. When needed, the aquatic herbicide is applied following label recommendations. No treated canal water is returned to the river; it is diverted into a dump site near Huson. In order to obtain liability insurance, the district has to restrict herbicide use to aquatic types only. This means that they practice no above-waterline chemical weed control. All herbicide use follows approved practices and does not result in herbicide residue in the Clark Fork. On-farm use of chemicals and fertilizers is not within Reclamation's discretionary authority.

### 2.3.4 POTENTIAL FUTURE OPERATION AND MAINTENANCE CHANGES

A fish screen may be installed near the headworks of the Frenchtown Canal. Any future fish screening of the canal is not part of this proposed action and would require separate consultation.

The Frenchtown Irrigation District does not anticipate any changes to operations or maintenance at this time.

# CHAPTER 3
# INTRODUCTION TO SPECIES DESCRIPTIONS AND EFFECTS ANALYSIS

## 3.1 ESA-LISTED AND CANDIDATE SPECIES IN MISSOULA COUNTY, MONTANA

Reclamation requested a list of Federally-listed species in the action area from the Montana State Office of the U.S. Fish and Wildlife Service (FWS) on January 31, 2002. The official list for Missoula County dated February 6, 2002, is reproduced in Attachment A. The list contains six animal and one plant species in Missoula County that are endangered or threatened. The list also contains one candidate bird species. All seven species are considered and discussed in this biological assessment.

| | | |
|---|---|---|
| 1. | Grizzly bear *Ursus arctos* | Threatened |
| 2. | Gray wolf *Canis lupus* | Endangered in part;<br>Nonessential/Experimental in part |
| 3. | Canada lynx *Lynx canadensis* | Threatened |
| 4. | Water howellia *Howellia aquatilis* | Threatened |
| 5. | Bull trout *Salvelinus confluentus* | Threatened |
| 6. | Bald eagle *Haliaeetus leucocephalus* | Threatened |
| 7. | Yellow-billed cuckoo *Coccyzus americanus* | Candidate |

## 3.2 ESA-LISTED SPECIES OCCURRING OUTSIDE THE ACTION AREA

Although the grizzly bear, gray wolf, Canada lynx, and water howellia are Federally-listed species occurring in Missoula County, Montana, they do not occur in the action area of the Big Flat Unit or the Frenchtown Project, and their habits and habitat requirements generally exclude them from the action area (Bob Henderson, MFWP, Missoula, 15 April 2002, pers. comm.)

Since these four species do not occur in the action area, the proposed action will have no effect on these species. Therefore, only brief descriptions are provided. Other than the discussions below, these species will not be considered further in this biological assessment.

### 3.2.1 GRIZZLY BEAR

The grizzly bear *Ursus arctos* was listed as threatened under the Endangered Species Act (ESA) in 1975 (Mattson et al.). They are wide-ranging and generally solitary animals, spending most of their time foraging for food. Their habitat is generally composed of diverse forests interspersed with moist meadows and grasslands in or near mountains. The bears usually use the lower elevations of their home range from spring into fall. During the fall, grizzly bears move to higher elevations for denning and winter hibernation.

Most grizzly bear use of the Clark Fork and Bitterroot River basins occurs substantially away from the project action area to the north or west (Bob Henderson, MFWP, Missoula, pers. comm). The action area does not provide the habitat requirements of the grizzly bear. Therefore, continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project will have no effect on grizzly bears.

### 3.2.2 GRAY WOLF

The gray wolf *Canis lupus* was listed as endangered under the ESA in 1974. In a portion of Missoula County, Montana, wolves have a nonessential experimental status (USFWS 2002). The Big Flat Unit and that portion of the Frenchtown Project south of Interstate 90 are within the central Idaho nonessential/experimental population area. In the portion of the Frenchtown Project north of Interstate 90, the gray wolf is still listed as endangered (USFWS 2002).

Wolves are generally distributed in the higher elevation wilderness and less roaded areas of northwestern Montana and Missoula County and away from the middle Clark Fork and Bitterroot River valleys where the projects are located. Gray wolves are opportunistic carnivores generally targeting large game animals (MFWP 2002). In Montana, the wolf diet tends to be white-tailed deer, mule deer, elk, and moose. Wolves also prey on smaller mammals such as rabbits or beaver, and they often scavenge carrion. Gray wolves are known to kill domestic livestock in some areas. Where depredation on livestock has been documented, wolves have been removed or eliminated by government animal control personnel.

Gray wolves survive and thrive better in areas of little or no human activity, such as wilderness areas or sparsely roaded areas (Houts 2000). As a result of this lack of association with humans, the action area of the projects in the valley of the middle Clark Fork and lower Bitterroot River does not provide preferred gray wolf habitat or prey. Therefore, continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project will have no effect on gray wolves.

### 3.2.3 CANADA LYNX

The Canada lynx *Lynx canadensis* is a rare, medium-sized, relatively secretive forest-dwelling cat of the northern latitudes whose range extends south from Alaska, throughout much of Canada, to the boreal forests in the northeastern United States, the Great Lakes, the Rocky Mountains, and the Cascade Mountains. In the West, Canada lynx occur predominantly on Federally-acquired lands. Their habitat is comprised of subalpine coniferous forest and they are most likely to persist in areas that receive deep snow, for which the lynx is highly adapted. The Northern Rockies/Cascades region supports the largest amount of Canada lynx habitat and has the strongest evidence of long-term occurrence of resident lynx populations, both historically and currently (Federal Register 2000). Lynx are highly specialized predators whose primary prey is the snowshoe hare *Lepus americanus* which is adapted to survive in areas that receive deep snow. Canada lynx also prey on small mammals and birds (Federal Register 2000). The Canada lynx's preference for subalpine coniferous forests and its preferred prey of snowshoe hare generally restrict the lynx to high mountain forested areas.

The Big Flat Unit and the Frenchtown Project do not provide suitable preferred habitat or prey for Canada lynx. Therefore, they are not known to be in the project action area. Because of their habitat and prey preferences, continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project will have no effect on Canada lynx.

### 3.2.4 WATER HOWELLIA

The water howellia *Howellia aquatilis*, a wetlands plant and a monotypic genus in the bellflower family (Campanulaceae), was listed by the FWS as threatened effective August 15, 1994 (Federal Register 1994). Water howellia historically occurred over a large area of the Pacific Northwest region of the United States, but currently the species is found only in specific habitats in widely separated populations in western Montana, Washington, and Idaho. The water howellia is generally restricted to small, vernal, freshwater ephemeral glacial pothole ponds or the quiet water of abandoned river oxbow sloughs in the valley zone that undergo periodic dessication. The plant is found in the drainage of the Swan River in northwestern Montana (Lake and Missoula counties), where 129 individual populations are documented (MNHP 2002). The Swan River location of the Missoula County populations of water howellia are in the northern part of several drainages in Missoula County about 40 miles north from the Frenchtown Project.

The plant is not known historically in the Clark Fork or Bitterroot River basins, and the habitat type preferred by the species is not available in the action area. Therefore, continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project will have no effect on water howellia.

## 3.3 ESA-LISTED AND CANDIDATE SPECIES OCCURRING WITHIN THE ACTION AREA

Bull trout and bald eagle are known to occur in the action area. The yellow-billed cuckoo may occur in the action area. The environmental baseline in the action area is presented in Chapter 4. Chapters 5, 6, and 7 discuss these three species, respectively, and present the analysis of potential effects stemming from continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project.

## 3.4 SPECIES DESCRIPTIONS AND EFFECTS ANALYSIS LITERATURE CITED

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Federal Register. 2000. Vol. 65, No. 58, p.16051-16056.

Houts, M. E. 2000. *Modeling Gray Wolf Habitat in the Northern Rocky Mountains*.

Mattson, D. J., R. G. Wright, K. C. Kendall, and C. J. Martinka. *Grizzly Bears*. http://biology.usgs.gov/s+t/noframe/c032.htm

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Montana Natural Heritage Program (MNHP). 2002. *Field Guide - Water Howellia, Helena*. http://nhp.nris.state.mt.us/plants/pguide.asp?gb_spp=pdcam0a010&dsply=all

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# CHAPTER 4
# ENVIRONMENTAL BASELINE

## 4.1 INTRODUCTION

Evaluation of ESA-listed and candidate species for this biological assessment focuses on the aquatic and terrestrial environments that may be influenced by the continued routine operation and maintenance of Reclamation's irrigation facilities. For the purpose of developing this biological assessment, Reclamation assumes that any listed animal or plant species not found in the action area would generally not be affected by Reclamation operations. With the bald eagles, it is recognized that the eagles may forage for food a substantial distance from their nests.

The Big Flat Unit of the Missoula Valley Project and the Frenchtown Project are in west-central Montana about 7 miles west from the city of Missoula. The irrigated lands of both projects are parallel to and adjacent to the Clark Fork.

The Big Flat Unit furnishes irrigation water from the Bitterroot River for about 500 acres of land on the south side of the Clark Fork. The principal project feature is the Big Flat Canal and headworks. Water flows directly from the Bitterroot River into an intake channel where it is conveyed through a headgate into a gravity distribution system.

The Frenchtown Project diverts water from the Clark Fork at Frenchtown Diversion Dam and irrigates approximately 5,000 acres of land between Grass Valley and Huson on the north side of the Clark Fork. Water diverted from the Clark Fork is conveyed through a gravity distribution system to project lands.

The environmental baseline describes the action area as it currently exists with all structures and facilities in place but without the diversion of water from the Bitterroot River or Clark Fork. For comparison, the analysis for effects to listed species includes the diversion of water for irrigation.

## 4.2 ENVIRONMENTAL AND CLIMATIC CONDITIONS

The area of western Montana in the Clark Fork and Bitterroot drainages is mountainous with many deep valleys and high ridges. This area lies in the Environmental Protection Agency's (EPA) Bitterroot - Frenchtown Valley level IV ecoregion (USEPA 2002). Located in the rain shadow of the Lolo Mountains which lie to the west, the Missoula area has a mild and dry climate for such a northern setting. The valley climate is classified as modified North Pacific with mild winters and cool summers. The average maximum temperatures ranges from 29.9 °F in January to 83.9 °F in July with the average minimums in those same months ranging from 14.6 °F to 49.8 °F. Annual precipitation over the period of record from 1961 to 1990 at Missoula, Montana, ranges from 9.01 to 19.35 inches with a normal precipitation of 13.46 inches. The wettest part of the season occurs during late spring and early summer. With a relatively low average elevation for agricultural land (just over 3,000 feet), the area has one of Montana's longest growing seasons (about 142 days). At one time, the area produced Montana's only commercial fruit crop.

## 4.3 IRRIGATION DEVELOPMENT IN THE CLARK FORK AND BITTERROOT BASINS

Currently, the Missoula Valley has four privately-operated and two Federally-developed irrigation projects. The Big Flat Unit diverts up to 25 cfs from the Bitterroot River to irrigate about 500 acres of mostly pasture and some hay fields. The Frenchtown Project generally diverts up to 115 cfs from the Clark Fork to irrigate about 5000 acres for similar uses.

Four private irrigation districts that divert Clark Fork water in this area include the Grass Valley-French Irrigation District, the Hellgate Valley Irrigation District, the Orchard Homes Irrigation District, and the Missoula Irrigation District The Grass Valley-French Irrigation District is comparable to the Frenchtown Irrigation District, while the others are smaller. It is unknown at this time the total volume of water diverted by these irrigation districts.

## 4.4 HYDROLOGIC DESCRIPTION AND WATER QUALITY

### 4.4.1 BITTERROOT RIVER

The Bitterroot River flows northerly from headwaters in the Bitterroot Mountains and Sapphire Range of western Montana. The Bitterroot River basin upstream from the Big Flat Unit drains about 2,814 square miles. Hydrologic information was gathered from the U. S. Geological Survey (USGS) gage, Bitterroot River near Missoula, approximately 1 mile downstream from the point of diversion of the Big Flat Unit of the Missoula Valley Project (USGS 1999). The Big Flat Canal was designed for a maximum capacity of approximately 25 cfs. Since there are no major side drainages entering the Bitterroot River between the point of diversion and the USGS gage, the flow at the point of diversion was estimated during the irrigation season by adding 25 cfs to the measured downstream flow.

The adjusted 1989 to 1999 average annual volume of the Bitterroot River at the Big Flat point of diversion was 1.88 million acre-feet, ranging from 984,000 acre-feet to 2.53 million acre-feet (USGS 1999). Figure 4-1 shows an April 15 to October 15 summary hydrograph of the Bitterroot River with the 10-year maximum, minimum, average, and 75 and 25 percent exceedance daily flow plots. The 75 percent exceedance line shows the flow when

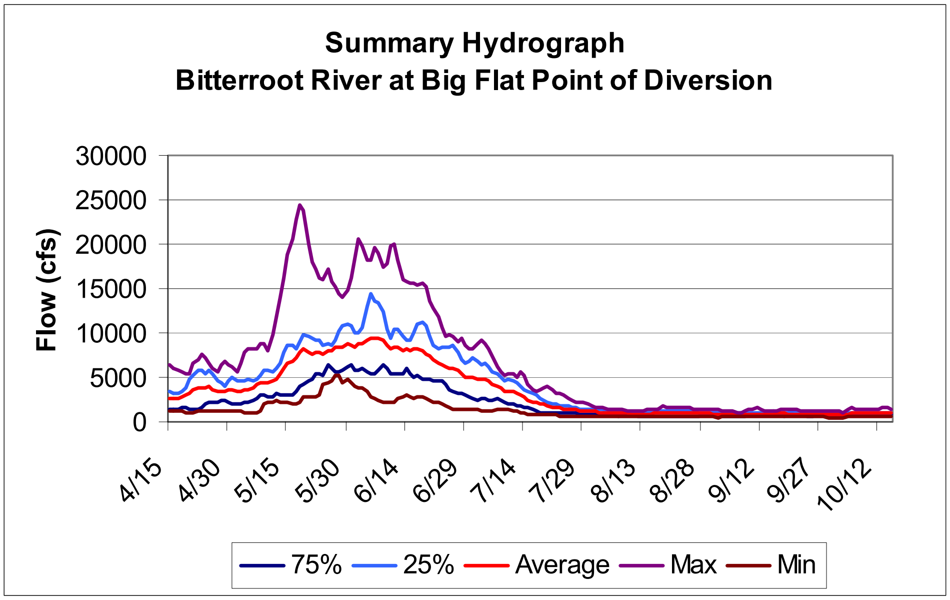


**Figure 4-1.** Summary Hydrograph, Bitterroot River at Big Flat Point of Diversion, April 15 to October 15.

75 percent of the flows are greater than the plotted flow. The maximum and minimum are the extreme for each day over the period of record. Adjusted daily flows ranged from 500 to 24,500 cfs.

Figure 4-2 graphs the water temperature at the Bitterroot River near the O'Brien Creek confluence during a below-average water year. Temperature in the Bitterroot River exceeds the 15 °C bull trout criterion beginning in May and continuing into September.

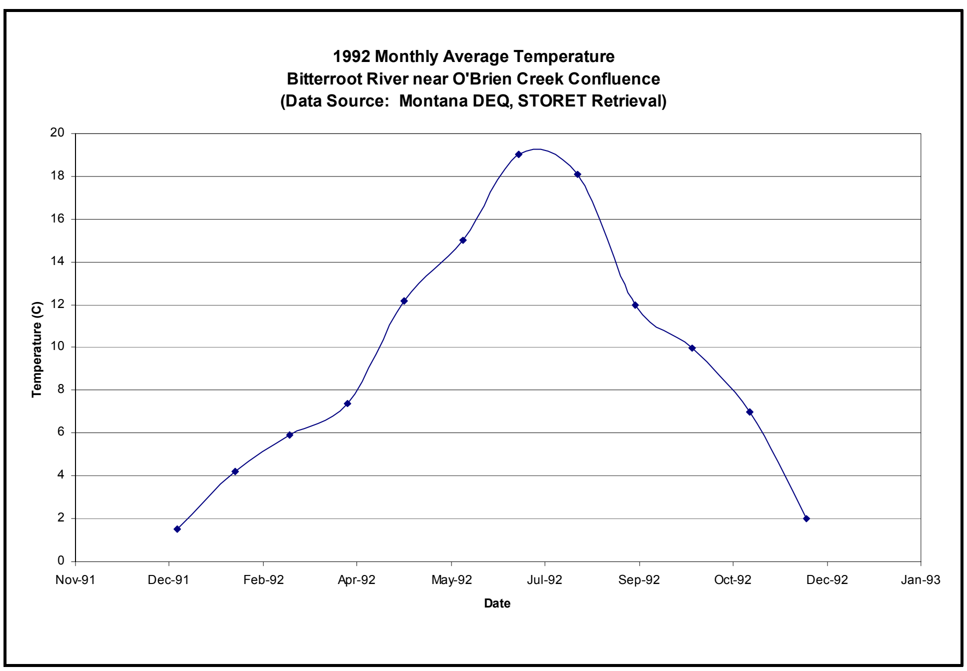


**Figure 4-2.** 1992 Monthly Average Temperature at the Bitterroot River near O'Brien Creek Confluence.

Figures 4-3 and 4-4 expand the data on Figure 4-1 for the period May 1 through August 31 for the Bitterroot River at the point of diversion. From Figure 4-4, the daily August flows range from 500 cfs to 1,705 cfs. The 10-year average total August flow on the Bitterroot River at the point of diversion for the Big Flat Unit is 58,185 acre-feet.

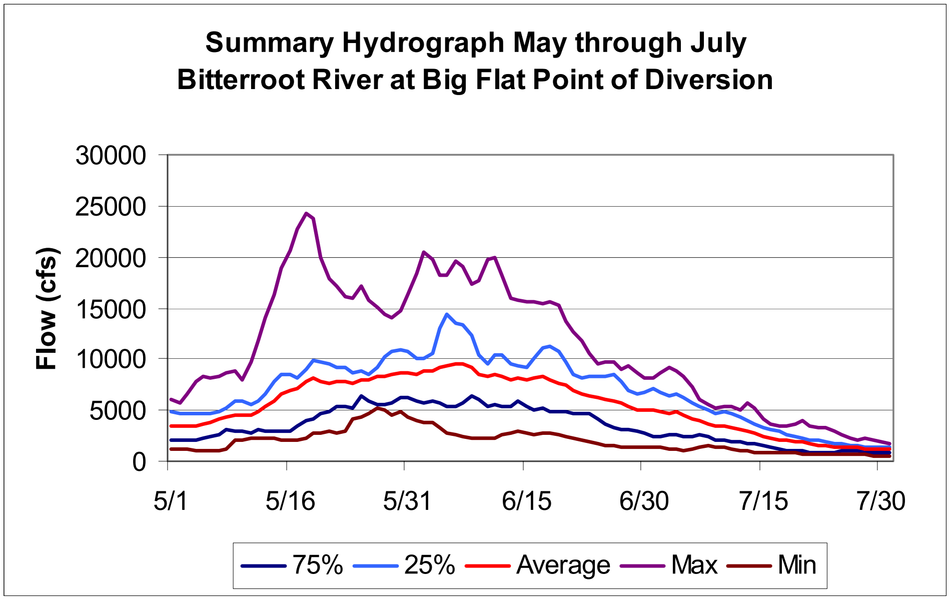


**Figure 4-3.** Summary Hydrograph for May through July, Bitterroot River at Big Flat Point of Diversion.

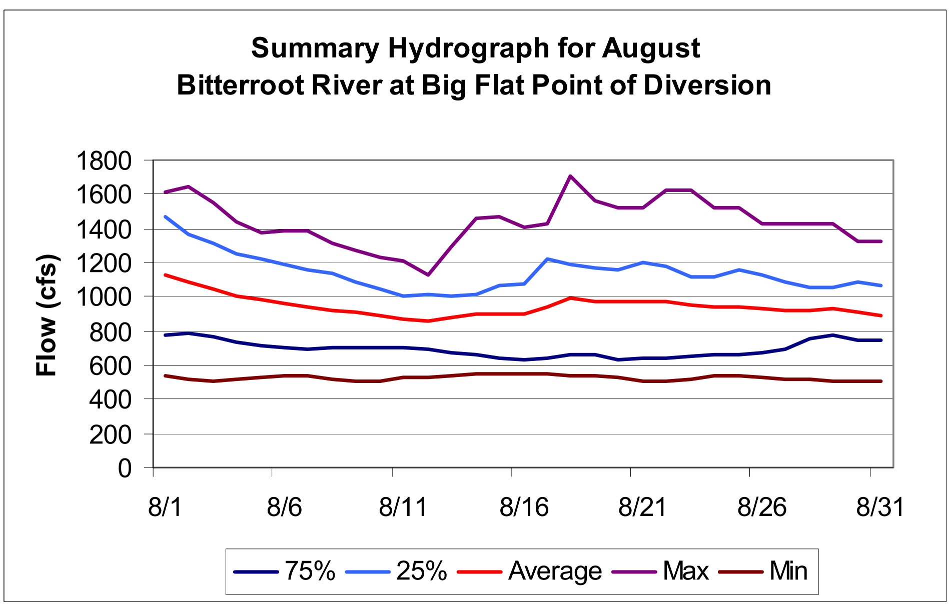


**Figure 4-4.** Summary Hydrograph for August, Bitterroot River at Big Flat Point of Diversion.

### 4.4.2 CLARK FORK

The Clark Fork flows northwesterly from its headwaters near Butte, Montana. The Clark Fork basin upstream from the Frenchtown Project drains about 9,000 square miles, including the Bitterroot River basin, which enters the Clark Fork a few miles upstream from the diversion for the project. The 1930 through 2000 annual average streamflow for the Clark Fork at the USGS gage located 1-1/2 miles upstream from the diversion averages about 3.9 million acre-feet (USGS 1999). The annual flows ranged from 1.8 to 6.0 million acre-feet.

Figure 4-5 displays a summary hydrograph of the Clark Fork below Missoula from April 1 through October 31. This hydrograph shows the daily average, maximum, minimum, and 75 and 25 percent exceedence on a daily basis. The 75 percent exceedence line shows the flow when 75 percent of the historical flows are greater than the plotted flow. The maximum and minimum plots are the extremes for each day over the 70-year period.

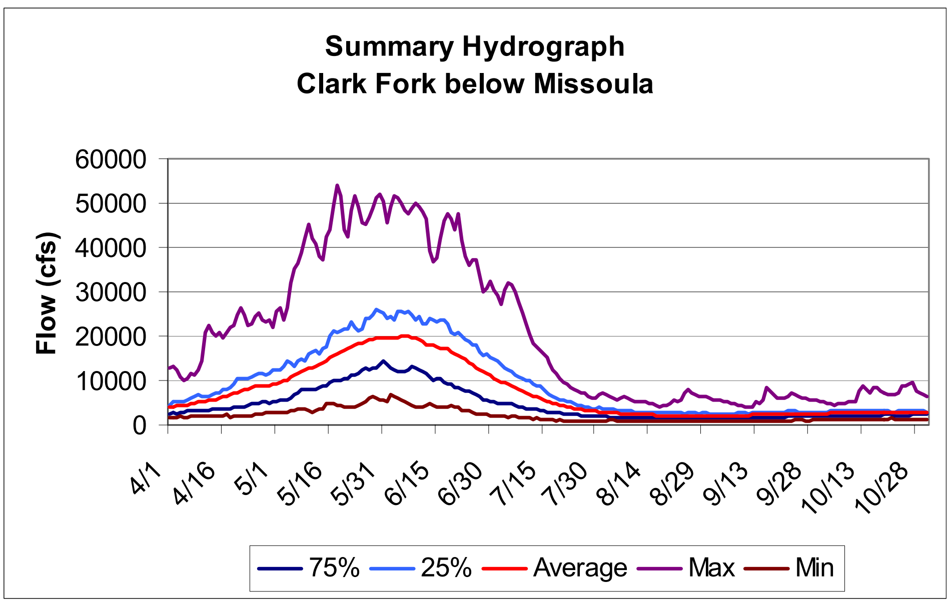


**Figure 4-5.** Summary Hydrograph, Clark Fork below Missoula.

Temperature data are available for two sites in the Clark Fork, near the Petty Creek confluence and near the Deep Creek confluence. Figure 4-6 shows the monthly average temperature during a below-average water year for these two sites. Temperature at both locations exceed the 15 °C bull trout criterion beginning in May and continuing into September.

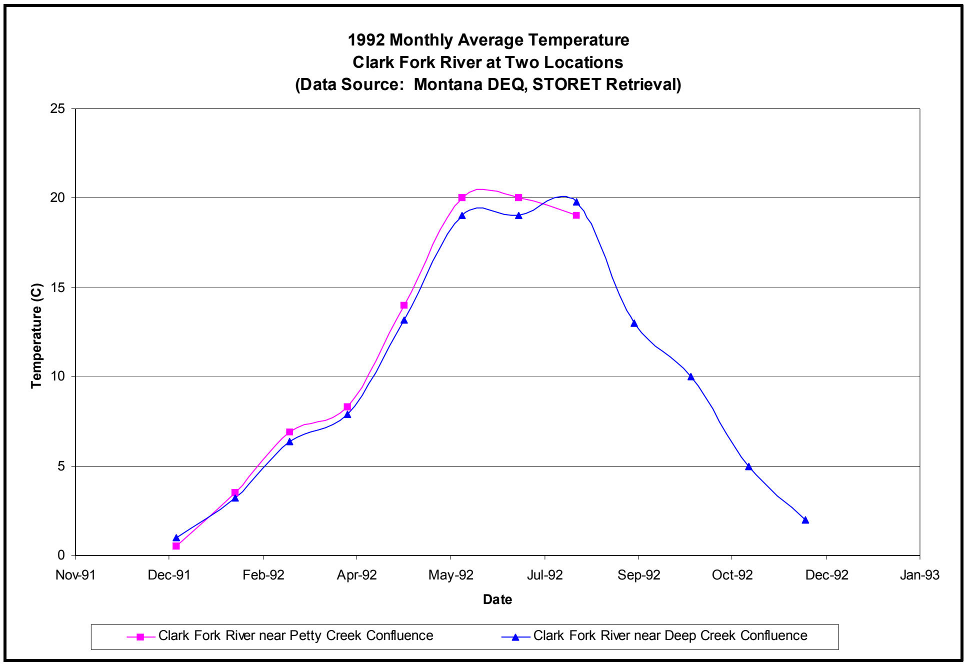


**Figure 4-6.** 1992 Monthly Average Temperature for the Clark Fork at Two Locations.

Figures 4-7 and 4-8 expand the data on Figure 4-5 for the period from May 1 to August 31. The 70-year daily extreme flows ranged from 703 cfs to 8,060 cfs in August. The 70-year average total July and August flows on the Clark Fork was 504,222 acre-feet. The average daily flow for August was 2,304 cfs (see Figure 4-8).

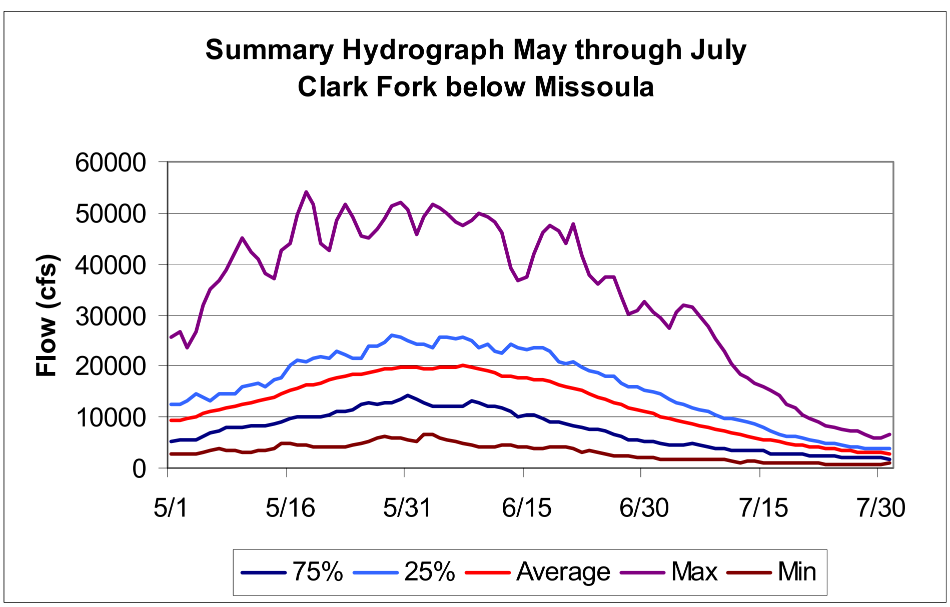


**Figure 4-7.** Summary Hydrograph for May through July, Clark Fork below Missoula.

Figures 4-7 and 4-8 show the extreme flows that have been encountered over the 70-year period; these flows would occur in a single water year. Examination of flows during selected individual years would give a more realistic example of the effect of the diversion. Figure 4-9 shows the daily flows for three individual years, a low (1988), medium (1998), and high (1972) year.

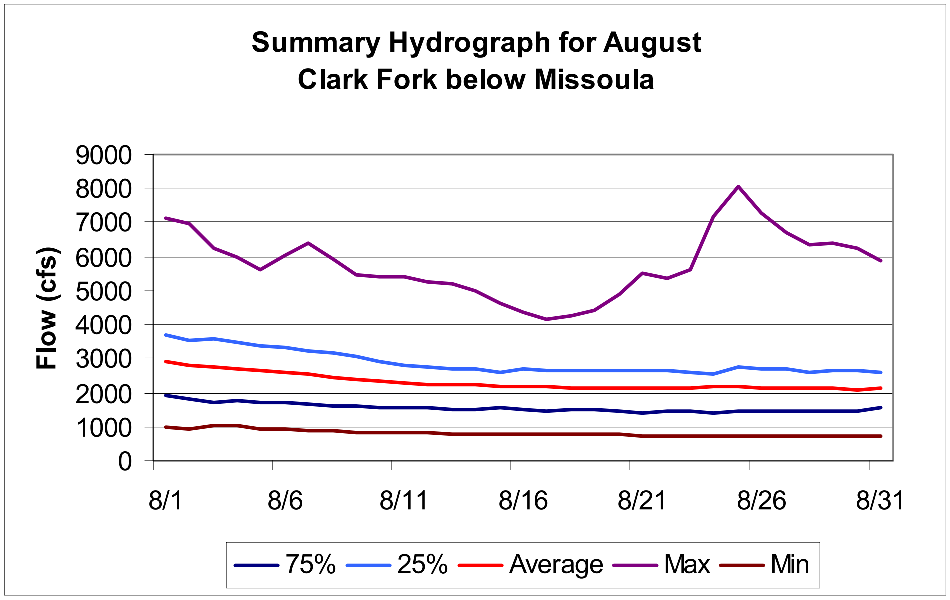


**Figure 4-8.** Summary Hydrograph for August, Clark Fork below Missoula.

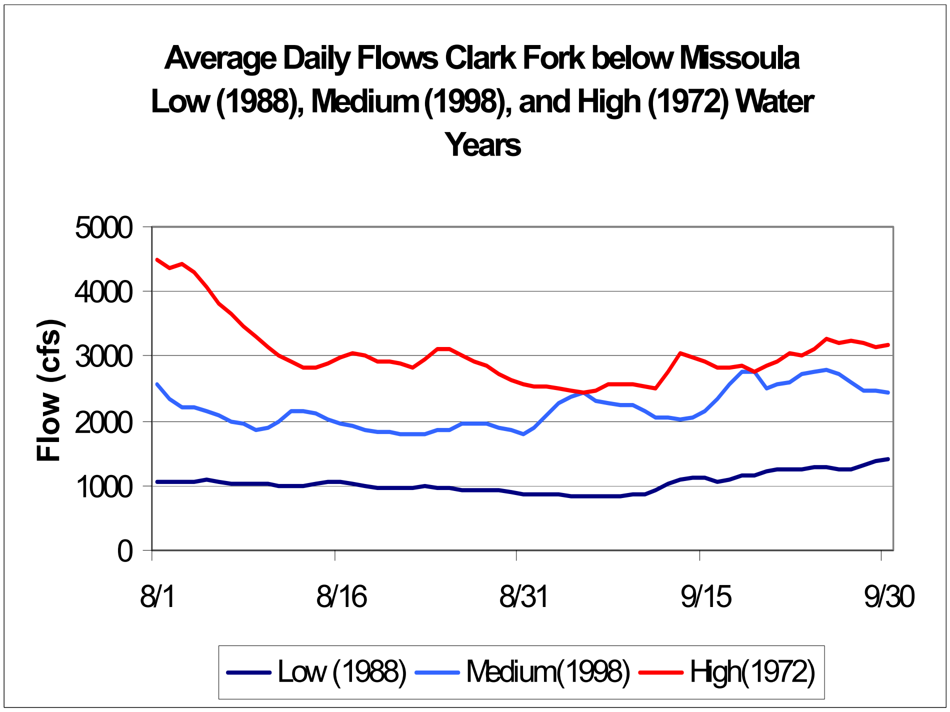


**Figure 4-9.** Average Daily flows for a Low (1988), Medium (1998), and High (1972) Water Year, Clark Fork below Missoula.

## 4.5 WATER QUALITY

Limited water quality data are available in the USEPA STORET database for the Bitterroot River near the Big Flat Unit and the Clark Fork near the Frenchtown Project (included in Attachment C). Additional data have been gathered by the Montana Department of Environmental Quality (MDEQ) for the development of a Total Maximum Daily Load (TMDL). Primary water quality concerns, or pollutants, in the Bitterroot River are nutrients and siltation or sediment. The probable sources of the pollutants noted in the 303(d) List developed by MDEQ include grazing, septic discharge, destabilization of shoreline, agriculture, municipal wastewater, and urban runoff (MDEQ 2000). MDEQ is also completing additional monitoring to assess the impact of fires on water quality in the watershed (Rob Raisch, MDEQ, 24 May 2002, pers. comm.)

Water quality impairments identified in the Clark Fork near the Frenchtown Project are metals and organic enrichment causing low dissolved oxygen (MDEQ 2000). Elevated metal concentrations found in the Clark Fork are likely from tailwater discharges from historic mining sites in the watershed. Organic enrichment that has lead to low dissolved oxygen concentrations are likely from municipal wastewater and runoff from private lands. MDEQ has developed a nutrient TMDL for the Clark Fork upstream from the Flathead River confluence to address nutrient loading from point and non-point sources.

An assessment of phosphorus and nitrogen in the Clark Fork Basin was conducted from 1988 to 1991 (Ingman 1992). Nineteen stations were sampled in the Clark Fork and 34 stations were sampled in various tributaries. Samples were analyzed for total and soluble forms of phosphorus and nitrogen. This long-term study found that nutrient concentrations were elevated just downstream from municipal wastewater treatment plants and declined progressively downstream. Mean concentration in the lower Bitterroot River and in the Clark Fork near Huson near the project action area were low compared to farther upstream sampling sites.

## 4.6 DIRECT AND INDIRECT EFFECTS

The direct effects of operation and maintenance of the Big Flat Unit and the Frenchtown Project are the withdrawal of irrigation water and its application to the irrigated acres. This is the authorized project use.

## 4.7 INTERRELATED AND INTERDEPENDENT ACTIVITIES

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity than has no independent utility apart from the action under consultation (50 CFR § 402.02).

An interdependent activity is the Big Flat Unit's occasional removal of a gravel bedload bar that accumulates near at the point of diversion on the Bitterroot River. BFID obtains a permit from the state for this in-water work through the coordination of the Missoula Conservation District. The district removes this bar using a backhoe to reach into the river to allow adequate flow into the intake channel. This is required only every few years.

Another interdependent activity is the Frenchtown Irrigation District's pushup dam it constructs in the Clark Fork during some periods of low river flow. When the river flows drop below the level needed to deliver water, district personnel obtain a 310 permit for this in-water work from the state through the coordination of the Missoula Conservation District to use a bulldozer to build up a gravel berm in the upstream river channel. This directs the flow of water over to the side channel. The berm is oriented diagonally upstream and does not extend all the way across the river. During the process of bulldozing up the pushup dam, some sedimentation occurs in the Clark Fork, although the level is not measured or quantified. At the end of the irrigation season, district personnel again use a bulldozer to remove the pushup dam. This disturbance redistributes the gravels forming the pushup dam and returns the riverbed to a more natural configuration. Again, this process produces some unquantified amount of sedimentation.

## 4.8 ENVIRONMENTAL BASELINE LITERATURE CITED

Ingman, G. L. 1992. *Assessment of Phosphorus and Nitrogen Sources in the Clark Fork River Basin 1988-1991, Final Report, Section 525 of the 1987 Clean Water Act Amendments*. State of Montana, Department of Health and Environmental Sciences, Water Quality Bureau, Cogswell Building, Helena, Montana 59620.

Montana Department of Environmental Quality (MDEQ). 2000. *Montana 303(d) List*. Montana Department of Environmental Quality, Planning, Prevention, and Assistance Division, Resource Protection Planning Bureau.

U.S. Environmental Protection Agency (USEPA). 2002. *Draft - Levels III and IV, Ecoregions of the Northwestern United States*. http://www.epa.gov/wed/pages/ecoregions/ecoregions.htm

U.S. Geological Survey (USGS). 1999. *Daily Streamflow for Montana.* http://waterdata.usgs.gov/mt/nwis/discharge

# CHAPTER 5
# BULL TROUT

Bull trout *Salvelinus confluentus*, formerly known as Dolly Varden *Salvelinus malma* in many locations, was classified as a species separate from Dolly Varden in 1978. The bull trout is the only *Salvelinus* species native to the middle Clark Fork, Montana. Other *Salvelinus* species in Montana include brook trout and lake trout. Brook trout *Salvelinus fontinalis* have been introduced into Montana from the eastern United States and are widely distributed in western Montana where they often compete with bull trout. Lake trout *Salvelinus namaycush* are not present in the middle Clark Fork or the Bitterroot River but are found in other waters of the state (Holton and Johnson 1996; Ladd Knotek, MFWP, 3 April 2002, pers. comm.). Bull trout and brook trout appear similar at first glance, but bull trout have neither the dark spots typical of brook trout on their dorsal fin nor red spots with blue halos on their sides. These two species occasionally hybridize.

## 5.1 STATUS, DISTRIBUTION, LIFE HISTORY, AND HABITAT REQUIREMENTS

### 5.1.1 STATUS

The FWS listed the Columbia River distinct population segment (DPS) of bull trout as threatened on June 10, 1998, (Federal Register 1998). Much of the information provided below is derived from the Federal Register listing notice.

Bull trout populations within this population segment have declined from historic levels and are generally considered to be isolated and remnant. An examination of 386 bull trout populations in the Columbia River DPS indicated that 33 percent were declining, 15 percent were stable, 3 percent were secure, and 2 percent were increasing. The population status of the remaining 47 percent in the Columbia River DPS within the United States is unknown. Since the FWS considers that documented trends within a distinct population segment are representative of the entire DPS, an overall declining trend of bull trout populations in the Columbia River basin was evident based on information in the 1994 FWS administrative record. Bull trout are recognized as a species of special concern by some state resource management agencies and as a sensitive species by the U.S. Forest Service.

### 5.1.2 DISTRIBUTION

Bull trout were likely widely dispersed throughout the western United States, limited only by natural passage and thermal barriers. Bull trout were present in the Snake River basin (except eastern Idaho above Shoshone Falls) and tributaries of the upper Columbia River basin (Behnke 1992). They occurred from the McCloud River in northern California to the headwaters of the Yukon River in Canada, with the Snake River the likely southern extent of their inland range (Bond 1992), except for a remnant population in the Jarbidge River in Nevada.

Bull trout distribution, growth, and survival are substantially limited by their requirement for water temperatures cooler than about 15 °C (Selong et al. 2001). Water temperature requirements for spawning and rearing are lower, and adults and juveniles differ in their optimum and maximum temperatures.

Bull trout are now generally restricted to headwater streams throughout the Columbia River basin including headwaters in Montana and Canada. Their requirement for relatively cold water substantially restricts their movement between adjacent watersheds and interaction with other populations during at least part of the year. Bull trout are found in numerous streams in western Montana, including the Bitterroot River and Clark Fork drainages, although quantitative data on their distribution and abundance are sparse.

### 5.1.3 LIFE HISTORY

Bull trout exhibit two distinct life history forms: migratory and resident. Resident fish remain in their natal streams for their entire lifetime, not venturing far from where they hatched. They do not grow as large as the migratory component of the population. Migratory fish emigrate from their small streams to larger rivers (fluvial form) or lakes (adfluvial form) at age 2+ to 3+. Generally, migratory forms spend several years in the rivers or lakes maturing and grow larger than the resident form. The larger mature fish migrate to cool headwater streams in spring or summer to spawn; they return to the river or lake in the fall after spawning. There is some indication that immature nonspawning adfluvial bull trout may also seasonally migrate from the lake to headwater streams to exploit better environmental conditions (Rick Rieber, USBR, Boise, 30 May 2002, pers. comm.).

In the Clark Fork and Bitterroot River basins near Missoula, resident bull trout mature at about 8 inches (20 cm) while migratory bull trout mature at about 14 to 16 inches (36 to 40 cm) (Ladd Knotek, MFWP, 15 April 2002, pers. comm.). Table 5-1 (Knowles and Gumtow 1996) summarizes some aspects of bull trout life history.

Bull trout can live up to 10 years. They mature slowly, often spawning for the first time in their fourth or fifth year. They spawn from September to November, in cold, flowing groundwater-fed streams that are clean and sediment-free. Their incubation period is extremely long, and it may take up to 225 days before young fry emerge from the gravel.

**Table 5-1.** Bull Trout Life History Summary

| Life Conditions | Criteria/Facts |
|---|---|
| Age at first reproduction | 4-5 years |
| Number of eggs produced | 1,300 to 9,000 |
| Maximum size | Greater than 30 pounds and 36 inches |
| Life span | Up to 10 years |
| Food habits | Juveniles are insectivorous. Adults are piscivorus. |
| Incubation success (percent) | Water temperature critical:<br>32-36 °F = 80 - 95 percent<br>43 °F = 60-90 percent<br>46-48 °F = 0-20 percent<br><br>Sediment size:<br>20 percent fines = 40 percent<br>30 percent fines = 20 percent<br>40 percent fines = 1 percent |
| Migration strategies | Resident, fluvial, adfluvial, and anadromous |
| Closely related species | Dolly Varden, lake trout, and brook trout |
| Optimal and maximum water temperature | Juveniles = 39-48 °F and 59 °F<br>Adults = 39-48 °F and 64 °F |
| Spawning season | September through November |

From Knowles and Gumtow 1996

Migratory bull trout usually emigrate from their rearing streams at age 2+ to 3+ when they are 6 to 8 inches (15 to 20 cm) long; however, younger fish may occasionally outmigrate earlier (Elle et al. 1994). They move downstream to a river or lake where they live and grow to maturity.

Migratory bull trout that migrated to larger rivers or lakes may live there for several years before returning to tributaries to spawn. In the larger rivers or lakes, they grow to a much larger size than resident forms. Growth differs little between the two life history forms during their first few years of life in headwater streams but diverges as migratory fish move into larger and more productive waters (Rieman and McIntyre 1993). Resident and migratory forms may live together, but it is unknown if they represent a single population or separate populations (Rieman and McIntyre 1993). Migratory forms of bull trout appear to use much of the river basin that they are located in through their life cycle (see Bjornn et al. in Batt, 1996).

After entering the river or lake, juvenile bull trout grow rapidly, often reaching over 20 inches long and 2 pounds by the time they are 5 to 6 years old. A 25 lb. 10.08 oz. Dolly Varden taken at an unspecified location in Montana in 1916 is thought to be the record Montana bull trout (Hot Spot Fishing 2002). Adfluvial mature bull trout appear to reside in reservoirs for about 6 months during the period from November to June. During this period, when water temperatures range from 7.2 to 12.2 °C, adult adfluvial bull trout live near shallower areas depending on food supply (Flatter 1998).

It appears that mature bull trout and some immature bull trout not yet ready to spawn migrate upstream beginning in May-June and return in November-December (Flatter 1998). This upstream migration of immature migratory bull trout may be in part to avoid high summertime water temperatures in some areas or insufficient flows or water levels (Rick Rieber, USBR, Boise, 30 May 2002, pers. comm.).

Rieman and McIntyre (1993) indicate that diverse life-history strategies are important to the stability and persistence of populations of any species. Such diversity is thought to stabilize populations in highly variable environments or to refound segments of populations that have been extirpated. Variation in the timing of outmigration and in the timing and frequency of spawning also represents diversity in life history. Bull trout may spawn each year or in alternate years (Block et al. in Batt 1996). It is possible that four or more year-classes could comprise any particular spawning population, with each year-class including up to three outmigration strategies. This theory supports the idea that the multiple life-history strategies found in bull trout populations represent important diversity (both spatial and genetic) within populations.

### 5.1.4 HABITAT REQUIREMENTS

Bull trout have more specific and some of the most demanding habitat requirements of any native trout species, mainly because they require water that is especially cold and clean. Outside of the reservoirs, channel stability, winter high flows, summer low flows, substrate, cover, temperature, and the presence of migration corridors consistently appear to influence bull trout distribution and abundance (Allen et al. in Batt 1996). Eggs are extremely vulnerable to high levels of sediment and bedload movement during the long incubation period. Any activity that causes erosion, increased siltation, removal of stream cover, or changes in water flow or temperature affects the number of bull trout that hatch and their ability to survive to maturity (Knowles and Gumtow 1996).

Water temperature is a critical habitat parameter for bull trout. Researchers recognized water temperature more consistently than any other factor influencing bull trout distribution. Temperatures above 15 °C are thought to limit bull trout distribution (Allen et al. in Batt 1996; Selong et al. 2001). Optimum water temperatures for rearing are thought to be 7.12 to 7.8 °C. However, it is poorly understood whether the influence of temperature is consistent throughout life or whether a particular stage is especially temperature sensitive.

Bull trout have voracious appetites; adults are generally piscivorous but utilize other prey items opportunistically. Fish are considered to be the major item in the diet of large bull trout. They feed primarily along the bottom and up to mid-water levels, consuming insects and other fish species such as suckers, sculpins, minnows, and trout. Mountain whitefish are one of the bull trout's preferred prey (Knowles and Gumtow 1996).

Adfluvial adult bull trout generally spend about half of each year associated with a lake or reservoir (generally during the period November-May). These fish most likely forage in shallow areas where the majority of prey exist. Depending on water conditions, bull trout will occupy deeper areas of the reservoir where water temperatures are cooler (7.2 to 12.2 °C) and move nearer to the surface when surface water temperatures drop below 12.2 °C.

## 5.2 FACTORS CONTRIBUTING TO SPECIES DECLINE

Several actions that are outside Reclamation's discretionary authority have contributed to the decline of bull trout. These actions are occurring throughout the bull trout's regional distribution area. Impacts on bull trout generally occur from combined land, water, and fisheries management practices. Current recognized threats to bull trout are discussed briefly in the following sections.

### 5.2.1 HABITAT DEGRADATION

Loss of riparian vegetation through a variety of human activities leads to increased water temperature and siltation. Instream cover is lost due to a reduction in riparian vegetation with a concomitant loss of woody debris recruitment and unstable banks that do not allow the formation of undercut banks. Other factors affecting habitat include sedimentation resulting from livestock grazing, mining activities, timber harvest, and road building.

Most bull trout spawning strongholds are associated with unmanaged watersheds with near-pristine streams.

### 5.2.2 PASSAGE BARRIERS AND STREAM DIVERSIONS

Dams, irrigation diversions, and other alterations of waterways have interrupted the migration corridors of bull trout. Dams without adequate fish passage have caused some populations with migratory life histories to decline and in some cases to assume resident life histories. Where migratory bull trout once linked resident bull trout to much of the species' gene pool, many resident populations are currently isolated, vulnerable to the effects of habitat degradation, and may suffer a loss of genetic diversity. If a barrier is high up in a drainage, the isolated population may be too small to sustain itself.

On bull trout streams where irrigation diversions occur, at least four potential problems may affect bull trout production. First, irrigation diversions reduce instream flows. Second, where substantial return flows occur via surface wasteways, the water returned to streams may be warmer than the water diverted from the stream. Third, sediment may be added to streams. Finally, unscreened diversions may entrain migrating juvenile and adult bull trout to conveyance systems and fields where they die.

Construction of water storage facilities appears to have been a significant factor in the reduction of bull trout range and distribution. From about 1908 to about 1950, dams were constructed on historical or current bull trout streams in numerous locations in the Columbia and Snake River basins. Construction and operation of these facilities have modified streamflows, changed stream water temperature regimes, blocked migration routes, entrained bull trout, and affected bull trout forage bases. However, some reservoirs may improve water habitat for adfluvial forms.

Some storage reservoirs experience substantial drawdowns during drought years. Reduced reservoir volume directly impacts the amount of aquatic environment for all organisms in the food web. Production of phytoplankton, zooplankton, and benthic aquatic insects may be altered and in some cases reduced when drawdowns are extreme. Reduction in the food base may reduce the prey available for predator species like bull trout, although in some cases, forage fish populations may be more concentrated and more available as prey. When reservoir volume is greatly reduced, bull trout and other fish species may be entrained through dams and forced into downstream riverine habitats. However, in some cases, adult bull trout that have made a spawning migration upstream out of the reservoir in the spring may actually be on their way to or already in headwater streams when drawdowns occur and may be less affected by the low reservoir water level.

Operation of storage facilities as components of irrigation projects is not relevant to this consultation since no storage of water is associated with or necessary for the operation of either the Big Flat Unit or the Frenchtown Project.

### 5.2.3 COMPETITION WITH INTRODUCED SPECIES

Brook trout, native to the eastern United States, were introduced into many western locations in the early 1900s. Brook trout not only compete directly with juvenile bull trout for food and space, but they also are genetically close enough to the bull trout to permit hybridization. The hybrids are thought to be sterile.

When brown trout and lake trout are present in the same waters as bull trout, they may depress or replace bull trout populations through competition for prey, and they may also prey upon juvenile bull trout, such as has occurred in the Flathead River system in Montana (Brian Marotz, MFWP, pers. comm.).

Other introduced species that provide forage and have different habitat preferences, such as kokanee, may benefit bull trout.

### 5.2.4 OVERFISHING AND ERADICATION EFFORTS

Bull trout were once viewed as undesirable by anglers, and especially disliked because they are documented to consume juvenile salmon and other game fish. Many fish and wildlife agencies mounted active campaigns to eliminate bull trout. Some populations of bull trout were eliminated and others have not recovered from overfishing and eradication efforts. The smaller populations remaining may suffer from a loss of genetic diversity and may in some cases be unable to sustain themselves.

Angling for bull trout is prohibited in almost all locations since it is a listed and hence protected species, but harvest of limited numbers of bull trout is allowed in the Metolius arm of Lake Billy Chinook, Oregon (ODFW 2002). Although the direct, legal harvest of bull trout has been eliminated or severely restricted, incidental take of this species in recreational trout fisheries and by poachers further impacts bull trout abundance. Since the bull trout is a relatively slow growing and maturing species, hook and release mortality or poaching in an otherwise legal trout fishery has a greater effect on population levels than on other trout species that mature at a younger age.

### 5.2.5 CATASTROPHIC EVENTS

Catastrophic fire events can drastically alter water quality, water temperature, abundance of woody debris, bank vegetation, and stream flow characteristics. Wildfire has been documented as adversely impacting bull trout populations. Salvage timber sales have a high potential to adversely impact isolated bull trout populations. Drought results in reduced summer streamflows (and reduced reservoir elevations) and increased water temperature and will predictably reduce spawning success and survival of bull trout (Knowles and Gumtow 1996).

Environmental stochasticity, or the effect of a catastrophic event (such as deep reservoir drawdowns for flood control or during drought conditions) influences the probability of bull trout extinction when population size is small (Rieman and McIntyre 1993).

## 5.3 CURRENT ENVIRONMENTAL CONDITIONS

Information on bull trout distribution and abundance in the Bitterroot River and Clark Fork was obtained from numerous sources, including the StreamNet website and Montana Natural Resources Information System. No reports or documents were located to corroborate the information shown on the several maps. Montana Fish, Wildlife and Parks (MFWP) fishery biologists were contacted to verify information on the distributional maps (Ladd Knotek, MFWP, Missoula, pers. comm.).

Bull trout occur in the Bitterroot River and middle Clark Fork near Missoula at an abundance of 1 to 3 fish per mile, brown and cutthroat trout occur at an abundance of 5 to 20 fish per mile, and rainbow trout occur at an abundance of 350 to 500 per mile (Ladd Knotek, MFWP, Missoula, 15 April 2002, pers. comm.). These abundance estimates are for fish 8 inches or greater in length. Knotek's designation for abundant is 10 bull trout in 150 feet of stream and for rare about 2 bull trout per mile (Ladd Knotek, MFWP, Missoula, pers. comm.).

In the Bitterroot River, the distribution of bull trout is shown Figure 5-1. This StreamNet map dated June 2001 is not consistent with recent sampling information from MFWP (Ladd Knotek, MFWP, Missoula, pers. comm.). The presence of bull trout for the Clark Fork is shown in Figure 5-2. These two maps use a subjective scale of abundance ranging from abundant, common, rare, uncommon, and present. No numbers or values are assigned to these abundance categories.

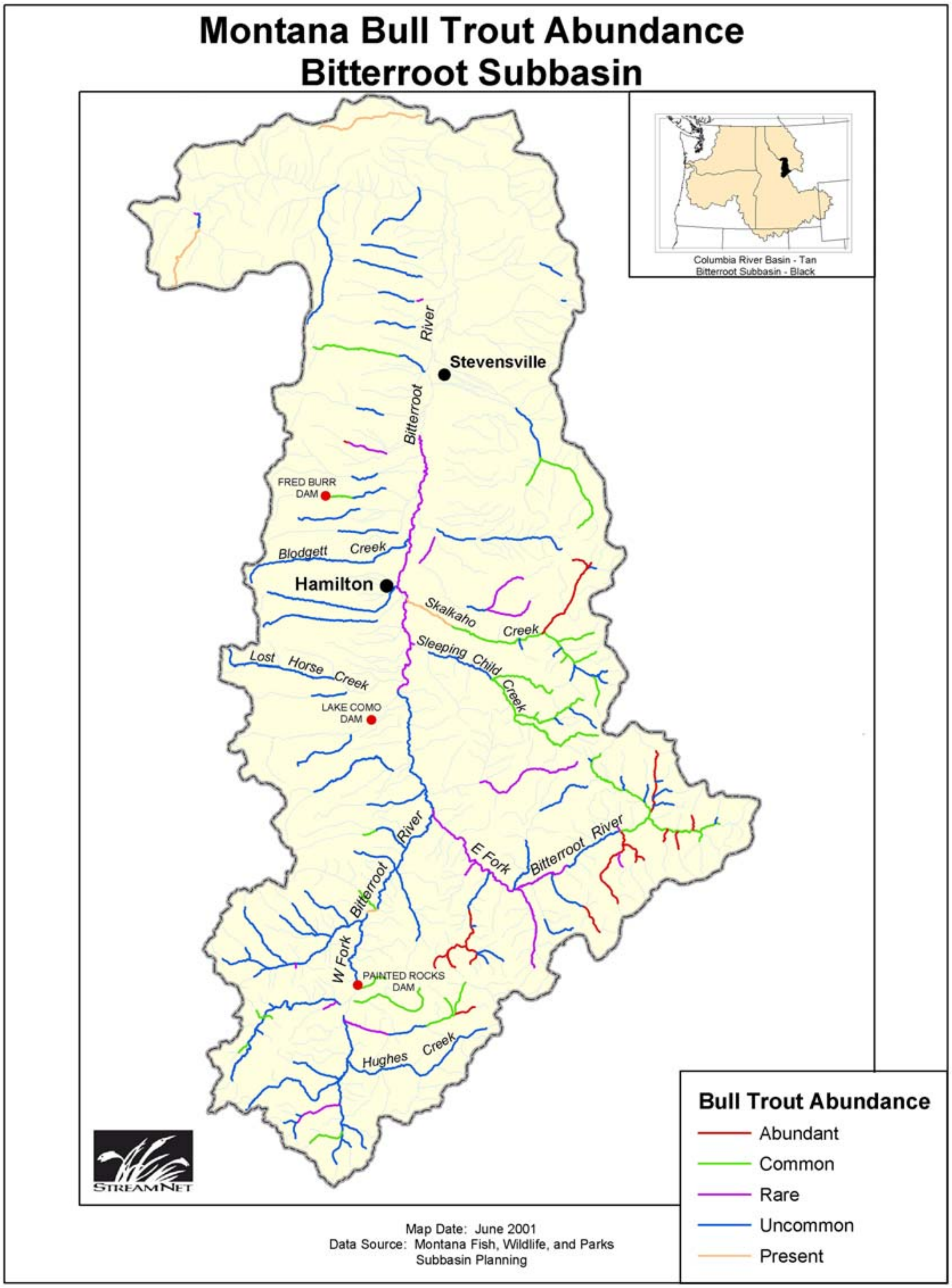


**Figure 5-1.** Montana Bull Trout Abundance in the Bitterroot Subbasin.

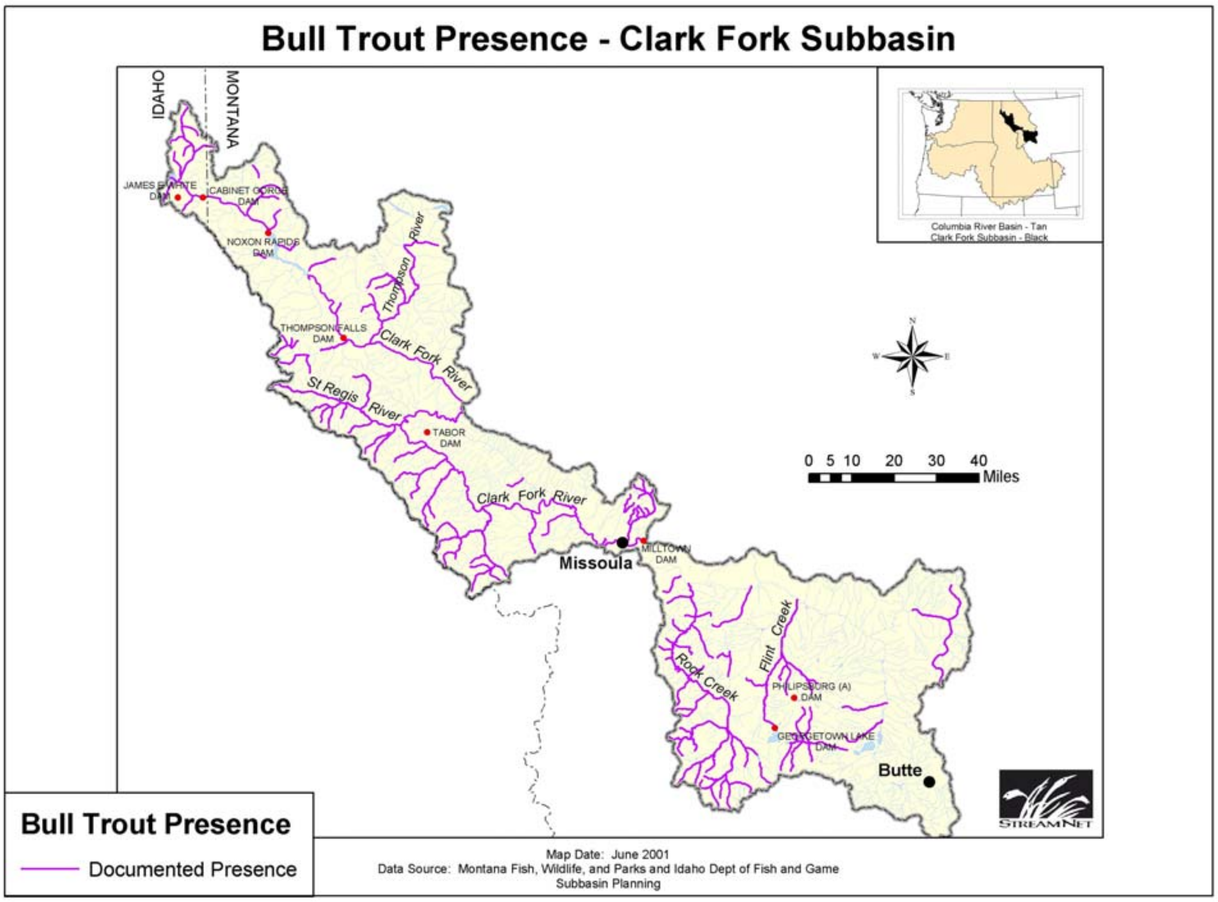


**Figure 5-2.** Bull Trout Presence in the Clark Fork Subbasin.

MFWP's information indicates that bull trout are rare rather than absent from Lolo Creek, the first relatively substantial tributary entering the Bitterroot River from the west upstream from Missoula (Ladd Knotek, MFWP, Missoula, 20 Mar 2002, pers. comm.). As shown on Figure 5-1, the two tributaries to Lolo Creek entering from the south should have abundance listed as common (green coloration) rather than uncommon (blue coloration). MFWP's sampling indicated that there are juvenile bull trout in the mainstem Lolo Creek that are probably migrating downstream to the Bitterroot River or Clark Fork.

MFWP has limited information on the distribution of bull trout in the lower Bitterroot River. MFWP conducts surveys on a 4.1-mile section of the lower Bitterroot River from below Lolo to the Highway 93 bridge that brackets the intake channel to the Big Flat Canal (Chris Clancy, MFWP, Hamilton, 27 June 2002, pers. comm.). During electrofishing surveys with a boom shocker in September 1999 and 2000, no bull trout were captured. Out of 1300 trout collected, most were rainbow trout, and none were bull trout. They captured fish as small as 3 inches, but during the time of sampling, water temperature was greater than 15 °C. Clancy (pers. comm.) implied that any bull trout use of the lower Bitterroot River would be incidental. However, there may be low densities of juvenile fluvial bull trout headed downstream (Ladd Knotek, MFWP, Missoula, pers. comm.; Chris Clancy, MFWP, Hamilton, pers. comm.). Three juvenile bull trout were found in Maclay Ditch about two miles upstream from the mouth of Lolo Creek. Aside from these observations, MFWP has no quantifiable estimates of fish numbers in irrigation ditches (Ladd Knotek, MFWP, Missoula, pers. comm.). MFWP has electrofished some irrigation ditches in the Missoula area and found an assemblage of fish similar to that which is found in the river, including other trout species and whitefish, but they have not collected bull trout.

In the Clark Fork near Missoula in the area of the Frenchtown Project, Knotek (pers. comm.) indicated that the bull trout abundance designations and distributions on the StreamNet map for the Clark Fork were not up-to-date. The mainstem Clark Fork upstream from Milltown Dam does contain bull trout. The National Fish and Wildlife Foundation awarded a grant in 2000 to reintroduce bull trout above Milltown Dam (Robert Christensen, USBR, Boise, 30 May 2002, pers. comm). Bull trout are abundant in the reach of Rattlesnake Creek upstream from the confluence with Spring Gulch. In the next westerly tributary, Grant Creek, bull trout are common; Albert Creek bull trout abundance should be common rather than uncommon; Petty Creek should be uncommon rather than rare; the southern branch of Fish Creek should be common rather than uncommon; and the western branch of Fish Creek and its few tributaries should be abundant rather than common and uncommon. At this time, bull trout do not appear to be present in Nine Mile Creek (Ladd Knotek, MFWP, Missoula, pers. comm.) although the StreamNet map shows rare abundance and an additional unconfirmed report indicates bull trout presence (Dan Downing, USFWS, Helena, pers. comm.). Fish Creek and Rattlesnake creeks seem to be strongholds for bull trout in this section of the middle Clark Fork.

Small remnant populations of bull trout may remain in other tributaries in the vicinity of Missoula, but their abundance is much reduced from historic abundance. Reasons for the decline are varied and include a range of anthropogenic factors such as intensive grazing, dewatering, losses in irrigation diversions, fish passage barriers, and a reduction in suitable spawning and rearing habitat from habitat degradation. Bull trout generally require good groundwater exchange for successful reproduction. Westslope cutthroat trout, on the other hand, are nearly ubiquitous in streams in the vicinity of Missoula.

## 5.4 RECOVERY EFFORTS

Numerous state and Federal efforts have been initiated in the northwestern states, including Montana, to evaluate the status of bull trout and develop appropriate recovery plans.

The Montana Bull Trout Restoration Team prepared a "Restoration Plan for Bull Trout in the Clark Fork River Basin and Kootenai River Basin Montana" for Governor Marc Racicot (Montana Bull Trout Restoration Team 2000). The plan provides a framework for a strategy to reverse the declining bull trout populations in western Montana. It provides general guidance for conservation and protection of populations that are stable or increasing and recommendations to restore populations that have declined.

## 5.5 EFFECTS ANALYSIS

To determine the effects of continued routine operation and maintenance of the Big Flat Unit of the Missoula Valley Project and the Frenchtown Project on bull trout in the action area, this assessment first addresses the hydrologic effect of operations in the action area. It then uses this hydrologic information to estimate the effects on bull trout in the action area.

### 5.5.1 BIG FLAT UNIT

#### Hydrology in the Bitterroot River

Irrigation diversions for the Big Flat Unit normally occur from May 1 through October 1 with a maximum diversion of 25 cfs. This is about 7,590 acre-feet, or less than 1 percent of the average flow of 1,112,960 acre-feet during this period.

Irrigation diversions have the greatest effect on the Bitterroot River in August when the water temperatures are the warmest, irrigation diversions are usually at maximum amounts, and the natural flow of the river is low. The 10-year average total August flow on the Bitterroot River at the point of diversion for the Big Flat Unit is 58,185 acre-feet. The total volume of diversion at 25 cfs per day is 1,537 acre-feet which is approximately 3 percent of the total flow. On the lowest flow days of 500 cfs, which occurs only during the driest years, the 25 cfs diversion is 5 percent of the total flow.

No direct measurements of return flow are available for the Big Flat Unit. A standard estimate of the return flow for a diversion of 25 cfs was not significant and fell within the range of the accuracy of the discharge measurements from the gaging stations. The accuracy of the discharge measurements of the Bitterroot River near Missoula as estimated by the USGS are within 10 percent of the true values. The estimates of the return flows are less than the 10 percent error range of the discharge measurements and would not be significant.

**Effects of Irrigation on Bull Trout in the Bitterroot River**

Bull trout are estimated to be present in the lower Bitterroot River at an abundance of one to three fish per river mile (Ladd Knotek, MFWP, 15 April 2002, pers. comm.). Infrequent fish sampling in the Big Flat Canal have turned up a fish assemblage similar to that found in the lower Bitterroot River, but no bull trout have been found.

Water temperature in the lower Bitterroot River exceeds the 15 °C temperature that generally limits the distribution of bull trout in the summer months (see Figure 4-2). Fluvial juvenile bull trout that are outmigrating to the river would probably be more likely to be moving later in the early fall, after water temperatures have decreased, although irrigation diversions continue until October 1. Information on migration of fluvial bull trout in the lower Bitterroot River is not available. Pratt (pers. comm.) indicated that bull trout populations in the Bitterroot River are mostly resident rather than migratory. However, bull trout may be migrating upstream through the lower Bitterroot River when water temperatures remain within the tolerable range of the species, during the early part of the irrigation season and diversions.

Little is known about the bull trout in O'Brien Creek, which enters the Bitterroot River downstream from the Big Flat Unit point of diversion. If bull trout do occupy this stream, they may make excursions into the lower Bitterroot River, but it is unknown if they would move upstream in the Bitterroot River or downstream into the Clark Fork. The available water temperature data for the lower Bitterroot River indicates that water temperatures increase above 15 °C in late May or early June. This would further restrict the occurrence of bull trout in the lower river and reduce opportunities for the fish to be entrained in the canal.

Based on the estimated abundance of bull trout of one to three fish per river mile and the MFWP estimate of 5 to 20 fish per river mile for cutthroat trout, 5 to 20 fish per river mile for brown trout, and 350 to 500 fish per river mile for rainbow trout (Ladd Knotek, MFWP, Missoula, 15 April 2002, pers. comm.), bull trout constitute 0.28 to 0.55 percent of the trout population 8 inches or greater in length in the lower Bitterroot River and Clark Fork, calculated using the low and high estimate for each trout species (1+5+5+350 = 361, 1/361 = 0.0028 => 0.28 percent; 3+20+20+500 = 543, 3/543 = 0.0055 => 0.55 percent). Whitefish and other species were not considered in the calculation. We could not locate information on the abundance of juvenile bull trout (less than 8 inches long).

It is difficult to estimate the level of bull trout entrainment into the Big Flat Canal. There is a very low estimated abundance of bull trout 8 inches or greater in length in the Bitterroot River. Further, we lack information on the abundance of juvenile bull trout, along with information on behavior and habitat preference of several life stages of bull trout in this system.

The intake canal to the headworks of the Big Flat Canal is about 488 feet long, and at the design flow of 25 cfs into the Big Flat Canal, the relatively low velocity may seasonally provide a low velocity refugium for juvenile and larger bull trout if they are present in the lower Bitterroot River. Juvenile bull trout have a high affinity for stream margins where the water velocity is reduced compared to the main river or stream (Ladd Knotek, MFWP, Missoula, 30 May 2002, pers. comm.; Fraley and Shepard 1989), and if they were seasonally in the lower Bitterroot River, they may use this lower velocity area as a refugium.

Fraley and Shepard (1989) found emigration of juvenile bull trout from Flathead River tributaries June through August by fish ages I (18%), II (49%), and III (32%) that averaged 73, 117, and 155 mm in length, respectively. They also note that these juvenile bull trout were generally found in side channel areas along the stream margins that may serve as velocity refugia. However, resident bull trout of any size would likely remain in the headwater tributaries, while subadults and adults of migratory bull trout may be passing the point of diversion at some time during the year. In addition, it is possible although not documented that some fish entrained into the Big Flat Canal would be returned to the Clark Fork at the end of the irrigation season when the canal is dewatered through the several drains.

Because of the low number of bull trout estimated in the lower Bitterroot River, the likely seasonal limitation on their presence there due to generally unfavorable water temperatures, their unknown behavior and likely but undocumented use of the intake channel to the headworks as a velocity refugium and use of the protective stream margin, it is not realistic to attempt to quantify the level of bull trout entrainment into the Big Flat Canal. However, because of the documented presence of bull trout in the system, we expect that over the period of operation of the Big Flat Unit, some bull trout will become entrained. Although unquantifiable based on limited information, continued routine operation and maintenance of the Big Flat Unit will entrain some bull trout, and therefore may affect, and is likely to adversely affect, bull trout.

### 5.5.2 FRENCHTOWN PROJECT

**Hydrology in the Clark Fork**

Irrigation diversions for the Frenchtown Project normally occur from May through September with a maximum diversion of 115 cfs. This amounts to approximately 34,900 acre-feet for the period, which is less than 2 percent of the average flow of 2,557,713 acre-feet.

Irrigation diversions would have the greatest effect on the Clark Fork during the months of July and August when water temperatures are the warmest, irrigation diversions are usually at maximum amounts, and the natural flow of the river is low. The 70-year average total July and August flows on the Clark Fork was 504,222 acre-feet. The maximum total amount of July and August diversions based on diversions of 115 cfs would be 14,142 acre-feet, which is about 3 percent of the average flow.

The effect of the diversion on the total flow in the channel can best be analyzed by comparing the daily diversion to the daily flow during a low-flow period. August flows are typically lower than July's, so August daily flows during the 1930 though 2000 period were analyzed. The 70-year average total July and August flows on the Clark Fork was 504,222 acre-feet. The average daily flow for August was 2,304 cfs (see Figure 4-8). The 115-cfs diversion would be 5 percent of the average daily flow, 16 percent of the lowest 70-year flow and 1 percent of the highest daily flow. By definition, the lowest August daily flow of 703 cfs occurred only once during the 70-year period of record.

When analyzing individual low, medium, and high water years (see Figure 4-9), it is clear that the effect of the 115-cfs diversion is not the same for all years. The flows normally remain near the 1000-cfs level and only drop below that level for short periods of time. In a low water year such as 1988, the lowest flows are in the 900 to 1000 cfs range in August. The 115-cfs diversion during this low-flow period is about 12 percent of the total flow.

No direct measurements of return flows are available for the Frenchtown Project. A standard estimate of return flows for a diversion of 115 cfs indicates that the amount of return flow is not significant and falls within the range of the accuracy of the discharge measurements of the gaging stations. The accuracy of the discharge measurements of the Clark Fork below Missoula is within 5 percent of the true values based on USGS quality control criteria. Estimates of return flows are less than this 5 percent error range of the discharge measurements and would be difficult to measure.

### Effects of Irrigation on Bull Trout in the Clark Fork

Bull trout are relatively rare in the middle Clark Fork, occurring at an estimated abundance of one to three fish per river mile. They have been documented in numerous tributaries, although population estimates are not available (MFWP). With the low abundance of bull trout in the middle Clark Fork, little information is available about their distribution and movement. It is unknown if the fish seek out the deeper water of the river channel or use shallower shoreline areas. As noted above, juvenile bull trout have a high affinity for stream margins where velocity is lower.

The Frenchtown Project diverts about 115 cfs from the middle Clark Fork from May 1 to October 1, which during the usual lowest flow period in August is 5 percent of the daily flow. Water temperature in the middle Clark Fork during the August diversion period exceeds the 15 °C temperature that generally limits distribution of bull trout; in addition, water temperature is often greater than 15 °C for much of the summer (see Figure 4-6).

Fluvial juvenile bull trout that migrate to the river would more likely move later in the early fall, after water temperatures have decreased, possibly after the irrigation diversions are shut down. However, subadult bull trout that have left the headwater streams and that are residing in the river may seek low water temperature refugia during the summer months, or as described above, they may migrate back to headwater streams. During high flow periods, bull trout and other fish may use the intake channel as a velocity refugium. Bull trout in the middle Clark Fork may be resident there seasonally for several years as they mature, and they may make seasonal in-river migrations to feeding and overwintering areas, dependent on the water temperature and velocity.

Based on the estimated abundance of bull trout of from one to three fish per river mile and the MFWP estimate of 5 to 20 fish per river mile for cutthroat trout, 5 to 20 fish per river mile for brown trout and 350 to 500 fish per river mile for rainbow trout, bull trout constitute 0.28 to 0.55 percent of the trout population 8 inches or greater in length in the lower Bitterroot River and Clark Fork, calculated using the low and high estimate for each trout species, as shown above. Whitefish were not considered in the calculation. We could not locate information on the abundance of juvenile bull trout (less than 8 inches long).

Because of the low number of bull trout estimated in the middle Clark Fork, the likely seasonal limitation on their presence there due to generally unfavorable water temperatures, their unknown behavior and likely but undocumented use of the intake channel to the headworks of the canal as a velocity refugium and use of the protective stream margin especially by smaller fish, it is not realistic to attempt to quantify the level of entrainment of bull trout into the Frenchtown Canal.

Some fish sampling in the Frenchtown Canal has indicated a fish assemblage similar to that found in the middle Clark Fork, but no bull trout have been found. However, this does not mean that bull trout were not entrained into the canal. Bull trout are documented in the river system, and we expect that over the period of operation of the Frenchtown Project, some bull trout will be entrained into the Frenchtown Canal. Although unquantifiable based on limited information, continued routine operation and maintenance of the Frenchtown Project will entrain some bull trout, and therefore may affect, and is likely to adversely affect, bull trout.

## 5.6 EFFECTS CONCLUSION

Bull trout are relatively rare in the lower Bitterroot River and the middle Clark Fork, with an abundance of one to three fish 8 inches or greater in length per mile (Ladd Knotek, MFWP, Missoula, 15 April 2002, pers. comm.). We could not locate information on the abundance of juvenile bull trout. They are generally restricted to areas with water temperatures less than about 15 °C, so it is expected that during the middle of the irrigation season when river water temperatures exceed 15 °C, bull trout are not likely to be in the vicinity of the projects points of diversion. Instead, we expect that they will be seeking cool water refugia elsewhere. However, when water temperatures are suitable, fish may use the intake channels as a velocity refugium and the channels' margins as protective habitat. Warm temperatures in the Clark Fork and Bitterroot River are largely unrelated to project diversions and return flows because Clark Fork diversions are generally less than 3 percent of the average flows and the Bitterroot River diversions are less than 1 percent of the average flow.

During the early and latter parts of the irrigation season when water temperatures are less than 15 °C, bull trout may be present in the lower Bitterroot River and the middle Clark Fork and may be affected by operation and maintenance of project facilities. Reclamation concludes that the continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project may affect and is likely to adversely affect bull trout locally in the lower Bitterroot River and middle Clark Fork; however, the proposed action will not jeopardize the continued existence of the Columbia River distinct population segment of bull trout.

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# CHAPTER 6
# BALD EAGLE

The bald eagle *Haliaeetus leucocephalu*s became the national symbol of the United States in 1782 and is protected by Federal law (Phoenix Zoo 2002). Mature adults are easily recognized by the white head and tail; yellow eyes, bill, and feet; and large size. It is a member of the hawk family (Accipitridae) with a weight ranging from 6-1/2 to 14 pounds and a wing span of 6 to 7-1/2 feet, and they measure about three feet long from head to tail. They have strong and sharp talons for seizing and carrying prey, and a strong curved beak for ripping food. They have keen eyesight and excellent hearing (Phoenix Zoo 2002). Immature bald eagles are difficult to identify because their plumage is more muted and tends to vary, and the characteristic white head and tail are not acquired until the bird is about five years old. Prior to that time, immature bald eagles are often confused with immature golden eagles. For the most part, bald eagles prey on fish and waterfowl, so they are more abundant along waterways and lakes, but they also feed on carrion. Montana has a relatively strong population of bald eagles. Some bald eagles migrate from Canada and Alaska to winter in Montana, while others pass through the area during their annual migration.

## 6.1 STATUS, DISTRIBUTION, LIFE HISTORY, AND HABITAT REQUIREMENTS

### 6.1.1 STATUS

The bald eagle is currently Federally listed as threatened in the lower 48 contiguous states. It was originally listed as endangered in 1967 under the Endangered Species Preservation Act of 1966 in the southern half of the United States; in 1978, under the Endangered Species Act, it was listed as endangered in 43 of the lower 48 states, including Montana, and threatened in five other states (Federal Register 1999). On July 12, 1995, the status was changed from endangered to threatened in the lower 48 states. It is the first and only Montana threatened or endangered species to be downlisted since the 1973 Endangered Species Act became law (Travel Montana 2002a). It is Federally listed as threatened in Missoula County, Montana, where they are considered both year-long residents and spring/fall migrants, with nesting near or along major waterways (USFWS 2002a).

Historically, the bald eagle was found nesting throughout most of the continent. However, reproduction in North America declined dramatically between 1947 and 1970 largely due to intake of organochloride pesticides (USFWS 1986). Habitat degradation, illegal harassment and disturbance, poisoning, and a reduced food base contributed to the decline.

In the 24 years since it was listed throughout the lower 48 States, the population has substantially increased in number and expanded its range. The improvement is a result of banning DDT and other persistent organochlorides, habitat protection, a growing public awareness of the bald eagles' plight, and other measures (USGS). Due to the overall population increase, the bald eagle was reclassified from endangered to threatened in all of the lower 48 states in 1995 (USFWS 1995).

### 6.1.2 DISTRIBUTION

The FWS reported that in the lower 48 states in 1963 there were a total of 417 bald eagle pairs. By 1982, the number of pairs had grown to 1,480. In 1998, the number of breeding pairs was 5,748 (Federal Register 1999), and in 1999, there were 6,104 bald eagle pairs (USFWS 2002b).

Bald eagle numbers, estimated at a quarter to a half million on the North American Continent before European arrival, declined steadily throughout the late 1800s and early 1900s (Federal Register 1999). During this period, raptors were regarded as vermin and shot indiscriminately. The Bald Eagle Protection Act of 1940 increased public awareness and made indiscriminate shooting, poisoning, collecting, and trading of bald eagles illegal. This temporarily halted the decline. Pesticides such as DDT used during and after World War II soon negatively affected eagle reproductive success and caused numbers to plummet.

Since surveys began in 1978, Montana's bald eagle population has grown consistently, both in total number of pairs and number of young fledged. The number of bald eagle nesting territories in Montana grew from 25 in 1980 to 108 in 1990, and the number of young fledged per year increased from 19 to 130. In 1991, 149 nesting sites were documented, out of which 87 pairs fledged a total of at least 153 young (USGS).

Between 1984 and 1994, the number of known breeding pairs in the Pacific States Bald Eagle Recovery Region (Washington, Oregon, California, Nevada, Idaho, Wyoming, and Montana) increased from 479 pairs to 1,192 pairs. One-fourth of all the breeding bald eagles in the lower 48 states come from this region.

In 1990, bald eagles nested in all but 5 of the 50 states. However, most bald eagle nesting is limited to the Pacific Northwest, Alaska, Canada, the Great Lake states, Chesapeake Bay, Arizona, and Florida. Oregon and Washington have been strongholds for bald eagles with more than two-thirds of the nesting population and one-half of the wintering population of the Pacific recovery area occurring in these two states (USFWS 1994). Occupied breeding territories surveyed in Oregon and the Washington portion of the Columbia River Recovery Zone have increased from less than 100 in 1979 to 393 in 2001 (Isaacs and Anthony 2001).

### 6.1.3 LIFE HISTORY

The bald eagle, like most birds of prey, exhibits sexual dimorphism with the females weighing more than the males. Bald eagles require 4 to 5 years to reach sexual maturity and attain full adult plumage. Males and females are thought to mate for life, returning to the same nesting territory year after year, sometimes using the same nest. A clutch of one to three eggs is laid and incubated mostly by the female for about 35 days. The young fledge in 72 to 75 days. Often the younger, weaker bird is killed by its sibling in the competition for food.

### 6.1.4 HABITAT REQUIREMENTS

#### Nesting Habitat

In the Pacific Northwest bald eagles typically nest in multi-layered coniferous stands with old growth trees within one mile of large bodies of water (lakes, reservoirs, large rivers, and coastal estuaries). They also use high cliffs. Availability of suitable trees for nesting and perching is critical. Nest trees in the Pacific Northwest are found primarily in ponderosa pine, mixed conifer, Douglas fir, and Sitka spruce/western hemlock forests (USFWS 1986). Species of trees used for nesting, however, vary among areas. In Idaho, nests are typically found in large cottonwoods, ponderosa pines, and Douglas firs (USFWS 1986). Wyoming nests have been reported in a variety of forest types including old growth ponderosa pine and narrow strips of forest vegetation surrounded by rangeland. A large stick nest is built high up in a tree or on an isolated cliff. Nests are generally not constructed in areas with nearby human activity. Both parents incubate eggs and feed young (Phoenix Zoo 2002). The nesting season for bald eagles in the Pacific Northwest generally extends from January 1 to mid-August (USFWS 1994). Young are usually produced in March and fledged in July; however, they may stay near the nest for several weeks after fledging.

#### Wintering Habitat

More than 25 percent of the wintering bald eagles in the lower 48 states are present in the Pacific Northwest (USFWS 1986). Bald eagles winter in the Northwest from approximately November through March and are primarily associated with open water near concentrated food sources. An important habitat feature is perch trees that provide an unobstructed view of the surrounding area near foraging sites (USFWS 1986). Ponderosa pine and cottonwood snags are preferred perches in some areas, probably due to their open structure and height.

Bald eagles may also use communal night roost sites in winter for protection from inclement weather. Characteristics of communal winter roost sites differ considerably from those of diurnal perch sites (USFWS 1986), although both are invariably located near concentrated food sources, such as migratory fish runs or high concentrations of waterfowl. Roost sites tend to provide more protection from weather than diurnal perch sites. Communal roosts in the Pacific Northwest tend to be located in uneven-aged forest stands with some degree of old-growth forest structure. Conifers might provide a more thermally favorable microenvironment than dead or deciduous trees, which might explain their high use by wintering eagles. In eastern Washington, bald eagles have been observed roosting in mixed stands of Douglas-fir and ponderosa pine and in stands of black locust and black cottonwood.

**Foraging Habitat**

Bald eagles are opportunistic foragers throughout their range. In the Pacific Northwest bald eagles consume a range of food items including a variety of game and nongame fish species, waterfowl, jackrabbits, and mammalian carrion (USFWS 1994). However, fish tend to be the staple food of bald eagles throughout most of North America. Winter-killed mammals can be important on big game winter ranges, while waterfowl are important where concentrations are significant. Dead fish may also be consumed, especially spawned-out kokanee (USFWS 1986). Bald eagles may forage for food great distances from their nests.

Eagles generally follow the same foraging pattern, returning to their same location each year. In the 1970s through mid 1980s, the kokanee salmon run was substantial at McDonald Creek in Glacier National Park, and attracted numerous foraging bald eagles, but the run has since declined.

## 6.2 FACTORS CONTRIBUTING TO SPECIES DECLINE

Some of the factors that contributed to the decline of bald eagles included habitat destruction, hunting, and increasing concentrations of pesticides in their food web (Phoenix Zoo 2002). Continued threats to recovery include habitat loss from logging and development, loss of wetland and riparian habitat, water pollution, nesting failure caused by human disturbance at active nest sites, lead poisoning, the use of certain insect and predator poisons, and electrocution from powerlines (USGS).

Reservoir drawdowns, low winter flows, or high ramping rates that reduce fish populations may impact bald eagle food supplies. Low winter flows that result in increased ice cover can affect the availability of fish and may be a factor in heavily used areas. Reservoir areas may not be available to bald eagles during the late winter because of ice conditions.

Contamination of waterways from point and non-point sources of pollution is also a potential problem. Contaminants may affect the reproductive success, health, and survival of bald eagles. After years of research, scientists determined that DDE, a breakdown product of DDT, accumulated in the fatty tissues of female eagles and impaired the calcium release necessary for eggshell formation. This resulted in thin shells and reproductive failure due to broken shells during incubation. These findings eventually led to the banning of DDT and related chemicals in the U.S. in 1972.

The abundance and quality of prey may be seriously affected by environmental contamination. Although many compounds implicated in reduced reproductive rates and direct mortality are no longer used, contaminants continue to be a major problem in some areas. Pesticide use in recent times has not affected the bald eagle on a population level; however, individual poisonings still occur.

Habitat loss resulting from increasing human population and urbanization or residential development will continue to be long-term threats to the bald eagle. Breeding, wintering, and foraging areas continue to be impacted by urban and recreational development.

## 6.3 RECOVERY EFFORTS

In establishing a recovery program for the bald eagle in the mid-1970s, the USFWS divided the lower 48 states into five recovery regions. A recovery plan with goals and identified tasks to achieve those goals was prepared for each region by separate recovery teams composed of species experts in each geographic area. The Pacific recovery region includes the states of Idaho, Oregon, Washington, Montana, Wyoming, California, and Nevada. The bald eagle recovery plan for the Pacific Region was approved in 1986.

Delisting requirements for the Pacific Region include: a minimum of 800 nesting pairs; an average reproductive rate of 1.0 fledged young per pair with an average success rate per occupied site of not less than 65 percent; breeding population goals met in at least 80 percent of the management zones; and stable or increasing wintering populations. These goals have been met in the Pacific states and, if conditions continue, it could be the first recovery region where the bald eagle is delisted (Travel Montana 2002a).

Montana has an active bald eagle working group comprised of representatives from Federal and State agencies, tribes, universities, conservation groups, and private industry. The Montana Bald Eagle Working Group, formed in 1982, provides leadership at the state level and advice in the recovery, research, management, inventory, and monitoring of the bald eagle and its habitat in Montana (USGS). In 1994 the group developed a "Montana Bald Eagle Management Plan" to provide information and guide landowners and resource managers in conserving eagle habitat (Travel Montana 2002a).

In Montana, the bald eagle population has improved substantially since listing under the Endangered Species Act. Between 1978 and 1995, the number of known breeding pairs increased from 12 to 166, well above the downlisting goal of 99 breeding pairs cited in the 1986 Bald Eagle Recovery Plan (Travel Montana 2002a).

The delisting goals described above have been met in the Pacific States, and bald eagle numbers are continuing to increase. In 1998, a total of 1,480 occupied territories were estimated (Federal Register 1999). The number of occupied territories has consistently increased since 1986 and exceeded 800 for 5 years since 1990 (Federal Register 1999). Productivity has averaged about 1.0 young per occupied territory since 1990. In 1998, 28 of the 37 specified management zones had met or exceeded their recovery goals for breeding, and 5 zones (in addition to the original 37 zones and are not part of the recovery goals for this region) also had nesting eagles. Delisting goals have been met in all categories except distribution in zones with nesting targets.

## 6.4 CURRENT ENVIRONMENTAL CONDITIONS

### 6.4.1 BITTERROOT RIVER

There are no reported bald eagle nesting territories along the Bitterroot River near the action area. Other environmental conditions are as described above.

### 6.4.2 CLARK FORK

Bald eagles reportedly have several nesting territories at several locations along the Clark Fork near the action area at Cyr Gulch, Pulp Mill, and Mill Creek, all in T. 14 N., R. 21 W. sections 26, 11 and 4, respectively (Martin Miller, Montana Natural Heritage Program, Helena, 6 Feb 2002, pers. comm.). Other environmental conditions are as described above.

The Pulp Mill nesting site has been abandoned, and the eagles reestablished a nest on the south side of the Clark Fork. The nest site has been relatively active over the years (John Prange, retired BLM biologist, Missoula, 28 May 2002, pers. comm.). The Cyr Gulch nesting site was originally on Pulp Mill property, but the eagles relocated the nest in a dead ponderosa pine tree on USFS land on the south side of the Clark Fork (John Prange, retired BLM biologist, Missoula, 28 May 2002, pers. comm.). The Mill Creek nesting site is on private property on the north side of the Clark Fork (John Prange, retired BLM biologist, Missoula, 28 May 2002, pers. comm.).

Bald eagles in the area usually hunt the river for fish and waterfowl. In addition, waterfowl are plentiful at the Pulp Mill ponds. Bald eagles have not been observed to forage for prey in the canals, although ospreys may forage there (John Prange, retired BLM biologist, Missoula, 28 May 2002, pers. comm.).

Eagles also use ground squirrels as forage. There appears to be an abundant food supply for both nesting and overwintering bald eagles in the area (John Prange, retired BLM biologist, Missoula, 28 May 2002, pers. comm.). Waterfowl are available in the winter, and the river is rarely iced-over, so fish are still available.

## 6.5 EFFECTS ANALYSIS

### 6.5.1 BITTERROOT RIVER

No nesting bald eagles were reported along the Bitterroot River near the action area.

### 6.5.2 CLARK FORK

Three bald eagle nests have been reported along the middle Clark Fork downstream from Missoula to Frenchtown, as described above. These nesting sites were used in 2001; however, no estimate of the reproductive success of these nests is available.

A prey base comprised of several species of salmonids, cyprinids, and catostomids is available in the Clark Fork, in addition to waterfowl, small mammals, and carrion. As described in Chapter 5, the diversion of 115 cfs from the Clark Fork for the Frenchtown Project results in the estimated diversion of 1.15 percent of the flow, with the assumption that 1.15 percent of the fish in the river would be diverted. It is likely that bald eagles nesting along the middle Clark Fork have in the past obtained sufficient food in the form of fish from the Clark Fork, waterfowl, or carrion. Therefore, the continued operation and maintenance of the Frenchtown Project should not appreciably alter abundance and distribution of bald eagle prey. It is unknown how extensively bald eagles would forage for prey in the canals where conditions are more confined than along the relatively open expanses of larger rivers.

## 6.6 EFFECTS CONCLUSION

Continued routine operation and maintenance of project facilities would have no adverse effect on bald eagles at the several nesting territories where they have been documented because there are abundant and adequate prey populations to support current nesting and winter use. Bald eagles have maintained nests and reproduced successfully under current project operations. Continued operations of the Big Flat Unit and the Frenchtown Project may affect habitats for the local fish and/or waterfowl prey base through diversion of a small percentage of the river flow, but they are not likely to adversely affect nesting and wintering bald eagle populations.

It is not known if nesting bald eagles in the area would utilize as food any fish diverted into the irrigation canals. During the overwintering period, the irrigation projects are not operating, no water is diverted, and river conditions in the project action area are essentially unmodified. Since only a small percentage of the flow from the rivers is diverted, there should be essentially no effect on existing riparian communities, including cottonwood trees used for perches. In addition, operation and maintenance activities are not expected to remove large gallery cottonwoods.

Reclamation concludes that the continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project may affect, but is not likely to adversely affect, the continued existence of the bald eagle along the middle Clark Fork, Missoula County, Montana.

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# CHAPTER 7
# YELLOW-BILLED CUCKOO

The yellow-billed cuckoo *Coccyzus americanus*, a candidate species, is a member of the avian family *Cuculidae* and order *Cuculiformes*. Six species of *Cuculidae* breed in the United States; two species breed west of the Continental Divide, the yellow-billed cuckoo and the greater roadrunner. The approximately 128 members of *Cuculidae* share the common feature of a zygodactyl foot, in which two toes point forward and two toes point backward. Most species have moderate to heavy bills, somewhat elongated bodies, a ring of colored, bare skin around the eye, and loose plumage. The yellow-billed cuckoo is a slender, medium-sized bird of about 12 inches (30 cm) in length weighing about 2 ounces (60 grams). It has a stout, slightly down-curved blue-black bill with a yellow base on its lower mandible. Both cuckoo species in Montana (the black-billed cuckoo east is found of the Continental Divide) are highly reliant on healthy riparian ecosystems, and populations of both species are essentially unmonitored. Yellow-billed cuckoo populations elsewhere in the West (for example, in Arizona and California) have undergone drastic population declines due to habitat loss and degradation (Montana Bird Conservation Plan 2000).

## 7.1 STATUS, DISTRIBUTION, LIFE HISTORY, AND HABITAT REQUIREMENTS

### 7.1.1 STATUS

The yellow-billed cuckoo is currently a FWS candidate species in Missoula County, Montana.

### 7.1.2 DISTRIBUTION

The western population of yellow-billed cuckoo historically ranged from southern Canada to northern Mexico and all states west of the Continental Divide and the eastern Rio Grande Basin. Populations of the western yellow-billed cuckoo have declined markedly during the last century, and the current breeding range is smaller, with populations much reduced and in some areas extirpated (Federal Register 2000). West of the Continental Divide, loss and degradation of western riparian habitats appears to be a primary factor for these declines (Federal Register 2000).

In western Montana, the yellow-billed cuckoo appears to have always been west of the Continental Divide. Only three specimens have been collected since the early 1960s (Center for Biological Diversity 2001a). A few birds have been sighted recently in the Flathead drainage further north and along Wolf Creek in north-central Wyoming just south of the Montana-Wyoming border (Bennett 2001). The yellow-billed cuckoo recently sighted in Montana may have been a transient bird since breeding of these birds has not been documented in western Montana (Montana Natural Heritage Program (MNHP) 2002).

The yellow-billed cuckoo breeds from interior California, east to northern Utah, Minnesota, and New Brunswick, and south to southern Baja California, Mexico, and the Gulf Coast. It winters in South America east of the Andes (Hughes 1999). The northern limit of breeding in the western interior states is reportedly southern Idaho, although there is suspected breeding in southeastern Montana. Sightings of yellow-billed cuckoos in the northern Rockies, especially in Missoula County, Montana, may be a transient bird. Hughes (1999) does not list northwestern Montana as breeding grounds but does note breeding in southeastern and southwestern Idaho. Suspected transient yellow-billed cuckoos have been recorded from Saskatchewan, Alberta, and Alaska (Hughes 1999). The yellow-billed cuckoo is listed as a migratory/transient and/or nonbreeding summer (June, July) resident of Montana by MNHP (2002).

Although a western population of the yellow-billed cuckoo is recognized as a subspecies and distinguished from an eastern subspecies, this distinction is equivocal and the taxonomic question has not been resolved (Federal Register 2000). The western continental United States distinct population segment of the yellow-billed cuckoo historically occurred in Arizona, California, Colorado, North Dakota, Montana, New Mexico, Nevada, Oregon, Texas, Utah, Washington, and Wyoming. In Oregon they were apparently extirpated by 1945, and in western Washington by 1934. There have been several accidental records during the breeding season since then (Hughes 1999). At present the strongest western populations occur in Arizona (Federal Register 2000). Populations in other states are not well documented, due to the somewhat skulking and furtive behavior of the bird.

Several factors were listed as contributing to the decline of yellow-billed cuckoos, including loss of habitat, overgrazing, tamarisk invasion of riparian areas, logging, pesticides and river management (Federal Register 2000).

### 7.1.3 LIFE HISTORY

Western yellow-billed cuckoos breed in large blocks of riparian habitats, particularly woodlands with cottonwoods and willows. The birds arrive on their breeding grounds in mid-June and leave for their South American wintering area by late August. Dense understory foliage appears to be an important factor in nest site selection. Nesting west of the Continental Divide occurs almost exclusively close to water. Nesting peaks later than in most co-occurring bird species (mid-June through August) and may be triggered by an abundance of the cicadas, katydids, caterpillars, or other large prey that form the bulk of the species' diet.

Clutch size is usually two or three large, heavy, blue eggs (Center for Biological Diversity 2001b). Development of the young is very rapid, with a breeding cycle of 17 days from egg-laying to fledgling of young (Hughes 1999); they have the shortest combined incubation/nestling period of any bird species. This short time period allows western yellow-billed cuckoos to time nesting around outbreaks of cicadas and caterpillars, some of their preferred food. Cottonwood tree stands are an important foraging habitat in areas where the species has been studied in California.

Yellow-billed cuckoos build nests in trees or shrubs; they usually raise their own young, but they are "facultative brood parasites," occasionally laying eggs in the nests of other yellow-billed cuckoos or other bird species. Their nests usually are 1.2 to 2.4 meters (4 to 8 feet) high in the tree or shrub, ranging from 0.9 to 6 meters (3 to 20 feet) (Ehrlich et al. 1988).

Yellow-billed cuckoos eat mainly caterpillars, and their populations tend to vary in response to tent caterpillar densities. They will also eat numerous other insects, some fruits, and occasionally small lizards and frogs (Ehrlich et al. 1988), but generally more than 75 percent of their diet is made up of grasshoppers and caterpillars. They have a unique ability to eat hairy and spiny caterpillars.

### 7.1.4 HABITAT REQUIREMENTS

The western yellow-billed cuckoo prefers willow and cottonwood stands in riparian river bottoms with a dense shrub understory for nesting and concealment. Old successional stage of forested riparian is better habitat. An overstory of tall deciduous forest (especially cottonwood) with canopy closure and a midstory of deciduous shrubs are necessary habitat constituents. Cuckoos will also use deciduous shrubs (e.g., willow, alder), but only if there are adjacent tall trees present. The tall trees are used for foraging and song perches. Cuckoos nest in low to mid layers. The tall tree corridor generally needs to be more than one or two trees wide.

Forested riparian patches general must be larger than 16 hectares (40 acres), with a minimum of 20 to 25 percent of this area having tall trees with a closed canopy; smaller areas do not generally support nesting cuckoos.

Water in the form of streams or ponds and lakes is usually present at most nest territories. Territories are usually along flood plains of larger streams at lower elevations. The humid, shady environment provides a protective microclimate that protects nesting birds, eggs, and fledglings from desiccation (Center for Biological Diversity 2001b).

## 7.2 FACTORS CONTRIBUTING TO SPECIES DECLINE

In areas where the birds do breed successfully, factors for their decline include habitat loss and fragmentation from flooding and dewatering, with extremely high flows removing vegetation and extended periods of low flows likely drying up yellow-billed cuckoo habitat; overgrazing, which contributes to the loss of subcanopy vegetation and cottonwood regeneration; and river recreational activity with associated disturbance. Habitat loss from floodplain development may also impact the species. Long-term irrigated agriculture and other development along the rivers has reduced the abundance of the expansive cottonwood and willow habitat preferred and required by the yellow-billed cuckoo.

## 7.3 CURRENT ENVIRONMENTAL CONDITIONS

The project action area includes the lower Bitterroot River and the Clark Fork near Missoula, Montana. The FWS lists the yellow-billed cuckoo as a candidate species in Missoula County. As described above in Chapter 4, operation and maintenance of the two projects withdraw 25 cfs of water from the Bitterroot River and 115 cfs from the Clark Fork.

Breeding of yellow-billed cuckoo has not been documented in the action area of these projects in Montana. In fact, the yellow-billed cuckoo is considered a non-breeding summer resident in Montana (MNHP 2002). The sighting of yellow-billed cuckoos in Montana occurred farther north in the Flathead drainage. The most recent yellow-billed cuckoo observation west of the continental divide in Montana was a few miles south from Missoula in Stevensville (Ravalli County) in 1997 (Jay Frederick, USFWS, Helena, 20 June 2002, pers. comm.). Two earlier sightings (1988) several miles to the east of Stevensville were in the foothills of the Sapphire Mountains. The climatic conditions around Missoula may be similar to those in the Stevensville area, and if so, may provide a suitable area for migrating yellow-billed cuckoos.

The preferred habitat for yellow-billed cuckoos of expansive mature cottonwood galleries with relatively thick undergrowth near riparian areas is not present in the action area along the middle Clark Fork and lower Bitterroot River just west from Missoula. As noted above, yellow-billed cuckoos generally have large home ranges, around 16 hectares (40 acres); smaller areas do not provide sufficient food and cover for cuckoos. Throughout the range of the yellow-billed cuckoo, fragmentation of cottonwood forests has resulted in many areas with patch sizes below the required minimum. Much of the area around the Big Flat Unit is developed into small ranches or large home sites. The Frenchtown Project likewise is substantially developed with virtually no suitable habitat.

## 7.4 EFFECTS ANALYSIS

Riparian forests of cottonwoods and a dense understory no smaller than 16 hectares (40 acres), with a minimum of 20 to 25 percent of this area having tall trees with a closed canopy, are not present in the proposed action area. Riparian areas with tall trees, but incomplete mid and lower stories, might be used as migratory corridors but will not provide the necessary environmental conditions for successful cuckoo reproduction.

The particular combination of dense midlevel vegetation near water with substantial tall cottonwood trees that provides a humid microclimate is not present in the action area. Although there does not appear to be sufficient habitat to support successful yellow-billed cuckoo reproduction near the projects, the existing limited gallery forests along the canals may provide feeding or sheltering habitat for occasional occurrence of this species.

Cottonwoods do occur in some locations in the action area, the most obvious places are near the upper portion of the irrigated area of the Big Flat Unit and on the island that forms the side channel of the Clark Fork near the Frenchtown Diversion Dam, but these areas have relatively sparse understory that may be due to grazing, periodic flooding or other management activities. It is not known if historical cottonwood stands were more expansive with dense understory in this area, but with the generally arid climate and average rainfall of 9 to 19 inches, there may not have been the necessary climatic or environmental conditions for development of preferred habitat for yellow-billed cuckoo to nest successfully and fledge young. Urbanized areas adjacent to preferred dense forested riparian habitat maybe reduce cuckoo use, as cuckoos are susceptible to human disturbance. Pesticides have been documented to be a problem for yellow-billed cuckoos; pesticides reduce potential prey items, and thinning of egg shells has been reported.

The environmental conditions that would support successful reproduction of yellow-billed cuckoo do not exist along the mainstem middle Clark Fork and Bitterroot River in Missoula County within the action area, although some of the conditions required of a migratory corridor exist.

## 7.5 EFFECTS CONCLUSION

Continued routine operation and maintenance of the Big Flat Unit of the Missoula Valley Project and the Frenchtown Project will have no effect on yellow-billed cuckoos. In addition, operations and maintenance activities will not involve removal of mature cottonwoods or understory vegetation. The recent Montana sighting occurred farther north in the Flathead drainage and south in Ravalli County. Montana is generally north of the historic breeding range of the yellow-billed cuckoo. The few birds documented in northern areas were thought to be nonbreeding transients. The large expanses of preferred habitat (16 hectares or 40 acres) consisting of cottonwood galleries with dense understory near streams or ponds and lakes is not present in the project action area near Missoula.

Reclamation concludes that the continued routine operation and maintenance of the Big Flat Unit and the Frenchtown Project will have no effect on yellow-billed cuckoos.

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# CHAPTER 8
# NON-FEDERAL CONTEMPORANEOUS AND CUMULATIVE EFFECTS

Numerous non-Federal, state, local government and other activities that are contemporaneous with Reclamation's proposed action contribute to the current environmental conditions of the ESA-listed species. Cumulative actions are future non-Federal actions that are reasonably certain to take place that could affect the condition of the species in this evaluation. Many non-Federal contemporaneous actions have an impact on the ESA species considered in this biological assessment and those impacts affect the environmental baseline. The non-Federal actions discussed below are expected to occur annually or with sufficient frequency to have recurring or continuous impacts. Private irrigation of lands from natural river flows and expected continued residential development are examples of major non-Federal contemporaneous actions and cumulative effects, respectively.

## 8.1 NON-FEDERAL IRRIGATION

The development of irrigation in the middle Clark Fork region is discussed in chapter 1. Four private irrigation districts that divert Clark Fork water in this area include the Grass Valley-French Irrigation District, the Hellgate Valley Irrigation District, the Orchard Homes Irrigation District, and the Missoula Irrigation District The Grass Valley-French Irrigation District is comparable to the Frenchtown Irrigation District, while the others are smaller. These small irrigation projects are expected to continue to operate in the future, but it is unknown what effect increasing urbanization and development of the area will have on these projects.

## 8.2 POPULATION GROWTH

Other than irrigation, most contemporaneous and cumulative impacts in the middle Clark Fork are associated with population growth and the resulting habitat reduction or degradation that generally has a negative impact on listed species. Some examples include increased point and non-point pollution. The population of the city of Missoula increased 32.9 percent from 42,918 in 1990 to 57,053 in 2000 (Missoulian 2001). Similarly, the population of Missoula County increased 13.5 percent from 1990 to 1999. In addition to the direct impacts to riverine riparian areas, the increasing population and its associated residential developments place additional demands on electricity, water, and sewage services. Suburban development for rural home-sites has increased in recent years. Area lands continuing to be subdivided into homesites ranging from 1 to 20 acres in size. Subdividing and urban development are expected to continue.

Increased point and non-point pollution from increased population, urbanization, and residential development also degrade habitat and affect listed species.

Thus, the increased population directly and indirectly adversely affects ESA-listed species and their habitats.

## 8.3 MUNICIPAL AND INDUSTRIAL WATER

Municipal and industrial water use in the Bitterroot River and Clark Fork is expected to continue to serve a growing area. Increased municipal and industrial water usage can result in habitat and water quality degradation, as noted in the water quality section of the environmental baseline that describes the effect that wastewater treatment has on concentrations of nutrients in the Clark Fork basin. As noted above, the population of the city of Missoula increased 32.9 percent from 1990 to 2000 (Missoulian 2001). Similarly, the population of Missoula County increased 13.5 percent from 1990 to 1999 (Missoula County 2001). Continued growth will result in additional demands on water resources.

## 8.4 OTHER MONTANA STATE AND NON-FEDERAL ACTIVITIES

### 8.4.1 MONTANA BULL TROUT PLAN

The State of Montana has developed a bull trout plan to bring this species back from its present low levels in some basins. Bull trout populations are currently scattered in various cold water tributaries of the Bitterroot River and Clark Fork, and seasonally in low numbers in the mainstems of these rivers. Montana Fish, Wildlife and Parks (MFWP) is encouraging the installation of fish screens at irrigation diversions in the basins to reduce the incidence of various species of fish being diverted into unfavorable habitat. Fish passage improvements at Milltown Dam is being considered.

## 8.5 CUMULATIVE EFFECTS LITERATURE CITED

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# CHAPTER 9
# SUMMARY OF EFFECTS

Reclamation's proposed action, the continued routine operation and maintenance of the Big Flat Unit, Missoula Valley Project, and the Frenchtown Project, will have no effect on the following species:

- Grizzly bear
- Gray wolf
- Canada lynx
- Water howellia
- Yellow-billed cuckoo

The proposed action may affect and is likely to adversely affect bull trout; however, the action will not jeopardize the continued existence of the Columbia River distinct population segment of bull trout.

The proposed action may affect, but is not likely to adversely affect, the bald eagle.

# ATTACHMENT A

Response to Reclamation's request for a list of Federally endangered and threatened species that may occur on the Big Flat Unit of the Missoula Valley Project on the Bitterroot River and the Frenchtown Project on the Clark Fork River. (U.S. Fish and Wildlife letter dated February 6, 2002, to Dr. Stephen Grabowski, Bureau of Reclamation).

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# United States Department of the Interior

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File: M.04 Big Flat Unit and Frenchtown Projects

Dr. Stephen Grabowski
PN-6540
Bureau of Reclamation
1150 N. Curtis Road, Suite 100
Boise, ID 83706-1234

6 February 2002

Dear Dr. Grabowski:

This letter responds to the January 31 2002 request for a list of Federally endangered and threatened species that may occur on the Big Flat Unit of the Missoula Valley Project on the Bitterroot River and the Frenchtown Project on the Clark Fork River. This list is provided for the operation and maintenance of these projects.

On November 22, 1994, the Service approved a plan to establish nonessential experimental populations of wolves in Yellowstone National Park and central Idaho. Rules published in the *Federal Register* designate gray wolves in each area as nonessential experimental populations under section 10(j) of the Act. Within the designated nonessential experimental population areas described and depicted in the rules, all gray wolves will be managed in accordance with the provisions outlined the rules which include the following:

a) For section 7 consultation purposes wolves designated as nonessential experimental that are within the boundaries of any unit of the National Park or National Wildlife Refuge systems are treated as a threatened species. As such, the section 7 procedures for listed species would apply to Federal actions within National Parks and National Wildlife Refuges.

b) Wolves designated as nonessential experimental that are not within units of the National Park or National Wildlife Refuge systems but are within the boundaries of the nonessential experimental population area are treated as proposed species for section 7 purposes. As such, Federal agencies are only required to confer with the Service when they determine that an action they authorize fund or carry out "is likely to jeopardize the continued existence" of the species.

c) Wolves occurring outside the central Idaho and Yellowstone nonessential experimental population areas retain their endangered status.

The Missoula Valley Project is within the central Idaho nonessential experimental population area. The Frenchtown Project occurs partially within and partially outside the central Idaho nonessential experimental population area. The central Idaho experimental population area includes portions of Idaho south of Interstate 90 and west of Interstate 15. It also includes a corner of Montana south of Interstate 90, east of Highway 93 as it runs south of Missoula, south of Highway 12 to Lolo pass, and west of Interstate 15. The experimental population area for the Yellowstone region includes the entire State of Wyoming, a portion of southeastern Idaho east of Interstate 15, and a portion of Montana east of Interstate 15 and south of the Missouri River.

The Service recommends that the Bureau of Reclamation analyze the impacts populations of fish and wildlife, when complying with the requirements of the National Environmental Policy Act (NEPA) and other relevant land management statutes. Any protective measures in addition to those outlined in the final rules for managing the nonessential experimental wolf populations, or additional review procedures, are at the discretion of the Bureau of Reclamation.

In accordance with section 7(c) of the Act, the Service has determined that the following listed, proposed, and candidate species are present in Missoula county:

| *Species* | *Status* | *Expected occurrence* |
|---|---|---|
| bald eagle (*Haliaeetus leucocephalus*) | threatened | Resident year-long, spring/fall migrant, nesting, near or along major waterways |
| gray wolf (*Canis lupus*) | Nonessential experimental | Resident, transient |
| grizzly bear (*Ursus arctos horribilis*) | threatened | Transient |
| Canada lynx (*Lynx canadensis*) | threatened | Resident |
| water howellia (*Howellia aquatilis*) | threatened | Wetlands |
| yellow-billed cuckoo (*Coccyzus americanus*) | candidate | riparian areas with cottonwoods and willows |
| bull trout (*Salvelinus confluentus*) | threatened | Resident in cold water streams, rivers, lakes |

Section 7(c) of the Act requires that Federal agencies proposing major construction activities complete a biological assessment to determine the effects of the proposed actions on listed and proposed species and use the biological assessment to determine whether formal consultation is required. A major construction activity is defined as "a construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in the National Environmental Policy Act" (50 CFR Part 402). If a biological assessment is not required (i.e. all other actions), the Federal agency is still required to review their proposed activities to determine whether listed species may be affected. If such a determination is made, formal consultation with the Service is required.

For those actions wherein a biological assessment is required, the assessment should be completed within 180 days of initiation. This time frame can be extended by mutual agreement between the Federal agency or its designated non-Federal representative and the Service. If an assessment is not initiated within 90 days, this list of threatened and endangered species should be verified with the Service prior to initiation of the assessment. The biological assessment may be undertaken as part of the Federal agency's compliance of section 102 of the NEPA and incorporated into the NEPA documents. We recommend that biological assessments include the following:

1. A description of the project.
2. A description of the specific area that may be affected by the action.

3. The current status, habitat use, and behavior of T/E species in the project area.
4. Discussion of the methods used to determine the information in Item 3.
5. An analysis of the affects of the action on listed species and proposed species and their habitats, including an analysis of any cumulative effects.
6. Coordination/mitigation measures that will reduce/eliminate adverse impacts to T/E species.
7. The expected status of T/E species in the future (short and long term) during and after project completion.
8. A determination of "May affect, likely to adversely affect" or "May affect, not likely to adversely affect" for listed species.
9. A determination of "is likely to jeopardize" or "is not likely to jeopardize" for proposed species.
10. Citation of literature and personal contacts used in developing the assessment.

If it is determined that a proposed program or project "is likely to adversely affect" any listed species, formal consultation should be initiated with this office. If it is concluded that the project "is not likely to adversely affect" listed species, the Service should be asked to review the assessment and concur with the determination of no adverse effect.

Pursuant to section 7(a) (4) of the Act, if it is determined that any proposed species may be jeopardized, the Federal agency should initiate a conference with the Service to discuss conservation measures for those species. Although candidate species have no legal status and are accorded no protection under the Act, they are included here to alert your agency of potential proposals or listings.

A Federal agency may designate a non-Federal representative to conduct informal consultation or prepare biological assessments. However, the ultimate responsibility for section 7 compliance remains with the Federal agency and written notice should be provided to the Service upon such a designation. We recommend that Federal agencies provide their non-Federal representatives with proper guidance and oversight during preparation of biological assessments and evaluation of potential impacts to listed species.

Section 7(d) of the Act requires that the Federal agency and permit/license applicant shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed.

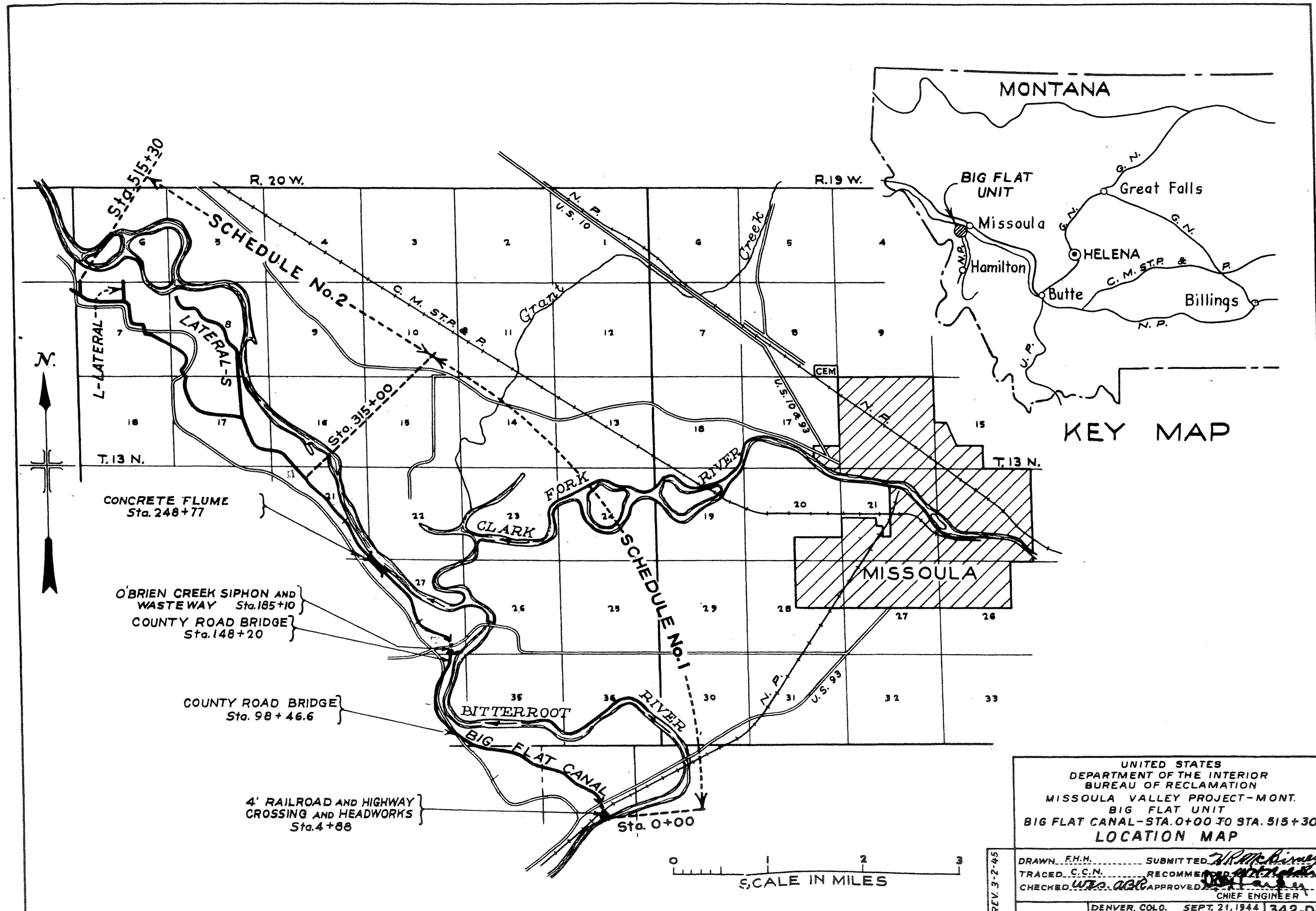
If we can be of further assistance, please contact Dan Downing at dan_downing@fws.gov or by phone 406.449.5225 X 221. Your interest and cooperation in meeting our joint responsibilities under the Endangered Species Act are appreciated.

Sincerely,

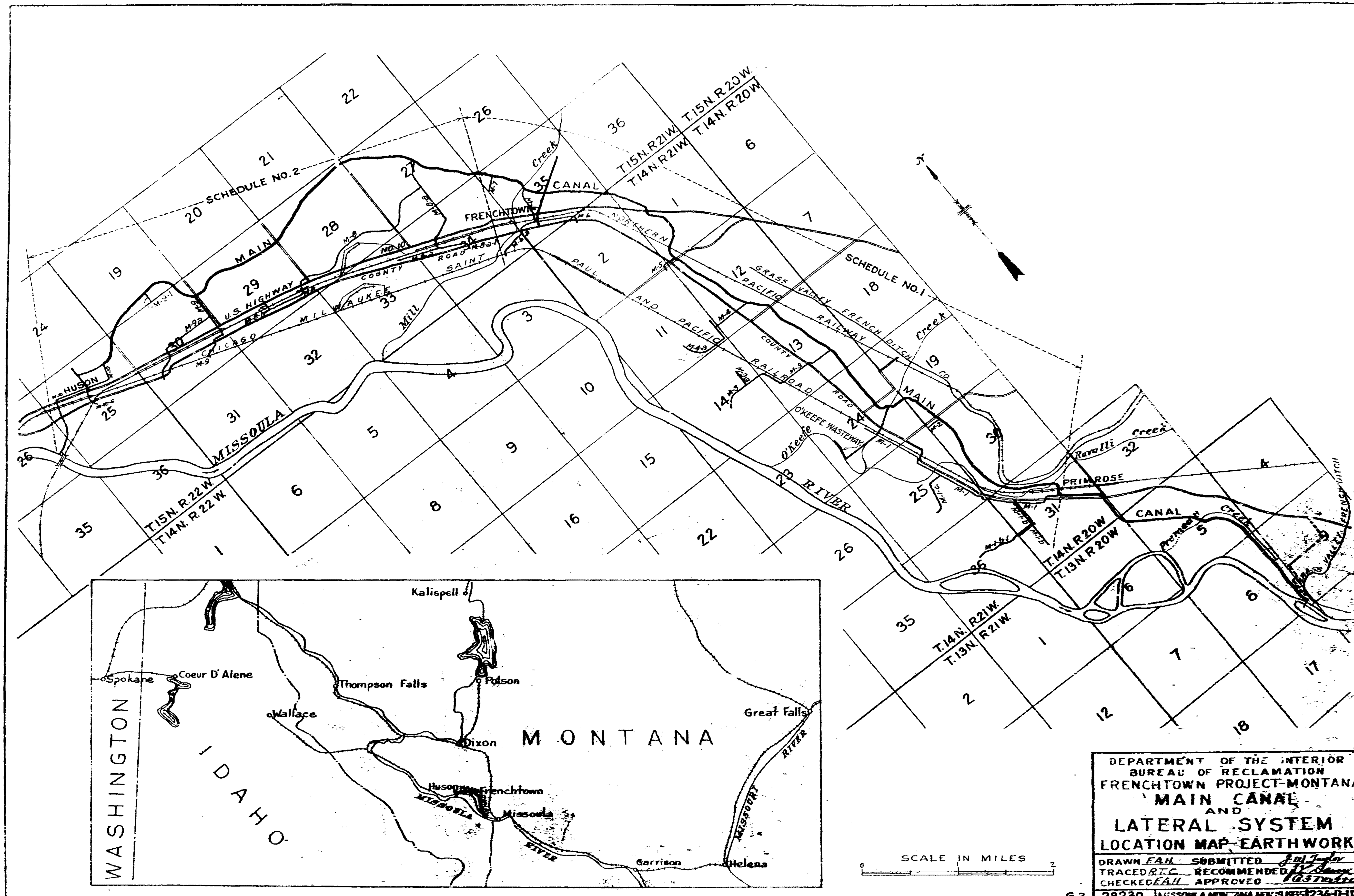
R. Mark Wilson
Field Supervisor

# ATTACHMENT B

Big Flat Canal - Sta. 0+00 to Sta. 515+30, Location Map and Frenchtown Project, Montana, Main Canal and Lateral System Location Map, Earthwork.



KEY MAP
MONTANA
BIG FLAT UNIT
Missoula
Great Falls
HELENA
Hamilton
Butte
Billings
G. N.
C. M. ST. P. & P.
N. P.
U. P.
R. 20 W.
R. 19 W.
T. 13 N.
N.
Sta. 515+30
SCHEDULE No. 2
SCHEDULE No. 1
Sta. 315+00
Sta. 0+00
L-LATERAL
LATERAL-S
C. M. ST. P. & P.
N. P.
U.S. 10
U.S. 10 & 93
U.S. 93
Grant Creek
CLARK FORK RIVER
BITTERROOT RIVER
BIG FLAT CANAL
MISSOULA
CEM
CONCRETE FLUME Sta. 248+77
O'BRIEN CREEK SIPHON AND WASTEWAY Sta. 185+10
COUNTY ROAD BRIDGE Sta. 148+20
COUNTY ROAD BRIDGE Sta. 98+46.6
4' RAILROAD AND HIGHWAY CROSSING AND HEADWORKS Sta. 4+88
0 1 2 3
SCALE IN MILES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
MISSOULA VALLEY PROJECT-MONT.
BIG FLAT UNIT
BIG FLAT CANAL-STA. 0+00 TO STA. 515+30
LOCATION MAP
DRAWN F.H.H.
TRACED C.C.N.
CHECKED
SUBMITTED
RECOMMENDED
APPROVED
CHIEF ENGINEER
REV. 3-2-45
DENVER, COLO. SEPT. 21, 1944
342-D-1


SCHEDULE NO. 2
SCHEDULE NO. 1
MAIN CANAL
FRENCHTOWN
HUSON
PRIMROSE
U.S. HIGHWAY
COUNTY ROAD
NORTHERN PACIFIC RAILWAY
CHICAGO MILWAUKEE SAINT PAUL AND PACIFIC RAILROAD
GRASS VALLEY FRENCH DITCH CO.
O'KEEFE WASTEWAY
O'Keefe Creek
Mill Creek
Ravalli Creek
Primeau Creek
MISSOULA RIVER
T.15N. R.22W.
T.14N. R.22W.
T.15N. R.21W.
T.14N. R.21W.
T.15N. R.20W.
T.14N. R.20W.
T.13N. R.20W.
T.14N. R.21W.
T.13N. R.21W.
WASHINGTON
IDAHO
MONTANA
Spokane
Coeur D'Alene
Kalispell
Thompson Falls
Polson
Wallace
Dixon
Great Falls
Huson
Frenchtown
Missoula
Garrison
Helena
MISSOURI RIVER
SCALE IN MILES
0
2
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
FRENCHTOWN PROJECT-MONTANA
MAIN CANAL AND LATERAL SYSTEM
LOCATION MAP-EARTHWORK
DRAWN F.A.H. SUBMITTED
TRACED R.T.C. RECOMMENDED
CHECKED F.A.H. APPROVED
G-3
28230
MISSOULA, MONTANA, NOV. 19, 1935
234-D-114

# ATTACHMENT C

Water Quality Sampling at:

- Bitterroot River near O'Brien Creek Confluence
- Clark Fork River near Petty Creek Confluence
- Clark Fork River near Deep Creek Confluence

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| Act Start | | Characteristic Name | Res Val | Res Unit | Result Val Text | Sampl Frac Type |
|---|---|---|---|---|---|---|
| 1/15/1992 | 13:00:00 | Alkalinity, Carbonate as CaCO3 | 80 | mg/l | 80 | Total |
| 2/12/1992 | 11:30:00 | Alkalinity, Carbonate as CaCO3 | 70 | mg/l | 70 | Total |
| 3/11/1992 | 12:20:00 | Alkalinity, Carbonate as CaCO3 | 53 | mg/l | 53 | Total |
| 4/8/1992 | 13:45:00 | Alkalinity, Carbonate as CaCO3 | 43 | mg/l | 43 | Total |
| 4/22/1992 | 14:20:00 | Alkalinity, Carbonate as CaCO3 | 31 | mg/l | 31 | Total |
| 5/20/1992 | 12:30:00 | Alkalinity, Carbonate as CaCO3 | 22 | mg/l | 22 | Total |
| 6/6/1992 | 12:00:00 | Alkalinity, Carbonate as CaCO3 | 19 | mg/l | 19 | Total |
| 6/10/1992 | 13:30:00 | Alkalinity, Carbonate as CaCO3 | 41 | mg/l | 41 | Total |
| 7/15/1992 | 12:15:00 | Alkalinity, Carbonate as CaCO3 | 68 | mg/l | 68 | Total |
| 8/11/1992 | 8:30:00 | Alkalinity, Carbonate as CaCO3 | 87 | mg/l | 87 | Total |
| 9/14/1992 | 13:00:00 | Alkalinity, Carbonate as CaCO3 | 129 | mg/l | 129 | Total |
| 10/20/1992 | 13:20:00 | Alkalinity, Carbonate as CaCO3 | 71 | mg/l | 71 | Total |
| 11/17/1992 | 12:35:00 | Alkalinity, Carbonate as CaCO3 | 85 | mg/l | 85 | Total |
| 12/15/1992 | 13:15:00 | Alkalinity, Carbonate as CaCO3 | 67 | mg/l | 67 | Total |
| 12/16/1992 | 13:15:00 | Alkalinity, Carbonate as CaCO3 | 130 | mg/l | 130 | Total |
| 1/12/1993 | 13:40:00 | Alkalinity, Carbonate as CaCO3 | 81.8 | mg/l | 81.8 | Total |
| 2/17/1993 | 13:40:00 | Alkalinity, Carbonate as CaCO3 | 90.4 | mg/l | 90.4 | Total |
| 3/18/1993 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 124 | mg/l | 124 | Total |
| 4/6/1993 | 14:30:00 | Alkalinity, Carbonate as CaCO3 | 44.6 | mg/l | 44.6 | Total |
| 4/21/1993 | 13:15:00 | Alkalinity, Carbonate as CaCO3 | 49.1 | mg/l | 49.1 | Total |
| 5/5/1993 | 13:10:00 | Alkalinity, Carbonate as CaCO3 | 36.8 | mg/l | 36.8 | Total |
| 5/18/1993 | 13:45:00 | Alkalinity, Carbonate as CaCO3 | 0 | mg/l | *Non-detect | Total |
| 6/15/1993 | 13:30:00 | Alkalinity, Carbonate as CaCO3 | 29 | mg/l | 29 | Total |
| 8/19/1993 | 10:00:00 | Alkalinity, Carbonate as CaCO3 | 63.3 | mg/l | 63.3 | Total |
| 11/16/1993 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 73 | mg/l | 73 | Total |
| 2/15/1994 | 13:30:00 | Alkalinity, Carbonate as CaCO3 | 76.3 | mg/l | 76.3 | Total |
| 5/17/1994 | 12:30:00 | Alkalinity, Carbonate as CaCO3 | 13.7 | mg/l | 13.7 | Total |
| 8/17/1994 | 20:00:00 | Alkalinity, Carbonate as CaCO3 | 95 | mg/l | 95 | Total |
| 11/16/1994 | 15:15:00 | Alkalinity, Carbonate as CaCO3 | 70 | mg/l | 70 | Total |
| 2/15/1995 | 13:00:00 | Alkalinity, Carbonate as CaCO3 | 64 | mg/l | 64 | Total |
| 5/16/1995 | 13:00:00 | Alkalinity, Carbonate as CaCO3 | 30 | mg/l | 30 | Total |
| 8/17/1995 | 19:00:00 | Alkalinity, Carbonate as CaCO3 | 67 | mg/l | 67 | Total |
| 2/27/1996 | 12:45:00 | Alkalinity, Carbonate as CaCO3 | 45 | mg/l | 45 | Total |
| 5/14/1996 | 13:15:00 | Alkalinity, Carbonate as CaCO3 | 0 | mg/l | *Non-detect | Total |
| 5/14/1996 | 13:15:00 | Alkalinity, Carbonate as CaCO3 | 0 | mg/l | *Non-detect | |
| 2/12/1992 | 11:30:00 | Bicarbonate | 85 | mg/l | 85 | |
| 3/11/1992 | 12:20:00 | Bicarbonate | 65 | mg/l | 65 | |
| 4/8/1992 | 13:45:00 | Bicarbonate | 52 | mg/l | 52 | |
| 4/22/1992 | 14:20:00 | Bicarbonate | 38 | mg/l | 38 | |
| 5/20/1992 | 12:30:00 | Bicarbonate | 27 | mg/l | 27 | |
| 6/6/1992 | 12:00:00 | Bicarbonate | 23 | mg/l | 23 | |
| 6/10/1992 | 13:30:00 | Bicarbonate | 50 | mg/l | 50 | |
| 11/17/1992 | 12:35:00 | Bicarbonate | 104 | mg/l | 104 | |
| 12/15/1992 | 13:15:00 | Bicarbonate | 82 | mg/l | 82 | |
| 1/15/1992 | 13:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 11:30:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 12:20:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 13:45:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 14:20:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 12:30:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 6/6/1992 | 12:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 13:30:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 12:15:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 13:00:00 | Calcium | 19.7 | mg/l | 19.7 | Dissolved |
| 2/12/1992 | 11:30:00 | Calcium | 16.2 | mg/l | 16.2 | Dissolved |
| 3/11/1992 | 12:20:00 | Calcium | 13.6 | mg/l | 13.6 | Dissolved |
| 4/8/1992 | 13:45:00 | Calcium | 9.9 | mg/l | 9.9 | Dissolved |
| 4/22/1992 | 14:20:00 | Calcium | 10.6 | mg/l | 10.6 | Dissolved |
| 5/20/1992 | 12:30:00 | Calcium | 5.6 | mg/l | 5.6 | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 6/6/1992 | 12:00:00 | Calcium | 4.8 | mg/l | 4.8 | Dissolved |
| 6/10/1992 | 13:30:00 | Calcium | 10.5 | mg/l | 10.5 | Dissolved |
| 7/15/1992 | 12:15:00 | Calcium | 16.79 | mg/l | 16.79 | Dissolved |
| 8/11/1992 | 8:30:00 | Calcium | 25.59 | mg/l | 25.59 | Dissolved |
| 9/14/1992 | 13:00:00 | Calcium | 22 | mg/l | 22 | Dissolved |
| 10/20/1992 | 13:20:00 | Calcium | 19.89 | mg/l | 19.89 | Dissolved |
| 11/17/1992 | 12:35:00 | Calcium | 17.59 | mg/l | 17.59 | Dissolved |
| 12/15/1992 | 13:15:00 | Calcium | 18.09 | mg/l | 18.09 | Dissolved |
| 2/12/1992 | 11:30:00 | Carbonate ion | 0 | mg/l | 0 | |
| 3/11/1992 | 12:20:00 | Carbonate ion | 0 | mg/l | 0 | |
| 4/8/1992 | 13:45:00 | Carbonate ion | 0 | mg/l | 0 | |
| 4/22/1992 | 14:20:00 | Carbonate ion | 0 | mg/l | 0 | |
| 5/20/1992 | 12:30:00 | Carbonate ion | 0 | mg/l | 0 | |
| 6/6/1992 | 12:00:00 | Carbonate ion | 0 | mg/l | 0 | |
| 6/10/1992 | 13:30:00 | Carbonate ion | 0 | mg/l | 0 | |
| 11/17/1992 | 12:35:00 | Carbonate ion | 0 | mg/l | 0 | |
| 12/15/1992 | 13:15:00 | Carbonate ion | 0 | mg/l | 0 | |
| 1/15/1992 | 13:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 11:30:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 12:20:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 13:45:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 14:20:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 12:30:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 6/6/1992 | 12:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 13:30:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 12:15:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 8/5/1994 | 3:30:00 | Dissolved Oxygen | 6.55 | mg/l | 6.55 | Dissolved |
| 8/5/1994 | 3:30:00 | Dissolved Oxygen | 6.55 | mg/l | 6.55 | Dissolved |
| 1/15/1992 | 13:00:00 | Hardness, Ca,Mg | 67 | mg/l | 67 | Total |
| 2/12/1992 | 11:30:00 | Hardness, Ca,Mg | 57 | mg/l | 57 | Total |
| 3/11/1992 | 12:20:00 | Hardness, Ca,Mg | 47 | mg/l | 47 | Total |
| 4/8/1992 | 13:45:00 | Hardness, Ca,Mg | 33 | mg/l | 33 | Total |
| 4/22/1992 | 14:20:00 | Hardness, Ca,Mg | 29 | mg/l | 29 | Total |
| 5/20/1992 | 12:30:00 | Hardness, Ca,Mg | 20 | mg/l | 20 | Total |
| 6/6/1992 | 12:00:00 | Hardness, Ca,Mg | 17 | mg/l | 17 | Total |
| 6/10/1992 | 13:30:00 | Hardness, Ca,Mg | 35 | mg/l | 35 | Total |
| 7/15/1992 | 12:15:00 | Hardness, Ca,Mg | 58 | mg/l | 58 | Total |
| 8/11/1992 | 8:30:00 | Hardness, Ca,Mg | 85 | mg/l | 85 | Total |
| 9/14/1992 | 13:00:00 | Hardness, Ca,Mg | 75 | mg/l | 75 | Total |
| 10/20/1992 | 13:20:00 | Hardness, Ca,Mg | 65 | mg/l | 65 | Total |
| 11/17/1992 | 12:35:00 | Hardness, Ca,Mg | 58 | mg/l | 58 | Total |
| 12/15/1992 | 13:15:00 | Hardness, Ca,Mg | 62 | mg/l | 62 | Total |
| 12/16/1992 | 13:15:00 | Hardness, Ca,Mg | 165.251 | mg/l | 165.251 | Total |
| 1/12/1993 | 13:40:00 | Hardness, Ca,Mg | 72.939 | mg/l | 72.939 | Total |
| 2/17/1993 | 13:40:00 | Hardness, Ca,Mg | 82.152 | mg/l | 82.152 | Total |
| 3/18/1993 | 14:00:00 | Hardness, Ca,Mg | 156.651 | mg/l | 156.651 | Total |
| 4/6/1993 | 14:30:00 | Hardness, Ca,Mg | 36.938 | mg/l | 36.938 | Total |
| 4/21/1993 | 13:15:00 | Hardness, Ca,Mg | 45.152 | mg/l | 45.152 | Total |
| 5/5/1993 | 13:10:00 | Hardness, Ca,Mg | 37.95 | mg/l | 37.95 | Total |
| 5/18/1993 | 13:45:00 | Hardness, Ca,Mg | 10.4 | mg/l | 10.4 | Total |
| 6/15/1993 | 13:30:00 | Hardness, Ca,Mg | 32.207 | mg/l | 32.207 | Total |
| 8/19/1993 | 10:00:00 | Hardness, Ca,Mg | 56.612 | mg/l | 56.612 | Total |
| 11/16/1993 | 14:00:00 | Hardness, Ca,Mg | 63.254 | mg/l | 63.254 | Total |
| 2/15/1994 | 13:30:00 | Hardness, Ca,Mg | 64.09 | mg/l | 64.09 | Total |
| 5/17/1994 | 12:30:00 | Hardness, Ca,Mg | 23.332 | mg/l | 23.332 | Total |
| 8/17/1994 | 20:00:00 | Hardness, Ca,Mg | 83.164 | mg/l | 83.164 | Total |
| 11/16/1994 | 15:15:00 | Hardness, Ca,Mg | 61.431 | mg/l | 61.431 | Total |
| 2/15/1995 | 13:00:00 | Hardness, Ca,Mg | 58.315 | mg/l | 58.315 | Total |
| 5/16/1995 | 13:00:00 | Hardness, Ca,Mg | 33.804 | mg/l | 33.804 | Total |
| 8/17/1995 | 19:00:00 | Hardness, Ca,Mg | 59.638 | mg/l | 59.638 | Total |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 2/27/1996 | 12:45:00 | Hardness, Ca,Mg | 42 | mg/l | 42 | Total |
| 5/14/1996 | 13:15:00 | Hardness, Ca,Mg | 19 | mg/l | 19 | Total |
| 5/18/1993 | 13:45:00 | Hardness, carbonate | 0 | Molal | *Non-detect | Total |
| 6/15/1993 | 13:30:00 | Hardness, carbonate | 1.9 | Molal | 1.9 | Total |
| 8/19/1993 | 10:00:00 | Hardness, carbonate | 3.3 | Molal | 3.3 | Total |
| 11/16/1993 | 14:00:00 | Hardness, carbonate | 3.7 | Molal | 3.7 | Total |
| 2/15/1994 | 13:30:00 | Hardness, carbonate | 3.8 | Molal | 3.8 | Total |
| 5/17/1994 | 12:30:00 | Hardness, carbonate | 1.4 | Molal | 1.4 | Total |
| 8/17/1994 | 20:00:00 | Hardness, carbonate | 4.9 | Molal | 4.9 | Total |
| 11/16/1994 | 15:15:00 | Hardness, carbonate | 3.6 | Molal | 3.6 | Total |
| 2/15/1995 | 13:00:00 | Hardness, carbonate | 3.4 | Molal | 3.4 | Total |
| 5/16/1995 | 13:00:00 | Hardness, carbonate | 2 | Molal | 2 | Total |
| 8/17/1995 | 19:00:00 | Hardness, carbonate | 3.5 | Molal | 3.5 | Total |
| 2/27/1996 | 12:45:00 | Hardness, carbonate | 2.4 | Molal | 2.4 | Total |
| 5/14/1996 | 13:15:00 | Hardness, carbonate | 1.1 | Molal | 1.1 | Total |
| 1/15/1992 | 13:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 11:30:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 12:20:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 13:45:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 14:20:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 12:30:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 6/6/1992 | 12:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 13:30:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 12:15:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 13:00:00 | Magnesium | 4.4 | mg/l | 4.4 | Dissolved |
| 2/12/1992 | 11:30:00 | Magnesium | 3.9 | mg/l | 3.9 | Dissolved |
| 3/11/1992 | 12:20:00 | Magnesium | 3.2 | mg/l | 3.2 | Dissolved |
| 4/8/1992 | 13:45:00 | Magnesium | 2.1 | mg/l | 2.1 | Dissolved |
| 4/22/1992 | 14:20:00 | Magnesium | 0.5 | mg/l | 0.5 | Dissolved |
| 5/20/1992 | 12:30:00 | Magnesium | 1.4 | mg/l | 1.4 | Dissolved |
| 6/6/1992 | 12:00:00 | Magnesium | 1.1 | mg/l | 1.1 | Dissolved |
| 6/10/1992 | 13:30:00 | Magnesium | 2.2 | mg/l | 2.2 | Dissolved |
| 7/15/1992 | 12:15:00 | Magnesium | 4 | mg/l | 4 | Dissolved |
| 1/15/1992 | 13:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 2/12/1992 | 11:30:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 3/11/1992 | 12:20:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 4/8/1992 | 13:45:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 4/22/1992 | 14:20:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 5/20/1992 | 12:30:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 6/6/1992 | 12:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 6/10/1992 | 13:30:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 7/15/1992 | 12:15:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 8/11/1992 | 8:30:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 9/14/1992 | 13:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 10/20/1992 | 13:20:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 11/17/1992 | 12:35:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 12/15/1992 | 13:15:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 12/16/1992 | 13:15:00 | Nitrogen, ammonia | 0.09 | mg/l | 0.09 | Dissolved |
| 1/12/1993 | 13:40:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/17/1993 | 13:40:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 3/18/1993 | 14:00:00 | Nitrogen, ammonia | 0.08 | mg/l | 0.08 | Dissolved |
| 4/6/1993 | 14:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 4/21/1993 | 13:15:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 5/5/1993 | 13:10:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 5/18/1993 | 13:45:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 6/15/1993 | 13:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 8/19/1993 | 10:00:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 11/16/1993 | 14:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/15/1994 | 13:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 5/17/1994 | 12:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 8/17/1994 | 20:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 11/16/1994 | 15:15:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/15/1995 | 13:00:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 5/16/1995 | 13:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 8/17/1995 | 19:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/27/1996 | 12:45:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 5/14/1996 | 13:15:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 1/15/1992 | 13:00:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/12/1992 | 11:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 3/11/1992 | 12:20:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 4/8/1992 | 13:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 4/22/1992 | 14:20:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 5/20/1992 | 12:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 6/6/1992 | 12:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 6/10/1992 | 13:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 7/15/1992 | 12:15:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/11/1992 | 8:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 9/14/1992 | 13:00:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 10/20/1992 | 13:20:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 11/17/1992 | 12:35:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 12/15/1992 | 13:15:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 12/16/1992 | 13:15:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 1/12/1993 | 13:40:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 2/17/1993 | 13:40:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 3/18/1993 | 14:00:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 4/6/1993 | 14:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 4/21/1993 | 13:15:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 5/5/1993 | 13:10:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 5/18/1993 | 13:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 6/15/1993 | 13:30:00 | Nitrogen, Kjeldahl | 0.19 | mg/l | 0.19 | Total |
| 8/19/1993 | 10:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 11/16/1993 | 14:00:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/15/1994 | 13:30:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 5/17/1994 | 12:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/17/1994 | 20:00:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 11/16/1994 | 15:15:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/15/1995 | 13:00:00 | Nitrogen, Kjeldahl | 0 | mg/l | *Non-detect | Total |
| 5/16/1995 | 13:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/17/1995 | 19:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 2/27/1996 | 12:45:00 | Nitrogen, Kjeldahl | 0 | mg/l | *Non-detect | Total |
| 5/14/1996 | 13:15:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 1/15/1992 | 13:00:00 | Nitrogen, Nitrite + Nitrate | 0.11 | mg/l | 0.11 | Dissolved |
| 2/12/1992 | 11:30:00 | Nitrogen, Nitrite + Nitrate | 0.12 | mg/l | 0.12 | Dissolved |
| 3/11/1992 | 12:20:00 | Nitrogen, Nitrite + Nitrate | 0 | mg/l | *Present <QL | Dissolved |
| 4/8/1992 | 13:45:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 4/22/1992 | 14:20:00 | Nitrogen, Nitrite + Nitrate | 0.07 | mg/l | 0.07 | Dissolved |
| 5/20/1992 | 12:30:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 6/6/1992 | 12:00:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 6/10/1992 | 13:30:00 | Nitrogen, Nitrite + Nitrate | 0.03 | mg/l | 0.03 | Dissolved |
| 7/15/1992 | 12:15:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 8/11/1992 | 8:30:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 9/14/1992 | 13:00:00 | Nitrogen, Nitrite + Nitrate | 0.07 | mg/l | 0.07 | Dissolved |
| 10/20/1992 | 13:20:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 11/17/1992 | 12:35:00 | Nitrogen, Nitrite + Nitrate | 0.02 | mg/l | 0.02 | Dissolved |
| 12/15/1992 | 13:15:00 | Nitrogen, Nitrite + Nitrate | 0.16 | mg/l | 0.16 | Dissolved |
| 12/16/1992 | 13:15:00 | Nitrogen, Nitrite + Nitrate | 0.16 | mg/l | 0.16 | Dissolved |
| 1/12/1993 | 13:40:00 | Nitrogen, Nitrite + Nitrate | 0.24 | mg/l | 0.24 | Dissolved |
| 2/17/1993 | 13:40:00 | Nitrogen, Nitrite + Nitrate | 0.23 | mg/l | 0.23 | Dissolved |
| 3/18/1993 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.16 | mg/l | 0.16 | Dissolved |
| 4/6/1993 | 14:30:00 | Nitrogen, Nitrite + Nitrate | 0.03 | mg/l | 0.03 | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 4/21/1993 | 13:15:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 5/5/1993 | 13:10:00 | Nitrogen, Nitrite + Nitrate | 0.02 | mg/l | 0.02 | Dissolved |
| 5/18/1993 | 13:45:00 | Nitrogen, Nitrite + Nitrate | 0.07 | mg/l | 0.07 | Dissolved |
| 6/15/1993 | 13:30:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 8/19/1993 | 10:00:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 11/16/1993 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.09 | mg/l | 0.09 | Dissolved |
| 2/15/1994 | 13:30:00 | Nitrogen, Nitrite + Nitrate | 0.17 | mg/l | 0.17 | Dissolved |
| 5/17/1994 | 12:30:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 8/17/1994 | 20:00:00 | Nitrogen, Nitrite + Nitrate | 0.03 | mg/l | 0.03 | Dissolved |
| 11/16/1994 | 15:15:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 2/15/1995 | 13:00:00 | Nitrogen, Nitrite + Nitrate | 0.17 | mg/l | 0.17 | Dissolved |
| 5/16/1995 | 13:00:00 | Nitrogen, Nitrite + Nitrate | 0 | mg/l | *Non-detect | Dissolved |
| 8/17/1995 | 19:00:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 2/27/1996 | 12:45:00 | Nitrogen, Nitrite + Nitrate | 0.14 | mg/l | 0.14 | Dissolved |
| 5/14/1996 | 13:15:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 1/15/1992 | 13:00:00 | pH | 8.35 | None | 8.35 | Total |
| 2/12/1992 | 11:30:00 | pH | 8.16 | None | 8.16 | Total |
| 3/11/1992 | 12:20:00 | pH | 8.22 | None | 8.22 | Total |
| 4/8/1992 | 13:45:00 | pH | 7.93 | None | 7.93 | Total |
| 4/22/1992 | 14:20:00 | pH | 7.81 | None | 7.81 | Total |
| 5/20/1992 | 12:30:00 | pH | 7.64 | None | 7.64 | Total |
| 6/6/1992 | 12:00:00 | pH | 7.69 | None | 7.69 | Total |
| 6/10/1992 | 13:30:00 | pH | 8.29 | None | 8.29 | Total |
| 7/15/1992 | 12:15:00 | pH | 8.38 | None | 8.38 | Total |
| 8/11/1992 | 8:30:00 | pH | 8.32 | None | 8.32 | Total |
| 9/14/1992 | 13:00:00 | pH | 8.33 | None | 8.33 | Total |
| 10/20/1992 | 13:20:00 | pH | 8.49 | None | 8.49 | Total |
| 11/17/1992 | 12:35:00 | pH | 8.24 | None | 8.24 | Total |
| 12/15/1992 | 13:15:00 | pH | 8.1 | None | 8.1 | Total |
| 12/16/1992 | 13:15:00 | pH | 8.1 | None | 8.1 | Total |
| 2/17/1993 | 13:40:00 | pH | 8.21 | None | 8.21 | Total |
| 3/18/1993 | 14:00:00 | pH | 8.5 | None | 8.5 | Total |
| 4/6/1993 | 14:30:00 | pH | 8.15 | None | 8.15 | Total |
| 4/21/1993 | 13:15:00 | pH | 8.27 | None | 8.27 | Total |
| 5/5/1993 | 13:10:00 | pH | 8.09 | None | 8.09 | Total |
| 5/18/1993 | 13:45:00 | pH | 7.72 | None | 7.72 | Total |
| 6/15/1993 | 13:30:00 | pH | 7.92 | None | 7.92 | Total |
| 8/19/1993 | 10:00:00 | pH | 8.14 | None | 8.14 | Total |
| 11/16/1993 | 14:00:00 | pH | 8.03 | None | 8.03 | Total |
| 2/15/1994 | 13:30:00 | pH | 8.15 | None | 8.15 | Total |
| 5/17/1994 | 12:30:00 | pH | 7.64 | None | 7.64 | Total |
| 8/17/1994 | 20:00:00 | pH | 8.96 | None | 8.96 | Total |
| 11/16/1994 | 15:15:00 | pH | 8.5 | None | 8.5 | Total |
| 2/15/1995 | 13:00:00 | pH | 7.96 | None | 7.96 | Total |
| 5/16/1995 | 13:00:00 | pH | 8.01 | None | 8.01 | Total |
| 8/17/1995 | 19:00:00 | pH | 8.19 | None | 8.19 | Total |
| 2/27/1996 | 12:45:00 | pH | 7.57 | None | 7.57 | Total |
| 5/14/1996 | 13:15:00 | pH | 7.62 | None | 7.62 | Total |
| 5/14/1996 | 13:15:00 | pH | 7.62 | None | 7.62 | |
| 1/15/1992 | 13:00:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 2/12/1992 | 11:30:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 3/11/1992 | 12:20:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 4/8/1992 | 13:45:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 4/22/1992 | 14:20:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 5/20/1992 | 12:30:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 6/6/1992 | 12:00:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 6/10/1992 | 13:30:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 7/15/1992 | 12:15:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 8/11/1992 | 8:30:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 9/14/1992 | 13:00:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 10/20/1992 | 13:20:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 11/17/1992 | 12:35:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 12/15/1992 | 13:15:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 12/16/1992 | 13:15:00 | Phosphorus as P | 0.044 | mg/l | 0.044 | Total |
| 1/12/1993 | 13:40:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 2/17/1993 | 13:40:00 | Phosphorus as P | 0.024 | mg/l | 0.024 | Total |
| 3/18/1993 | 14:00:00 | Phosphorus as P | 0.058 | mg/l | 0.058 | Total |
| 4/6/1993 | 14:30:00 | Phosphorus as P | 0.027 | mg/l | 0.027 | Total |
| 4/21/1993 | 13:15:00 | Phosphorus as P | 0.013 | mg/l | 0.013 | Total |
| 5/5/1993 | 13:10:00 | Phosphorus as P | 0.037 | mg/l | 0.037 | Total |
| 5/18/1993 | 13:45:00 | Phosphorus as P | 0.033 | mg/l | 0.033 | Total |
| 6/15/1993 | 13:30:00 | Phosphorus as P | 0.015 | mg/l | 0.015 | Total |
| 8/19/1993 | 10:00:00 | Phosphorus as P | 0.025 | mg/l | 0.025 | Total |
| 11/16/1993 | 14:00:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 2/15/1994 | 13:30:00 | Phosphorus as P | 0.022 | mg/l | 0.022 | Total |
| 5/17/1994 | 12:30:00 | Phosphorus as P | 0.016 | mg/l | 0.016 | Total |
| 8/17/1994 | 20:00:00 | Phosphorus as P | 0.012 | mg/l | 0.012 | Total |
| 11/16/1994 | 15:15:00 | Phosphorus as P | 0.006 | mg/l | 0.006 | Total |
| 2/15/1995 | 13:00:00 | Phosphorus as P | 0.015 | mg/l | 0.015 | Total |
| 5/16/1995 | 13:00:00 | Phosphorus as P | 0.017 | mg/l | 0.017 | Total |
| 8/17/1995 | 19:00:00 | Phosphorus as P | 0.019 | mg/l | 0.019 | Total |
| 2/27/1996 | 12:45:00 | Phosphorus as P | 0.017 | mg/l | 0.017 | Total |
| 5/14/1996 | 13:15:00 | Phosphorus as P | 0.067 | mg/l | 0.067 | Total |
| 1/15/1992 | 13:00:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 2/12/1992 | 11:30:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 3/11/1992 | 12:20:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 4/8/1992 | 13:45:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 4/22/1992 | 14:20:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/20/1992 | 12:30:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 6/6/1992 | 12:00:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 6/10/1992 | 13:30:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 7/15/1992 | 12:15:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 8/11/1992 | 8:30:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 9/14/1992 | 13:00:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 10/20/1992 | 13:20:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 11/17/1992 | 12:35:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 12/15/1992 | 13:15:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 12/16/1992 | 13:15:00 | Phosphorus, orthophosphate as P | 0.037 | mg/l | 0.037 | Dissolved |
| 1/12/1993 | 13:40:00 | Phosphorus, orthophosphate as P | 0.009 | mg/l | 0.009 | Dissolved |
| 2/17/1993 | 13:40:00 | Phosphorus, orthophosphate as P | 0.009 | mg/l | 0.009 | Dissolved |
| 3/18/1993 | 14:00:00 | Phosphorus, orthophosphate as P | 0.029 | mg/l | 0.029 | Dissolved |
| 4/6/1993 | 14:30:00 | Phosphorus, orthophosphate as P | 0.005 | mg/l | 0.005 | Dissolved |
| 4/21/1993 | 13:15:00 | Phosphorus, orthophosphate as P | 0.002 | mg/l | 0.002 | Dissolved |
| 5/5/1993 | 13:10:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 5/18/1993 | 13:45:00 | Phosphorus, orthophosphate as P | 0.005 | mg/l | 0.005 | Dissolved |
| 6/15/1993 | 13:30:00 | Phosphorus, orthophosphate as P | 0.005 | mg/l | 0.005 | Dissolved |
| 8/19/1993 | 10:00:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 11/16/1993 | 14:00:00 | Phosphorus, orthophosphate as P | 0.003 | mg/l | 0.003 | Dissolved |
| 2/15/1994 | 13:30:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 5/17/1994 | 12:30:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 8/17/1994 | 20:00:00 | Phosphorus, orthophosphate as P | 0.001 | mg/l | 0.001 | Dissolved |
| 11/16/1994 | 15:15:00 | Phosphorus, orthophosphate as P | 0.001 | mg/l | 0.001 | Dissolved |
| 2/15/1995 | 13:00:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 5/16/1995 | 13:00:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 8/17/1995 | 19:00:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 2/27/1996 | 12:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/14/1996 | 13:15:00 | Phosphorus, orthophosphate as P | 0.007 | mg/l | 0.007 | Dissolved |
| 1/15/1992 | 13:00:00 | Residue | 1.6 | mg/l | 1.6 | Non-filterable |
| 1/15/1992 | 13:00:00 | Residue | 0.5 | mg/l | 0.5 | |
| 2/12/1992 | 11:30:00 | Residue | 11.8 | mg/l | 11.8 | Non-filterable |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 2/12/1992 | 11:30:00 | Residue | 3.3 | mg/l | 3.3 | |
| 3/11/1992 | 12:20:00 | Residue | 9.3 | mg/l | 9.3 | Non-filterable |
| 3/11/1992 | 12:20:00 | Residue | 2 | mg/l | 2 | |
| 4/8/1992 | 13:45:00 | Residue | 5.6 | mg/l | 5.6 | Non-filterable |
| 4/8/1992 | 13:45:00 | Residue | 1.7 | mg/l | 1.7 | |
| 4/22/1992 | 14:20:00 | Residue | 13.3 | mg/l | 13.3 | Non-filterable |
| 4/22/1992 | 14:20:00 | Residue | 2.3 | mg/l | 2.3 | |
| 5/20/1992 | 12:30:00 | Residue | 16.89 | mg/l | 16.89 | Non-filterable |
| 5/20/1992 | 12:30:00 | Residue | 2.9 | mg/l | 2.9 | |
| 6/6/1992 | 12:00:00 | Residue | 17.89 | mg/l | 17.89 | Non-filterable |
| 6/6/1992 | 12:00:00 | Residue | 2.8 | mg/l | 2.8 | |
| 6/10/1992 | 13:30:00 | Residue | 3.7 | mg/l | 3.7 | Non-filterable |
| 6/10/1992 | 13:30:00 | Residue | 1 | mg/l | 1 | |
| 7/15/1992 | 12:15:00 | Residue | 2.4 | mg/l | 2.4 | Non-filterable |
| 7/15/1992 | 12:15:00 | Residue | 0.8 | mg/l | 0.8 | |
| 8/11/1992 | 8:30:00 | Residue | 1.7 | mg/l | 1.7 | Non-filterable |
| 8/11/1992 | 8:30:00 | Residue | 0.8 | mg/l | 0.8 | |
| 9/14/1992 | 13:00:00 | Specific Conductance | 193 | umho/cm | 193 | |
| 10/20/1992 | 13:20:00 | Specific Conductance | 166 | umho/cm | 166 | |
| 11/17/1992 | 12:35:00 | Specific Conductance | 164 | umho/cm | 164 | |
| 12/15/1992 | 13:15:00 | Specific Conductance | 190 | umho/cm | 190 | |
| 12/16/1992 | 13:15:00 | Specific Conductance | 190 | umho/cm | 190 | |
| 1/12/1993 | 13:40:00 | Specific Conductance | 187 | umho/cm | 187 | |
| 2/17/1993 | 13:40:00 | Specific Conductance | 200 | umho/cm | 200 | |
| 3/18/1993 | 14:00:00 | Specific Conductance | 348 | umho/cm | 348 | |
| 4/6/1993 | 14:30:00 | Specific Conductance | 100 | umho/cm | 100 | |
| 4/21/1993 | 13:15:00 | Specific Conductance | 116 | umho/cm | 116 | |
| 5/5/1993 | 13:10:00 | Specific Conductance | 90 | umho/cm | 90 | |
| 5/18/1993 | 13:45:00 | Specific Conductance | 41 | umho/cm | 41 | |
| 6/15/1993 | 13:30:00 | Specific Conductance | 82 | umho/cm | 82 | |
| 8/19/1993 | 10:00:00 | Specific Conductance | 139 | umho/cm | 139 | |
| 11/16/1993 | 14:00:00 | Specific Conductance | 161 | umho/cm | 161 | |
| 2/15/1994 | 13:30:00 | Specific Conductance | 164 | umho/cm | 164 | |
| 5/17/1994 | 12:30:00 | Specific Conductance | 64 | umho/cm | 64 | |
| 8/17/1994 | 20:00:00 | Specific Conductance | 198 | umho/cm | 198 | |
| 11/16/1994 | 15:15:00 | Specific Conductance | 156 | umho/cm | 156 | |
| 2/15/1995 | 13:00:00 | Specific Conductance | 149 | umho/cm | 149 | |
| 5/16/1995 | 13:00:00 | Specific Conductance | 80 | umho/cm | 80 | |
| 8/17/1995 | 19:00:00 | Specific Conductance | 146 | umho/cm | 146 | |
| 2/27/1996 | 12:45:00 | Specific Conductance | 112 | umho/cm | 112 | |
| 5/14/1996 | 13:15:00 | Specific Conductance | 49 | umho/cm | 49 | |
| 5/14/1996 | 13:15:00 | Specific Conductance | 49 | umho/cm | 49 | |
| 1/15/1992 | 13:00:00 | Temperature, water | 1.5 | deg C | 1.5 | |
| 2/12/1992 | 11:30:00 | Temperature, water | 4.2 | deg C | 4.2 | |
| 3/11/1992 | 12:20:00 | Temperature, water | 5.9 | deg C | 5.9 | |
| 4/8/1992 | 13:45:00 | Temperature, water | 6.8 | deg C | 6.8 | |
| 4/22/1992 | 14:20:00 | Temperature, water | 8 | deg C | 8 | |
| 5/20/1992 | 12:30:00 | Temperature, water | 12.2 | deg C | 12.2 | |
| 6/6/1992 | 12:00:00 | Temperature, water | 12 | deg C | 12 | |
| 6/10/1992 | 13:30:00 | Temperature, water | 18 | deg C | 18 | |
| 7/15/1992 | 12:15:00 | Temperature, water | 19 | deg C | 19 | |
| 8/11/1992 | 8:30:00 | Temperature, water | 18.09 | deg C | 18.09 | |
| 9/14/1992 | 13:00:00 | Temperature, water | 12 | deg C | 12 | |
| 10/20/1992 | 13:20:00 | Temperature, water | 10 | deg C | 10 | |
| 11/17/1992 | 12:35:00 | Temperature, water | 7 | deg C | 7 | |
| 12/15/1992 | 13:15:00 | Temperature, water | 2 | deg C | 2 | |
| 5/14/1996 | 13:15:00 | Temperature, water | 8 | deg C | 8 | |
| 1/15/1992 | 13:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 2/12/1992 | 11:30:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 3/11/1992 | 12:20:00 | Zinc | 0 | ug/l | *Present >QL | Total |

MONT-DEQ Montana Department of Environmental Quality
4115BI01 Bitterroot River near O'Brien Creek Confluence
Latitude Longitude
46.853272 -114.098275

| | | | | | | |
|---|---|---|---|---|---|---|
| 4/8/1992 | 13:45:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 4/22/1992 | 14:20:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 5/20/1992 | 12:30:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 6/6/1992 | 12:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 6/10/1992 | 13:30:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 7/15/1992 | 12:15:00 | Zinc | 0 | ug/l | *Present >QL | Total |

MONT-DEQ Montana Department of Environmental Quality
4212CL01 Clark Fork River near Petty Creek Confluence
Latitude Longitude
46.991563 -114.445653

| Act Start | | Characteristic Name | Res Val | Res Unit | Result Val Text | Sampl Frac Type |
|---|---|---|---|---|---|---|
| 1/15/1992 | 15:30:00 | Alkalinity, Carbonate as CaCO3 | 68 | mg/l | 68 | Total |
| 2/12/1992 | 13:55:00 | Alkalinity, Carbonate as CaCO3 | 111 | mg/l | 111 | Total |
| 3/11/1992 | 15:45:00 | Alkalinity, Carbonate as CaCO3 | 92 | mg/l | 92 | Total |
| 4/8/1992 | 16:30:00 | Alkalinity, Carbonate as CaCO3 | 72 | mg/l | 72 | Total |
| 4/22/1992 | 17:45:00 | Alkalinity, Carbonate as CaCO3 | 66 | mg/l | 66 | Total |
| 5/6/1992 | 14:55:00 | Alkalinity, Carbonate as CaCO3 | 50 | mg/l | 50 | Total |
| 5/20/1992 | 16:10:00 | Alkalinity, Carbonate as CaCO3 | 53 | mg/l | 53 | Total |
| 6/10/1992 | 16:45:00 | Alkalinity, Carbonate as CaCO3 | 74 | mg/l | 74 | Total |
| 7/15/1992 | 15:25:00 | Alkalinity, Carbonate as CaCO3 | 101 | mg/l | 101 | Total |
| 8/12/1992 | 11:15:00 | Alkalinity, Carbonate as CaCO3 | 114 | mg/l | 114 | Total |
| 1/15/1992 | 15:30:00 | Bicarbonate | 83 | mg/l | 83 | |
| 4/22/1992 | 17:45:00 | Bicarbonate | 81 | mg/l | 81 | |
| 5/6/1992 | 14:55:00 | Bicarbonate | 61 | mg/l | 61 | |
| 5/20/1992 | 16:10:00 | Bicarbonate | 64 | mg/l | 64 | |
| 1/15/1992 | 15:30:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 13:55:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 15:45:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 16:30:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 17:45:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 14:55:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 16:10:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 16:45:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 15:25:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 15:30:00 | Calcium | 37.09 | mg/l | 37.09 | Dissolved |
| 2/12/1992 | 13:55:00 | Calcium | 33.7 | mg/l | 33.7 | Dissolved |
| 3/11/1992 | 15:45:00 | Calcium | 25.09 | mg/l | 25.09 | Dissolved |
| 4/8/1992 | 16:30:00 | Calcium | 20.39 | mg/l | 20.39 | Dissolved |
| 4/22/1992 | 17:45:00 | Calcium | 18.79 | mg/l | 18.79 | Dissolved |
| 5/6/1992 | 14:55:00 | Calcium | 15 | mg/l | 15 | Dissolved |
| 5/20/1992 | 16:10:00 | Calcium | 11.7 | mg/l | 11.7 | Dissolved |
| 6/10/1992 | 16:45:00 | Calcium | 20.09 | mg/l | 20.09 | Dissolved |
| 7/15/1992 | 15:25:00 | Calcium | 28.39 | mg/l | 28.39 | Dissolved |
| 8/12/1992 | 11:15:00 | Calcium | 31.79 | mg/l | 31.79 | Dissolved |
| 1/15/1992 | 15:30:00 | Carbonate ion | 0 | mg/l | 0 | |
| 4/22/1992 | 17:45:00 | Carbonate ion | 0 | mg/l | 0 | |
| 5/6/1992 | 14:55:00 | Carbonate ion | 0 | mg/l | 0 | |
| 5/20/1992 | 16:10:00 | Carbonate ion | 0 | mg/l | 0 | |
| 1/15/1992 | 15:30:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 13:55:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 15:45:00 | Copper | 0 | ug/l | *Present >QL | Total |
| 4/8/1992 | 16:30:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 17:45:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 14:55:00 | Copper | 0 | ug/l | *Present >QL | Total |
| 5/20/1992 | 16:10:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 16:45:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 15:25:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 8/5/1994 | 6:15:00 | Dissolved Oxygen | 6.81 | mg/l | 6.81 | Dissolved |
| 8/5/1994 | 6:15:00 | Dissolved Oxygen | 6.88 | mg/l | 6.88 | Dissolved |
| 1/15/1992 | 15:30:00 | Hardness, Ca,Mg | 132 | mg/l | 132 | Total |
| 2/12/1992 | 13:55:00 | Hardness, Ca,Mg | 122 | mg/l | 122 | Total |
| 3/11/1992 | 15:45:00 | Hardness, Ca,Mg | 92 | mg/l | 92 | Total |
| 4/8/1992 | 16:30:00 | Hardness, Ca,Mg | 75 | mg/l | 75 | Total |

MONT-DEQ Montana Department of Environmental Quality
4212CL01 Clark Fork River near Petty Creek Confluence
Latitude Longitude
46.991563 -114.445653

| | | | | | | |
|---|---|---|---|---|---|---|
| 4/22/1992 | 17:45:00 | Hardness, Ca,Mg | 64 | mg/l | 64 | Total |
| 5/6/1992 | 14:55:00 | Hardness, Ca,Mg | 56 | mg/l | 56 | Total |
| 5/20/1992 | 16:10:00 | Hardness, Ca,Mg | 44 | mg/l | 44 | Total |
| 6/10/1992 | 16:45:00 | Hardness, Ca,Mg | 73 | mg/l | 73 | Total |
| 7/15/1992 | 15:25:00 | Hardness, Ca,Mg | 105 | mg/l | 105 | Total |
| 8/12/1992 | 11:15:00 | Hardness, Ca,Mg | 116 | mg/l | 116 | Total |
| 1/15/1992 | 15:30:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 13:55:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 15:45:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 16:30:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 17:45:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 14:55:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 16:10:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 16:45:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 15:25:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 15:30:00 | Magnesium | 9.5 | mg/l | 9.5 | Dissolved |
| 2/12/1992 | 13:55:00 | Magnesium | 9.1 | mg/l | 9.1 | Dissolved |
| 3/11/1992 | 15:45:00 | Magnesium | 7.2 | mg/l | 7.2 | Dissolved |
| 4/8/1992 | 16:30:00 | Magnesium | 5.9 | mg/l | 5.9 | Dissolved |
| 4/22/1992 | 17:45:00 | Magnesium | 4.1 | mg/l | 4.1 | Dissolved |
| 5/6/1992 | 14:55:00 | Magnesium | 4.5 | mg/l | 4.5 | Dissolved |
| 5/20/1992 | 16:10:00 | Magnesium | 3.6 | mg/l | 3.6 | Dissolved |
| 6/10/1992 | 16:45:00 | Magnesium | 5.6 | mg/l | 5.6 | Dissolved |
| 7/15/1992 | 15:25:00 | Magnesium | 8.2 | mg/l | 8.2 | Dissolved |
| 1/15/1992 | 15:30:00 | Nitrogen, ammonia | 0.56 | mg/l | 0.56 | Dissolved |
| 2/12/1992 | 13:55:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 3/11/1992 | 15:45:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 4/8/1992 | 16:30:00 | Nitrogen, ammonia | 0.23 | mg/l | 0.23 | Dissolved |
| 4/22/1992 | 17:45:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 5/6/1992 | 14:55:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 5/20/1992 | 16:10:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 6/10/1992 | 16:45:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 7/15/1992 | 15:25:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 8/12/1992 | 11:15:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 1/15/1992 | 15:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 2/12/1992 | 13:55:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 3/11/1992 | 15:45:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 4/8/1992 | 16:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 4/22/1992 | 17:45:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 5/6/1992 | 14:55:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 5/20/1992 | 16:10:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 6/10/1992 | 16:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 7/15/1992 | 15:25:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/12/1992 | 11:15:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 1/15/1992 | 15:30:00 | Nitrogen, Nitrite + Nitrate | 0.12 | mg/l | 0.12 | Dissolved |
| 2/12/1992 | 13:55:00 | Nitrogen, Nitrite + Nitrate | 0.1 | mg/l | 0.1 | Dissolved |
| 3/11/1992 | 15:45:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 4/8/1992 | 16:30:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 4/22/1992 | 17:45:00 | Nitrogen, Nitrite + Nitrate | 0.07 | mg/l | 0.07 | Dissolved |
| 5/6/1992 | 14:55:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 5/20/1992 | 16:10:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 6/10/1992 | 16:45:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 7/15/1992 | 15:25:00 | Nitrogen, Nitrite + Nitrate | 0.01 | mg/l | 0.01 | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4212CL01 Clark Fork River near Petty Creek Confluence
Latitude Longitude
46.991563 -114.445653

| | | | | | | |
|---|---|---|---|---|---|---|
| 8/12/1992 | 11:15:00 | Nitrogen, Nitrite + Nitrate | 0 | mg/l | *Present <QL | Dissolved |
| 1/15/1992 | 15:30:00 | pH | 8.16 | None | 8.16 | Total |
| 2/12/1992 | 13:55:00 | pH | 8.42 | None | 8.42 | Total |
| 3/11/1992 | 15:45:00 | pH | 8.53 | None | 8.53 | Total |
| 4/8/1992 | 16:30:00 | pH | 8.34 | None | 8.34 | Total |
| 4/22/1992 | 17:45:00 | pH | 8.28 | None | 8.28 | Total |
| 5/6/1992 | 14:55:00 | pH | 8.09 | None | 8.09 | Total |
| 5/20/1992 | 16:10:00 | pH | 7.99 | None | 7.99 | Total |
| 6/10/1992 | 16:45:00 | pH | 8.48 | None | 8.48 | Total |
| 7/15/1992 | 15:25:00 | pH | 8.6 | None | 8.6 | Total |
| 8/12/1992 | 11:15:00 | pH | 8.62 | None | 8.62 | Total |
| 1/15/1992 | 15:30:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 2/12/1992 | 13:55:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 3/11/1992 | 15:45:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 4/8/1992 | 16:30:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 4/22/1992 | 17:45:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 5/6/1992 | 14:55:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 5/20/1992 | 16:10:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 6/10/1992 | 16:45:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 7/15/1992 | 15:25:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 8/12/1992 | 11:15:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 1/15/1992 | 15:30:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 2/12/1992 | 13:55:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 3/11/1992 | 15:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 4/8/1992 | 16:30:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 4/22/1992 | 17:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/6/1992 | 14:55:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/20/1992 | 16:10:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 6/10/1992 | 16:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 7/15/1992 | 15:25:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 8/12/1992 | 11:15:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 1/15/1992 | 15:30:00 | Residue | 4.8 | mg/l | 4.8 | Non-filterable |
| 1/15/1992 | 15:30:00 | Residue | 1 | mg/l | 1 | |
| 2/12/1992 | 13:55:00 | Residue | 6.8 | mg/l | 6.8 | Non-filterable |
| 2/12/1992 | 13:55:00 | Residue | 1.5 | mg/l | 1.5 | |
| 3/11/1992 | 15:45:00 | Residue | 9.5 | mg/l | 9.5 | Non-filterable |
| 3/11/1992 | 15:45:00 | Residue | 1.9 | mg/l | 1.9 | |
| 4/8/1992 | 16:30:00 | Residue | 7.4 | mg/l | 7.4 | Non-filterable |
| 4/8/1992 | 16:30:00 | Residue | 1.6 | mg/l | 1.6 | |
| 4/22/1992 | 17:45:00 | Residue | 15.1 | mg/l | 15.1 | Non-filterable |
| 4/22/1992 | 17:45:00 | Residue | 2.7 | mg/l | 2.7 | |
| 5/6/1992 | 14:55:00 | Residue | 19.7 | mg/l | 19.7 | Non-filterable |
| 5/6/1992 | 14:55:00 | Residue | 2.9 | mg/l | 2.9 | |
| 5/20/1992 | 16:10:00 | Residue | 14.5 | mg/l | 14.5 | Non-filterable |
| 5/20/1992 | 16:10:00 | Residue | 2.5 | mg/l | 2.5 | |
| 6/10/1992 | 16:45:00 | Residue | 4.6 | mg/l | 4.6 | Non-filterable |
| 6/10/1992 | 16:45:00 | Residue | 1.1 | mg/l | 1.1 | |
| 7/15/1992 | 15:25:00 | Residue | 2.9 | mg/l | 2.9 | Non-filterable |
| 7/15/1992 | 15:25:00 | Residue | 0.9 | mg/l | 0.9 | |
| 8/12/1992 | 11:15:00 | Residue | 6.1 | mg/l | 6.1 | Non-filterable |
| 8/12/1992 | 11:15:00 | Residue | 1.5 | mg/l | 1.5 | |
| 1/15/1992 | 15:30:00 | Temperature, water | 0.5 | deg C | 0.5 | |
| 2/12/1992 | 13:55:00 | Temperature, water | 3.5 | deg C | 3.5 | |

MONT-DEQ Montana Department of Environmental Quality
4212CL01 Clark Fork River near Petty Creek Confluence
Latitude Longitude
46.991563 -114.445653

| | | | | | | |
|---|---|---|---|---|---|---|
| 3/11/1992 | 15:45:00 | Temperature, water | 6.9 | deg C | 6.9 | |
| 4/8/1992 | 16:30:00 | Temperature, water | 7.6 | deg C | 7.6 | |
| 4/22/1992 | 17:45:00 | Temperature, water | 9 | deg C | 9 | |
| 5/6/1992 | 14:55:00 | Temperature, water | 14 | deg C | 14 | |
| 5/20/1992 | 16:10:00 | Temperature, water | 14 | deg C | 14 | |
| 6/10/1992 | 16:45:00 | Temperature, water | 20 | deg C | 20 | |
| 7/15/1992 | 15:25:00 | Temperature, water | 20 | deg C | 20 | |
| 8/12/1992 | 11:15:00 | Temperature, water | 19 | deg C | 19 | |
| 1/15/1992 | 15:30:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 2/12/1992 | 13:55:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 3/11/1992 | 15:45:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 4/8/1992 | 16:30:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 4/22/1992 | 17:45:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 5/6/1992 | 14:55:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 5/20/1992 | 16:10:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 6/10/1992 | 16:45:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 7/15/1992 | 15:25:00 | Zinc | 0 | ug/l | *Present >QL | Total |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

| Act Start | | Characteristic Name | Res Val | Res Unit | Result Val Text | Sampl Frac Type |
|---|---|---|---|---|---|---|
| 1/15/1992 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 115 | mg/l | 115 | Total |
| 2/12/1992 | 12:55:00 | Alkalinity, Carbonate as CaCO3 | 109 | mg/l | 109 | Total |
| 3/11/1992 | 13:20:00 | Alkalinity, Carbonate as CaCO3 | 92 | mg/l | 92 | Total |
| 4/8/1992 | 14:45:00 | Alkalinity, Carbonate as CaCO3 | 75 | mg/l | 75 | Total |
| 4/22/1992 | 16:00:00 | Alkalinity, Carbonate as CaCO3 | 69 | mg/l | 69 | Total |
| 5/6/1992 | 13:20:00 | Alkalinity, Carbonate as CaCO3 | 52 | mg/l | 52 | Total |
| 5/20/1992 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 53 | mg/l | 53 | Total |
| 6/10/1992 | 14:50:00 | Alkalinity, Carbonate as CaCO3 | 71 | mg/l | 71 | Total |
| 7/15/1992 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 100 | mg/l | 100 | Total |
| 8/11/1992 | 14:00:00 | Alkalinity, Carbonate as CaCO3 | 107 | mg/l | 107 | Total |
| 9/14/1992 | 14:30:00 | Alkalinity, Carbonate as CaCO3 | 153 | mg/l | 153 | Total |
| 10/20/1992 | 14:45:00 | Alkalinity, Carbonate as CaCO3 | 105 | mg/l | 105 | Total |
| 11/17/1992 | 14:45:00 | Alkalinity, Carbonate as CaCO3 | 122 | mg/l | 122 | Total |
| 12/15/1992 | 14:10:00 | Alkalinity, Carbonate as CaCO3 | 105 | mg/l | 105 | Total |
| 12/16/1992 | 14:10:00 | Alkalinity, Carbonate as CaCO3 | 105 | mg/l | 105 | Total |
| 1/12/1993 | 15:15:00 | Alkalinity, Carbonate as CaCO3 | 114 | mg/l | 114 | Total |
| 2/17/1993 | 15:50:00 | Alkalinity, Carbonate as CaCO3 | 119 | mg/l | 119 | Total |
| 3/16/1993 | 15:10:00 | Alkalinity, Carbonate as CaCO3 | 98.5 | mg/l | 98.5 | Total |
| 4/6/1993 | 16:00:00 | Alkalinity, Carbonate as CaCO3 | 76.3 | mg/l | 76.3 | Total |
| 4/21/1993 | 15:30:00 | Alkalinity, Carbonate as CaCO3 | 85.7 | mg/l | 85.7 | Total |
| 5/5/1993 | 15:10:00 | Alkalinity, Carbonate as CaCO3 | 70 | mg/l | 70 | Total |
| 5/18/1993 | 15:40:00 | Alkalinity, Carbonate as CaCO3 | 45.1 | mg/l | 45.1 | Total |
| 6/15/1993 | 15:15:00 | Alkalinity, Carbonate as CaCO3 | 68.5 | mg/l | 68.5 | Total |
| 8/19/1993 | 13:30:00 | Alkalinity, Carbonate as CaCO3 | 103 | mg/l | 103 | Total |
| 11/16/1993 | 15:00:00 | Alkalinity, Carbonate as CaCO3 | 112 | mg/l | 112 | Total |
| 2/15/1994 | 15:30:00 | Alkalinity, Carbonate as CaCO3 | 111 | mg/l | 111 | Total |
| 5/17/1994 | 14:30:00 | Alkalinity, Carbonate as CaCO3 | 61.1 | mg/l | 61.1 | Total |
| 8/18/1994 | 11:30:00 | Alkalinity, Carbonate as CaCO3 | 116 | mg/l | 116 | Total |
| 11/16/1994 | 16:45:00 | Alkalinity, Carbonate as CaCO3 | 113 | mg/l | 113 | Total |
| 2/15/1995 | 14:40:00 | Alkalinity, Carbonate as CaCO3 | 103 | mg/l | 103 | Total |
| 5/16/1995 | 15:00:00 | Alkalinity, Carbonate as CaCO3 | 66 | mg/l | 66 | Total |
| 8/18/1995 | 10:00:00 | Alkalinity, Carbonate as CaCO3 | 92 | mg/l | 92 | Total |
| 2/27/1996 | 12:15:00 | Alkalinity, Carbonate as CaCO3 | 89 | mg/l | 89 | Total |
| 5/14/1996 | 15:00:00 | Alkalinity, Carbonate as CaCO3 | 48 | mg/l | 48 | Total |
| 5/6/1992 | 13:20:00 | Bicarbonate | 63 | mg/l | 63 | |
| 5/20/1992 | 14:00:00 | Bicarbonate | 65 | mg/l | 65 | |
| 1/15/1992 | 14:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 12:55:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 13:20:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 14:45:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 16:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 13:20:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 14:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 14:50:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 14:00:00 | Cadmium | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 14:00:00 | Calcium | 34.89 | mg/l | 34.89 | Dissolved |
| 2/12/1992 | 12:55:00 | Calcium | 35 | mg/l | 35 | Dissolved |
| 3/11/1992 | 13:20:00 | Calcium | 26.59 | mg/l | 26.59 | Dissolved |
| 4/8/1992 | 14:45:00 | Calcium | 22.59 | mg/l | 22.59 | Dissolved |
| 4/22/1992 | 16:00:00 | Calcium | 20.5 | mg/l | 20.5 | Dissolved |
| 5/6/1992 | 13:20:00 | Calcium | 15.7 | mg/l | 15.7 | Dissolved |
| 5/20/1992 | 14:00:00 | Calcium | 14.6 | mg/l | 14.6 | Dissolved |
| 6/10/1992 | 14:50:00 | Calcium | 20 | mg/l | 20 | Dissolved |

| | |
|---|---|
| MONT-DEQ | Montana Department of Environmental Quality |
| 4214CL01 | Clark Fork River near Deep Creek Confluence |
| Latitude | Longitude |
| 46.932088 | -114.2087 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7/15/1992 | 14:00:00 | Calcium | 29 | mg/l | 29 | Dissolved |
| 8/11/1992 | 14:00:00 | Calcium | 33.09 | mg/l | 33.09 | Dissolved |
| 9/14/1992 | 14:30:00 | Calcium | 31.59 | mg/l | 31.59 | Dissolved |
| 10/20/1992 | 14:45:00 | Calcium | 36 | mg/l | 36 | Dissolved |
| 11/17/1992 | 14:45:00 | Calcium | 33.79 | mg/l | 33.79 | Dissolved |
| 12/15/1992 | 14:10:00 | Calcium | 34 | mg/l | 34 | Dissolved |
| 5/6/1992 | 13:20:00 | Carbonate ion | 0 | mg/l | 0 | |
| 5/20/1992 | 14:00:00 | Carbonate ion | 0 | mg/l | 0 | |
| 5/20/1992 | 10:40:00 | Color | 18 | PCU | 18 | |
| 5/20/1992 | 10:40:00 | Color | 18 | JTU | 18 | |
| 1/15/1992 | 14:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 12:55:00 | Copper | 0 | ug/l | *Present >QL | Total |
| 3/11/1992 | 13:20:00 | Copper | 0 | ug/l | *Present >QL | Total |
| 4/8/1992 | 14:45:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 16:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 13:20:00 | Copper | 0 | ug/l | *Present >QL | Total |
| 5/20/1992 | 14:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 14:50:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 14:00:00 | Copper | 0 | ug/l | *Present <QL | Total |
| 8/5/1994 | 5:00:00 | Dissolved Oxygen | 6.2 | mg/l | 6.2 | Dissolved |
| 8/5/1994 | 5:00:00 | Dissolved Oxygen | 6.2 | mg/l | 6.2 | Dissolved |
| 5/20/1992 | 14:00:00 | Flow | 13.3 | cfs | 13.3 | |
| 1/15/1992 | 14:00:00 | Hardness, Ca,Mg | 124 | mg/l | 124 | Total |
| 2/12/1992 | 12:55:00 | Hardness, Ca,Mg | 126 | mg/l | 126 | Total |
| 3/11/1992 | 13:20:00 | Hardness, Ca,Mg | 97 | mg/l | 97 | Total |
| 4/8/1992 | 14:45:00 | Hardness, Ca,Mg | 82 | mg/l | 82 | Total |
| 4/22/1992 | 16:00:00 | Hardness, Ca,Mg | 67 | mg/l | 67 | Total |
| 5/6/1992 | 13:20:00 | Hardness, Ca,Mg | 58 | mg/l | 58 | Total |
| 5/20/1992 | 14:00:00 | Hardness, Ca,Mg | 54 | mg/l | 54 | Total |
| 6/10/1992 | 14:50:00 | Hardness, Ca,Mg | 74 | mg/l | 74 | Total |
| 7/15/1992 | 14:00:00 | Hardness, Ca,Mg | 106 | mg/l | 106 | Total |
| 8/11/1992 | 14:00:00 | Hardness, Ca,Mg | 118 | mg/l | 118 | Total |
| 9/14/1992 | 14:30:00 | Hardness, Ca,Mg | 116 | mg/l | 116 | Total |
| 10/20/1992 | 14:45:00 | Hardness, Ca,Mg | 126 | mg/l | 126 | Total |
| 11/17/1992 | 14:45:00 | Hardness, Ca,Mg | 120 | mg/l | 120 | Total |
| 12/15/1992 | 14:10:00 | Hardness, Ca,Mg | 122 | mg/l | 122 | Total |
| 12/16/1992 | 14:10:00 | Hardness, Ca,Mg | 122.372 | mg/l | 122.372 | Total |
| 1/12/1993 | 15:15:00 | Hardness, Ca,Mg | 130.573 | mg/l | 130.573 | Total |
| 2/17/1993 | 15:50:00 | Hardness, Ca,Mg | 135.567 | mg/l | 135.567 | Total |
| 3/16/1993 | 15:10:00 | Hardness, Ca,Mg | 111.363 | mg/l | 111.363 | Total |
| 4/6/1993 | 16:00:00 | Hardness, Ca,Mg | 81.228 | mg/l | 81.228 | Total |
| 4/21/1993 | 15:30:00 | Hardness, Ca,Mg | 99.627 | mg/l | 99.627 | Total |
| 5/5/1993 | 15:10:00 | Hardness, Ca,Mg | 83.637 | mg/l | 83.637 | Total |
| 5/18/1993 | 15:40:00 | Hardness, Ca,Mg | 56.437 | mg/l | 56.437 | Total |
| 6/15/1993 | 15:15:00 | Hardness, Ca,Mg | 78.818 | mg/l | 78.818 | Total |
| 8/19/1993 | 13:30:00 | Hardness, Ca,Mg | 108.441 | mg/l | 108.441 | Total |
| 11/16/1993 | 15:00:00 | Hardness, Ca,Mg | 124.282 | mg/l | 124.282 | Total |
| 2/15/1994 | 15:30:00 | Hardness, Ca,Mg | 126.529 | mg/l | 126.529 | Total |
| 5/17/1994 | 14:30:00 | Hardness, Ca,Mg | 65.948 | mg/l | 65.948 | Total |
| 8/18/1994 | 11:30:00 | Hardness, Ca,Mg | 120.611 | mg/l | 120.611 | Total |
| 11/16/1994 | 16:45:00 | Hardness, Ca,Mg | 125.206 | mg/l | 125.206 | Total |
| 2/15/1995 | 14:40:00 | Hardness, Ca,Mg | 118.723 | mg/l | 118.723 | Total |
| 5/16/1995 | 15:00:00 | Hardness, Ca,Mg | 81.846 | mg/l | 81.846 | Total |
| 8/18/1995 | 10:00:00 | Hardness, Ca,Mg | 95.55 | mg/l | 95.55 | Total |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

| | | | | | | |
|---|---|---|---|---|---|---|
| 2/27/1996 | 12:15:00 | Hardness, Ca,Mg | 64 | mg/l | 64 | Total |
| 5/14/1996 | 15:00:00 | Hardness, Ca,Mg | 63 | mg/l | 63 | Total |
| 5/18/1993 | 15:40:00 | Hardness, carbonate | 3.3 | Molal | 3.3 | Total |
| 6/15/1993 | 15:15:00 | Hardness, carbonate | 4.6 | Molal | 4.6 | Total |
| 8/19/1993 | 13:30:00 | Hardness, carbonate | 6.3 | Molal | 6.3 | Total |
| 11/16/1993 | 15:00:00 | Hardness, carbonate | 7.3 | Molal | 7.3 | Total |
| 2/15/1994 | 15:30:00 | Hardness, carbonate | 7.4 | Molal | 7.4 | Total |
| 5/17/1994 | 14:30:00 | Hardness, carbonate | 3.9 | Molal | 3.9 | Total |
| 8/18/1994 | 11:30:00 | Hardness, carbonate | 7.1 | Molal | 7.1 | Total |
| 11/16/1994 | 16:45:00 | Hardness, carbonate | 7.3 | Molal | 7.3 | Total |
| 2/15/1995 | 14:40:00 | Hardness, carbonate | 6.9 | Molal | 6.9 | Total |
| 5/16/1995 | 15:00:00 | Hardness, carbonate | 4.8 | Molal | 4.8 | Total |
| 8/18/1995 | 10:00:00 | Hardness, carbonate | 5.6 | Molal | 5.6 | Total |
| 2/27/1996 | 12:15:00 | Hardness, carbonate | 3.8 | Molal | 3.8 | Total |
| 5/14/1996 | 15:00:00 | Hardness, carbonate | 3.7 | Molal | 3.7 | Total |
| 1/15/1992 | 14:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 2/12/1992 | 12:55:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 3/11/1992 | 13:20:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/8/1992 | 14:45:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 4/22/1992 | 16:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 5/6/1992 | 13:20:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 5/20/1992 | 14:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 6/10/1992 | 14:50:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 7/15/1992 | 14:00:00 | Lead | 0 | ug/l | *Present <QL | Total |
| 1/15/1992 | 14:00:00 | Magnesium | 9 | mg/l | 9 | Dissolved |
| 2/12/1992 | 12:55:00 | Magnesium | 9.4 | mg/l | 9.4 | Dissolved |
| 3/11/1992 | 13:20:00 | Magnesium | 7.3 | mg/l | 7.3 | Dissolved |
| 4/8/1992 | 14:45:00 | Magnesium | 6.2 | mg/l | 6.2 | Dissolved |
| 4/22/1992 | 16:00:00 | Magnesium | 3.9 | mg/l | 3.9 | Dissolved |
| 5/6/1992 | 13:20:00 | Magnesium | 4.6 | mg/l | 4.6 | Dissolved |
| 5/20/1992 | 14:00:00 | Magnesium | 4.3 | mg/l | 4.3 | Dissolved |
| 6/10/1992 | 14:50:00 | Magnesium | 5.8 | mg/l | 5.8 | Dissolved |
| 7/15/1992 | 14:00:00 | Magnesium | 8.2 | mg/l | 8.2 | Dissolved |
| 1/15/1992 | 14:00:00 | Nitrogen, ammonia | 0.03 | mg/l | 0.03 | Dissolved |
| 2/12/1992 | 12:55:00 | Nitrogen, ammonia | 0.03 | mg/l | 0.03 | Dissolved |
| 3/11/1992 | 13:20:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 4/8/1992 | 14:45:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 4/22/1992 | 16:00:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 5/6/1992 | 13:20:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 5/20/1992 | 14:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 6/10/1992 | 14:50:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 7/15/1992 | 14:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 8/11/1992 | 14:00:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 9/14/1992 | 14:30:00 | Nitrogen, ammonia | 0 | mg/l | *Present <QL | Dissolved |
| 10/20/1992 | 14:45:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 11/17/1992 | 14:45:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 12/15/1992 | 14:10:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 12/16/1992 | 14:10:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 1/12/1993 | 15:15:00 | Nitrogen, ammonia | 0.03 | mg/l | 0.03 | Dissolved |
| 2/17/1993 | 15:50:00 | Nitrogen, ammonia | 0.03 | mg/l | 0.03 | Dissolved |
| 3/16/1993 | 15:10:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 4/6/1993 | 16:00:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 4/21/1993 | 15:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 5/5/1993 | 15:10:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

| | | | | | | |
|---|---|---|---|---|---|---|
| 5/18/1993 | 15:40:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 6/15/1993 | 15:15:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 8/19/1993 | 13:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 11/16/1993 | 15:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/15/1994 | 15:30:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 5/17/1994 | 14:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 8/18/1994 | 11:30:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 11/16/1994 | 16:45:00 | Nitrogen, ammonia | 0.01 | mg/l | 0.01 | Dissolved |
| 2/15/1995 | 14:40:00 | Nitrogen, ammonia | 0.05 | mg/l | 0.05 | Dissolved |
| 5/16/1995 | 15:00:00 | Nitrogen, ammonia | 0.02 | mg/l | 0.02 | Dissolved |
| 8/18/1995 | 10:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 2/27/1996 | 12:15:00 | Nitrogen, ammonia | 0.04 | mg/l | 0.04 | Dissolved |
| 5/14/1996 | 15:00:00 | Nitrogen, ammonia | 0 | mg/l | *Non-detect | Dissolved |
| 1/15/1992 | 14:00:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/12/1992 | 12:55:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 3/11/1992 | 13:20:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 4/8/1992 | 14:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 4/22/1992 | 16:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 5/6/1992 | 13:20:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 5/20/1992 | 14:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 6/10/1992 | 14:50:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 7/15/1992 | 14:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/11/1992 | 14:00:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 9/14/1992 | 14:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 10/20/1992 | 14:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 11/17/1992 | 14:45:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 12/15/1992 | 14:10:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 12/16/1992 | 14:10:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 1/12/1993 | 15:15:00 | Nitrogen, Kjeldahl | 0.24 | mg/l | 0.24 | Total |
| 2/17/1993 | 15:50:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 3/16/1993 | 15:10:00 | Nitrogen, Kjeldahl | 0.32 | mg/l | 0.32 | Total |
| 4/6/1993 | 16:00:00 | Nitrogen, Kjeldahl | 0.4 | mg/l | 0.4 | Total |
| 4/21/1993 | 15:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 5/5/1993 | 15:10:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 5/18/1993 | 15:40:00 | Nitrogen, Kjeldahl | 0.5 | mg/l | 0.5 | Total |
| 6/15/1993 | 15:15:00 | Nitrogen, Kjeldahl | 0.25 | mg/l | 0.25 | Total |
| 8/19/1993 | 13:30:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 11/16/1993 | 15:00:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/15/1994 | 15:30:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 5/17/1994 | 14:30:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 8/18/1994 | 11:30:00 | Nitrogen, Kjeldahl | 0.3 | mg/l | 0.3 | Total |
| 11/16/1994 | 16:45:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 2/15/1995 | 14:40:00 | Nitrogen, Kjeldahl | 0.1 | mg/l | 0.1 | Total |
| 5/16/1995 | 15:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 8/18/1995 | 10:00:00 | Nitrogen, Kjeldahl | 0.2 | mg/l | 0.2 | Total |
| 2/27/1996 | 12:15:00 | Nitrogen, Kjeldahl | 2.37 | mg/l | 2.37 | Total |
| 5/14/1996 | 15:00:00 | Nitrogen, Kjeldahl | 1.2 | mg/l | 1.2 | Total |
| 1/15/1992 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.14 | mg/l | 0.14 | Dissolved |
| 2/12/1992 | 12:55:00 | Nitrogen, Nitrite + Nitrate | 0.12 | mg/l | 0.12 | Dissolved |
| 3/11/1992 | 13:20:00 | Nitrogen, Nitrite + Nitrate | 0.1 | mg/l | 0.1 | Dissolved |
| 4/8/1992 | 14:45:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 4/22/1992 | 16:00:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 5/6/1992 | 13:20:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 5/20/1992 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

| | | | | | | |
|---|---|---|---|---|---|---|
| 6/10/1992 | 14:50:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 7/15/1992 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.02 | mg/l | 0.02 | Dissolved |
| 8/11/1992 | 14:00:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 9/14/1992 | 14:30:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 10/20/1992 | 14:45:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 11/17/1992 | 14:45:00 | Nitrogen, Nitrite + Nitrate | 0.1 | mg/l | 0.1 | Dissolved |
| 12/15/1992 | 14:10:00 | Nitrogen, Nitrite + Nitrate | 0.16 | mg/l | 0.16 | Dissolved |
| 12/16/1992 | 14:10:00 | Nitrogen, Nitrite + Nitrate | 0.16 | mg/l | 0.16 | Dissolved |
| 1/12/1993 | 15:15:00 | Nitrogen, Nitrite + Nitrate | 0.27 | mg/l | 0.27 | Dissolved |
| 2/17/1993 | 15:50:00 | Nitrogen, Nitrite + Nitrate | 0.2 | mg/l | 0.2 | Dissolved |
| 3/16/1993 | 15:10:00 | Nitrogen, Nitrite + Nitrate | 0.14 | mg/l | 0.14 | Dissolved |
| 4/6/1993 | 16:00:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 4/21/1993 | 15:30:00 | Nitrogen, Nitrite + Nitrate | 0.03 | mg/l | 0.03 | Dissolved |
| 5/5/1993 | 15:10:00 | Nitrogen, Nitrite + Nitrate | 0.02 | mg/l | 0.02 | Dissolved |
| 5/18/1993 | 15:40:00 | Nitrogen, Nitrite + Nitrate | 0.1 | mg/l | 0.1 | Dissolved |
| 6/15/1993 | 15:15:00 | Nitrogen, Nitrite + Nitrate | 0.11 | mg/l | 0.11 | Dissolved |
| 8/19/1993 | 13:30:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 11/16/1993 | 15:00:00 | Nitrogen, Nitrite + Nitrate | 0.09 | mg/l | 0.09 | Dissolved |
| 2/15/1994 | 15:30:00 | Nitrogen, Nitrite + Nitrate | 0.17 | mg/l | 0.17 | Dissolved |
| 5/17/1994 | 14:30:00 | Nitrogen, Nitrite + Nitrate | 0.05 | mg/l | 0.05 | Dissolved |
| 8/18/1994 | 11:30:00 | Nitrogen, Nitrite + Nitrate | 0.08 | mg/l | 0.08 | Dissolved |
| 11/16/1994 | 16:45:00 | Nitrogen, Nitrite + Nitrate | 0.07 | mg/l | 0.07 | Dissolved |
| 2/15/1995 | 14:40:00 | Nitrogen, Nitrite + Nitrate | 0.19 | mg/l | 0.19 | Dissolved |
| 5/16/1995 | 15:00:00 | Nitrogen, Nitrite + Nitrate | 0.06 | mg/l | 0.06 | Dissolved |
| 8/18/1995 | 10:00:00 | Nitrogen, Nitrite + Nitrate | 0.04 | mg/l | 0.04 | Dissolved |
| 2/27/1996 | 12:15:00 | Nitrogen, Nitrite + Nitrate | 0.17 | mg/l | 0.17 | Dissolved |
| 5/14/1996 | 15:00:00 | Nitrogen, Nitrite + Nitrate | 0.02 | mg/l | 0.02 | Dissolved |
| 1/15/1992 | 14:00:00 | pH | 8.53 | None | 8.53 | Total |
| 2/12/1992 | 12:55:00 | pH | 8.4 | None | 8.4 | Total |
| 3/11/1992 | 13:20:00 | pH | 8.49 | None | 8.49 | Total |
| 4/8/1992 | 14:45:00 | pH | 8.39 | None | 8.39 | Total |
| 4/22/1992 | 16:00:00 | pH | 8.35 | None | 8.35 | Total |
| 5/6/1992 | 13:20:00 | pH | 8.13 | None | 8.13 | Total |
| 5/20/1992 | 14:00:00 | pH | 7.96 | None | 7.96 | Total |
| 6/10/1992 | 14:50:00 | pH | 8.64 | None | 8.64 | Total |
| 7/15/1992 | 14:00:00 | pH | 8.82 | None | 8.82 | Total |
| 8/11/1992 | 14:00:00 | pH | 8.87 | None | 8.87 | Total |
| 9/14/1992 | 14:30:00 | pH | 8.57 | None | 8.57 | Total |
| 10/20/1992 | 14:45:00 | pH | 8.67 | None | 8.67 | Total |
| 11/17/1992 | 14:45:00 | pH | 8.41 | None | 8.41 | Total |
| 12/15/1992 | 14:10:00 | pH | 8.37 | None | 8.37 | Total |
| 12/16/1992 | 14:10:00 | pH | 8.37 | None | 8.37 | Total |
| 2/17/1993 | 15:50:00 | pH | 8.24 | None | 8.24 | Total |
| 3/16/1993 | 15:10:00 | pH | 8.38 | None | 8.38 | Total |
| 4/6/1993 | 16:00:00 | pH | 8.43 | None | 8.43 | Total |
| 4/21/1993 | 15:30:00 | pH | 8.62 | None | 8.62 | Total |
| 5/5/1993 | 15:10:00 | pH | 8.27 | None | 8.27 | Total |
| 5/18/1993 | 15:40:00 | pH | 8.01 | None | 8.01 | Total |
| 6/15/1993 | 15:15:00 | pH | 8.19 | None | 8.19 | Total |
| 8/19/1993 | 13:30:00 | pH | 8.43 | None | 8.43 | Total |
| 11/16/1993 | 15:00:00 | pH | 8.48 | None | 8.48 | Total |
| 2/15/1994 | 15:30:00 | pH | 8.31 | None | 8.31 | Total |
| 5/17/1994 | 14:30:00 | pH | 7.95 | None | 7.95 | Total |
| 8/18/1994 | 11:30:00 | pH | 8.51 | None | 8.51 | Total |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

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|---|---|---|---|---|---|---|
| 11/16/1994 | 16:45:00 | pH | 8.59 | None | 8.59 | Total |
| 2/15/1995 | 14:40:00 | pH | 8.14 | None | 8.14 | Total |
| 5/16/1995 | 15:00:00 | pH | 8.2 | None | 8.2 | Total |
| 8/18/1995 | 10:00:00 | pH | 8.05 | None | 8.05 | Total |
| 2/27/1996 | 12:15:00 | pH | 7.97 | None | 7.97 | Total |
| 5/14/1996 | 15:00:00 | pH | 8.02 | None | 8.02 | Total |
| 1/15/1992 | 14:00:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 2/12/1992 | 12:55:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 3/11/1992 | 13:20:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 4/8/1992 | 14:45:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 4/22/1992 | 16:00:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 5/6/1992 | 13:20:00 | Phosphorus as P | 0.03 | mg/l | 0.03 | Total |
| 5/20/1992 | 14:00:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 6/10/1992 | 14:50:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 7/15/1992 | 14:00:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 8/11/1992 | 14:00:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 9/14/1992 | 14:30:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 10/20/1992 | 14:45:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 11/17/1992 | 14:45:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 12/15/1992 | 14:10:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 12/16/1992 | 14:10:00 | Phosphorus as P | 0.019 | mg/l | 0.019 | Total |
| 1/12/1993 | 15:15:00 | Phosphorus as P | 0.025 | mg/l | 0.025 | Total |
| 2/17/1993 | 15:50:00 | Phosphorus as P | 0.045 | mg/l | 0.045 | Total |
| 3/16/1993 | 15:10:00 | Phosphorus as P | 0.049 | mg/l | 0.049 | Total |
| 4/6/1993 | 16:00:00 | Phosphorus as P | 0.036 | mg/l | 0.036 | Total |
| 4/21/1993 | 15:30:00 | Phosphorus as P | 0.023 | mg/l | 0.023 | Total |
| 5/5/1993 | 15:10:00 | Phosphorus as P | 0.064 | mg/l | 0.064 | Total |
| 5/18/1993 | 15:40:00 | Phosphorus as P | 0.056 | mg/l | 0.056 | Total |
| 6/15/1993 | 15:15:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 8/19/1993 | 13:30:00 | Phosphorus as P | 0.027 | mg/l | 0.027 | Total |
| 11/16/1993 | 15:00:00 | Phosphorus as P | 0.014 | mg/l | 0.014 | Total |
| 2/15/1994 | 15:30:00 | Phosphorus as P | 0.024 | mg/l | 0.024 | Total |
| 5/17/1994 | 14:30:00 | Phosphorus as P | 0.025 | mg/l | 0.025 | Total |
| 8/18/1994 | 11:30:00 | Phosphorus as P | 0.022 | mg/l | 0.022 | Total |
| 11/16/1994 | 16:45:00 | Phosphorus as P | 0.01 | mg/l | 0.01 | Total |
| 2/15/1995 | 14:40:00 | Phosphorus as P | 0.025 | mg/l | 0.025 | Total |
| 5/16/1995 | 15:00:00 | Phosphorus as P | 0.041 | mg/l | 0.041 | Total |
| 8/18/1995 | 10:00:00 | Phosphorus as P | 0.02 | mg/l | 0.02 | Total |
| 2/27/1996 | 12:15:00 | Phosphorus as P | 0.036 | mg/l | 0.036 | Total |
| 5/14/1996 | 15:00:00 | Phosphorus as P | 0.06 | mg/l | 0.06 | Total |
| 1/15/1992 | 14:00:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 2/12/1992 | 12:55:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 3/11/1992 | 13:20:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 4/8/1992 | 14:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 4/22/1992 | 16:00:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/6/1992 | 13:20:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/20/1992 | 14:00:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 6/10/1992 | 14:50:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 7/15/1992 | 14:00:00 | Phosphorus, orthophosphate as P | 0 | mg/l | 0 | Dissolved |
| 8/11/1992 | 14:00:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 9/14/1992 | 14:30:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 10/20/1992 | 14:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 11/17/1992 | 14:45:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 12/15/1992 | 14:10:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |

MONT-DEQ Montana Department of Environmental Quality
4214CL01 Clark Fork River near Deep Creek Confluence
Latitude Longitude
46.932088 -114.2087

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|---|---|---|---|---|---|---|
| 12/16/1992 | 14:10:00 | Phosphorus, orthophosphate as P | 0.009 | mg/l | 0.009 | Dissolved |
| 1/12/1993 | 15:15:00 | Phosphorus, orthophosphate as P | 0.017 | mg/l | 0.017 | Dissolved |
| 2/17/1993 | 15:50:00 | Phosphorus, orthophosphate as P | 0.019 | mg/l | 0.019 | Dissolved |
| 3/16/1993 | 15:10:00 | Phosphorus, orthophosphate as P | 0.017 | mg/l | 0.017 | Dissolved |
| 4/6/1993 | 16:00:00 | Phosphorus, orthophosphate as P | 0.007 | mg/l | 0.007 | Dissolved |
| 4/21/1993 | 15:30:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 5/5/1993 | 15:10:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 5/18/1993 | 15:40:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 6/15/1993 | 15:15:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 8/19/1993 | 13:30:00 | Phosphorus, orthophosphate as P | 0.017 | mg/l | 0.017 | Dissolved |
| 11/16/1993 | 15:00:00 | Phosphorus, orthophosphate as P | 0.003 | mg/l | 0.003 | Dissolved |
| 2/15/1994 | 15:30:00 | Phosphorus, orthophosphate as P | 0.011 | mg/l | 0.011 | Dissolved |
| 5/17/1994 | 14:30:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 8/18/1994 | 11:30:00 | Phosphorus, orthophosphate as P | 0.002 | mg/l | 0.002 | Dissolved |
| 11/16/1994 | 16:45:00 | Phosphorus, orthophosphate as P | 0.003 | mg/l | 0.003 | Dissolved |
| 2/15/1995 | 14:40:00 | Phosphorus, orthophosphate as P | 0.01 | mg/l | 0.01 | Dissolved |
| 5/16/1995 | 15:00:00 | Phosphorus, orthophosphate as P | 0.009 | mg/l | 0.009 | Dissolved |
| 8/18/1995 | 10:00:00 | Phosphorus, orthophosphate as P | 0.004 | mg/l | 0.004 | Dissolved |
| 2/27/1996 | 12:15:00 | Phosphorus, orthophosphate as P | 0.008 | mg/l | 0.008 | Dissolved |
| 5/14/1996 | 15:00:00 | Phosphorus, orthophosphate as P | 0.006 | mg/l | 0.006 | Dissolved |
| 1/15/1992 | 14:00:00 | Residue | 1.7 | mg/l | 1.7 | Non-filterable |
| 1/15/1992 | 14:00:00 | Residue | 0.6 | mg/l | 0.6 | |
| 2/12/1992 | 12:55:00 | Residue | 6.7 | mg/l | 6.7 | Non-filterable |
| 2/12/1992 | 12:55:00 | Residue | 1.5 | mg/l | 1.5 | |
| 3/11/1992 | 13:20:00 | Residue | 9.8 | mg/l | 9.8 | Non-filterable |
| 3/11/1992 | 13:20:00 | Residue | 2.1 | mg/l | 2.1 | |
| 4/8/1992 | 14:45:00 | Residue | 8 | mg/l | 8 | Non-filterable |
| 4/8/1992 | 14:45:00 | Residue | 1.6 | mg/l | 1.6 | |
| 4/22/1992 | 16:00:00 | Residue | 13 | mg/l | 13 | Non-filterable |
| 4/22/1992 | 16:00:00 | Residue | 2.5 | mg/l | 2.5 | |
| 5/6/1992 | 13:20:00 | Residue | 16.89 | mg/l | 16.89 | Non-filterable |
| 5/6/1992 | 13:20:00 | Residue | 2.8 | mg/l | 2.8 | |
| 5/20/1992 | 14:00:00 | Residue | 14.3 | mg/l | 14.3 | Non-filterable |
| 5/20/1992 | 14:00:00 | Residue | 2.7 | mg/l | 2.7 | |
| 6/10/1992 | 14:50:00 | Residue | 4.2 | mg/l | 4.2 | Non-filterable |
| 6/10/1992 | 14:50:00 | Residue | 1.3 | mg/l | 1.3 | |
| 7/15/1992 | 14:00:00 | Residue | 2.7 | mg/l | 2.7 | Non-filterable |
| 7/15/1992 | 14:00:00 | Residue | 0.7 | mg/l | 0.7 | |
| 8/11/1992 | 14:00:00 | Residue | 2.8 | mg/l | 2.8 | Non-filterable |
| 8/11/1992 | 14:00:00 | Residue | 0.9 | mg/l | 0.9 | |
| 9/14/1992 | 14:30:00 | Specific Conductance | 269 | umho/cm | 269 | |
| 10/20/1992 | 14:45:00 | Specific Conductance | 276 | umho/cm | 276 | |
| 11/17/1992 | 14:45:00 | Specific Conductance | 280 | umho/cm | 280 | |
| 12/15/1992 | 14:10:00 | Specific Conductance | 281 | umho/cm | 281 | |
| 12/16/1992 | 14:10:00 | Specific Conductance | 281 | umho/cm | 281 | |
| 1/12/1993 | 15:15:00 | Specific Conductance | 303 | umho/cm | 303 | |
| 2/17/1993 | 15:50:00 | Specific Conductance | 305 | umho/cm | 305 | |
| 3/16/1993 | 15:10:00 | Specific Conductance | 255 | umho/cm | 255 | |
| 4/6/1993 | 16:00:00 | Specific Conductance | 195 | umho/cm | 195 | |
| 4/21/1993 | 15:30:00 | Specific Conductance | 217 | umho/cm | 217 | |
| 5/5/1993 | 15:10:00 | Specific Conductance | 179 | umho/cm | 179 | |
| 5/18/1993 | 15:40:00 | Specific Conductance | 125 | umho/cm | 125 | |
| 6/15/1993 | 15:15:00 | Specific Conductance | 175 | umho/cm | 175 | |
| 8/19/1993 | 13:30:00 | Specific Conductance | 240 | umho/cm | 240 | |

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| MONT-DEQ | Montana Department of Environmental Quality |
| 4214CL01 | Clark Fork River near Deep Creek Confluence |
| Latitude | Longitude |
| 46.932088 | -114.2087 |

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|---|---|---|---|---|---|---|
| 11/16/1993 | 15:00:00 | Specific Conductance | 275 | umho/cm | 275 | |
| 2/15/1994 | 15:30:00 | Specific Conductance | 280 | umho/cm | 280 | |
| 5/17/1994 | 14:30:00 | Specific Conductance | 146 | umho/cm | 146 | |
| 8/18/1994 | 11:30:00 | Specific Conductance | 263 | umho/cm | 263 | |
| 11/16/1994 | 16:45:00 | Specific Conductance | 277 | umho/cm | 277 | |
| 2/15/1995 | 14:40:00 | Specific Conductance | 257 | umho/cm | 257 | |
| 5/16/1995 | 15:00:00 | Specific Conductance | 169 | umho/cm | 169 | |
| 8/18/1995 | 10:00:00 | Specific Conductance | 212 | umho/cm | 212 | |
| 2/27/1996 | 12:15:00 | Specific Conductance | 210 | umho/cm | 210 | |
| 5/14/1996 | 15:00:00 | Specific Conductance | 137 | umho/cm | 137 | |
| 1/15/1992 | 14:00:00 | Temperature, water | 1 | deg C | 1 | |
| 2/12/1992 | 12:55:00 | Temperature, water | 3.2 | deg C | 3.2 | |
| 3/11/1992 | 13:20:00 | Temperature, water | 6.4 | deg C | 6.4 | |
| 4/8/1992 | 14:45:00 | Temperature, water | 7.3 | deg C | 7.3 | |
| 4/22/1992 | 16:00:00 | Temperature, water | 8.5 | deg C | 8.5 | |
| 5/6/1992 | 13:20:00 | Temperature, water | 13 | deg C | 13 | |
| 5/20/1992 | 14:00:00 | Temperature, water | 13.3 | deg C | 13.3 | |
| 6/10/1992 | 14:50:00 | Temperature, water | 19 | deg C | 19 | |
| 7/15/1992 | 14:00:00 | Temperature, water | 19 | deg C | 19 | |
| 8/11/1992 | 14:00:00 | Temperature, water | 19.79 | deg C | 19.79 | |
| 9/14/1992 | 14:30:00 | Temperature, water | 13 | deg C | 13 | |
| 10/20/1992 | 14:45:00 | Temperature, water | 10 | deg C | 10 | |
| 11/17/1992 | 14:45:00 | Temperature, water | 5 | deg C | 5 | |
| 12/15/1992 | 14:10:00 | Temperature, water | 2 | deg C | 2 | |
| 12/16/1992 | 14:10:00 | Temperature, water | 2 | deg C | 2 | |
| 5/14/1996 | 15:00:00 | Temperature, water | 9 | deg C | 9 | |
| 1/15/1992 | 14:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 2/12/1992 | 12:55:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 3/11/1992 | 13:20:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 4/8/1992 | 14:45:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 4/22/1992 | 16:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 5/6/1992 | 13:20:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 5/20/1992 | 14:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 6/10/1992 | 14:50:00 | Zinc | 0 | ug/l | *Present >QL | Total |
| 7/15/1992 | 14:00:00 | Zinc | 0 | ug/l | *Present >QL | Total |