

## **APPENDIX A**

# **WATERSHED CHARACTERIZATION REPORT JEFFERSON RIVER WATER QUALITY RESTORATION PLANNING AREAS**



## TABLE OF CONTENTS

1.0 WATERSHED CHARACTERIZATION .....	9
1.1 Physical Characteristics .....	9
1.1.1 Location .....	9
1.1.2 Climate .....	11
1.1.3 Hydrology .....	14
1.1.4 Irrigation Practices .....	18
1.1.5 Channel Morphology .....	20
1.1.6 Topography, Slope, and Relief .....	23
1.1.7 Major Land Resource Areas .....	27
1.1.8 Land Ownership .....	28
1.1.9 Vegetative Cover .....	29
1.1.10 Land Use and Land Cover .....	32
1.1.11 Geology .....	34
1.1.12 Soils .....	37
1.1.13 Mineral Extraction and Mining .....	43
1.1.14 Point Source Discharges .....	43
1.2 Fisheries .....	45
1.3 Orthophoto Quadrangle Maps .....	47
1.4 Water Quality Monitoring Stations .....	47
2.0 REFERENCE SOURCES .....	51

## Appendices

Appendix A Summary Climatic Data for Selected NOAA Stations, Jefferson River Planning Areas .....	53
Appendix B USGS Gauging Stations, Jefferson River Planning Areas .....	57
Appendix C Major Land Resource Areas (MLRAs), Jefferson River Planning Areas .....	59
Appendix D Soil Series of the Jefferson River Planning Areas, Jefferson River Planning Areas .....	63
Appendix E Mineral Prospects and Operations, Jefferson River Planning Areas .....	67



## FIGURES

Figure 1	Location Map
Figure 2	303(d) Streams
Figure 3	Elevation and Average Annual Snowfall and Precipitation Twin Bridges, Pony, and Norris NOAA Stations
Figure 4	Pony NOAA Station 246655
Figure 5	Norris NOAA Station 246153
Figure 6	Twin Bridges NOAA Station 248430
Figure 7	USGS Stations
Figure 8	Average Monthly Flows at 2 USGS Jefferson River Gauging Stations
Figure 9	Average Monthly Flows at 4 USGS Gauging Stations on 303(d)-listed Streams
Figure 10	Irrigated Lands
Figure 11	Elevation
Figure 12	Slope (Percent)
Figure 13	Shaded Relief
Figure 14	Major Land Resource Area
Figure 15	Ownership
Figure 16	Vegetation Cover
Figure 17	Land Use and Land Cover
Figure 18	Geology
Figure 19	General Soil Units
Figure 20	Soil Clay Content
Figure 21	Soil Permeability
Figure 22	Soil Salinity
Figure 23	USLE K-factor
Figure 24	Mines and Prospects
Figure 25	Point Source Discharge Locations
Figure 26	Westslope Cutthroat Distribution
Figure 27	Digital Orthophoto Quadrangle Maps
Figure 28	Water Quality Monitoring Stations



**TABLES**

Table 1	Average January, July, and Annual Minimum and Maximum Temperatures at the Twin Bridges, Pony, and Norris NOAA Climate Stations (degrees F)
Table 2	Selected USGS Stream Gauges in the Jefferson River Planning Areas
Table 3	Irrigation by County in the Jefferson River Planning Areas
Table 4	Major Irrigation Projects in the Jefferson River Planning Areas
Table 5	Stream Morphology and Functional Status Summary for Selected Streams in the Big Pipestone 5 <sup>th</sup> Code HUC
Table 6	Stream Morphology and Functional Status Summary for Selected Streams in the Hells Canyon 5 <sup>th</sup> Code HUC
Table 7	Stream Morphology and Functional Status Summary for Selected Streams in the South Boulder River 5 <sup>th</sup> Code HUC
Table 8	Elevation in the Jefferson River Planning Areas
Table 9	Slope in the Jefferson River Planning Areas
Table 10	Major Land Resource Areas of the Jefferson River Planning Areas
Table 11	Land Ownership within the Jefferson River Planning Areas
Table 12	Vegetation Classification (GAP) within the Jefferson River Planning Areas
Table 13	Land Use and Land Cover in the Jefferson River Planning Areas
Table 14	Geology of the Jefferson River Planning Areas
Table 15	Major Soil Series within the Jefferson River Planning Areas
Table 16	Soil Clay Content in the Jefferson River Planning Areas
Table 17	Soil Permeability in the Jefferson River Planning Areas
Table 18	Soil Salinity in the Jefferson River Planning Areas
Table 19	Soil Erosion K Factor in the Jefferson River Planning Areas
Table 20	Point Source Discharges





## 1.0 WATERSHED CHARACTERIZATION

This document has been prepared to provide an overview of watershed characteristics in the Jefferson River drainage of southwestern Montana. It is intended to provide a general understanding of physical, climatic, hydrologic, and other ecological features within the Jefferson watershed. This watershed characterization report is a companion to a second document, the *Jefferson Watershed Water Quality Status Report*, which reviews and describes water quality conditions of streams within the Jefferson drainage basin and provides monitoring recommendations. Together, the reports are intended to provide a foundation for water quality restoration planning and implementation activities by the Jefferson River Watershed Council, the Jefferson Valley Conservation District, and cooperating landowners and agencies.

### 1.1 Physical Characteristics

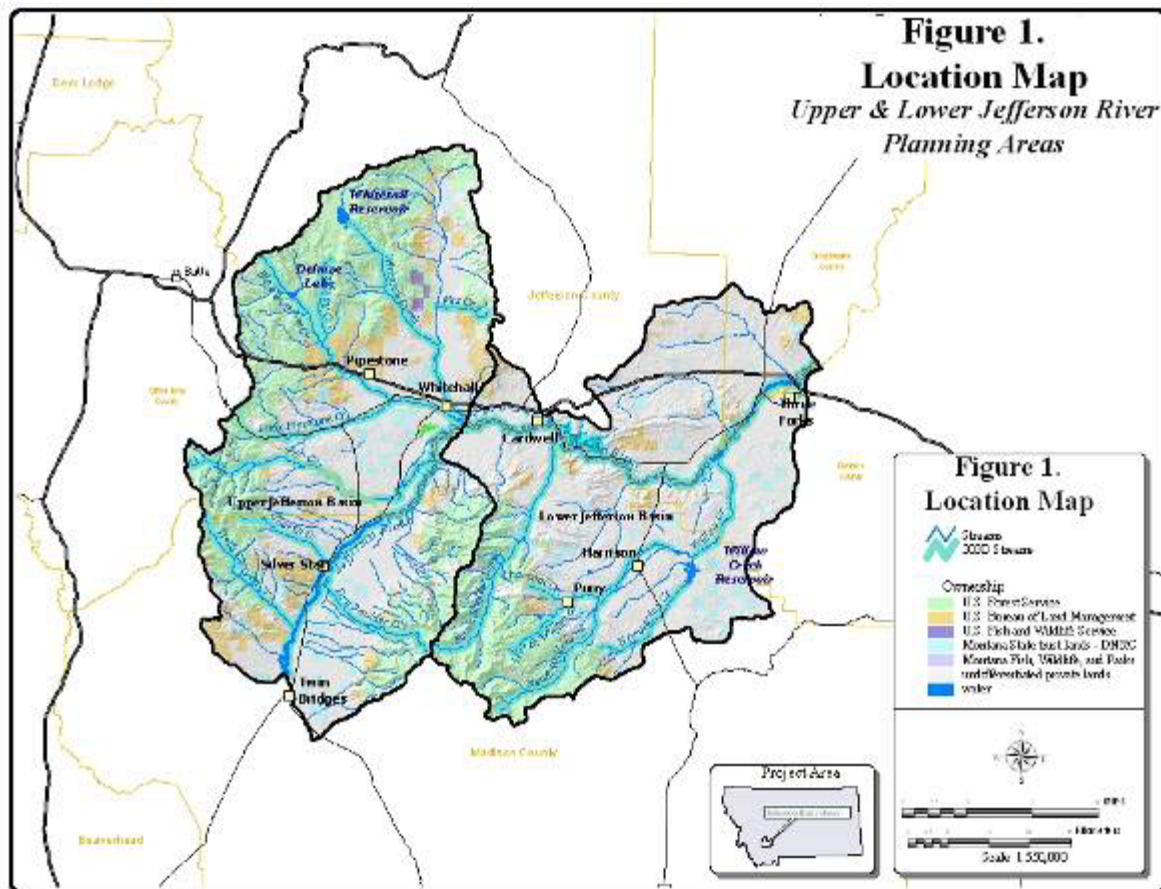
#### 1.1.1 Location

The Montana Department of Environmental Quality (DEQ) has divided the Jefferson River watershed into two regions (Upper and Lower. See map **Figure 1**) for purposes of developing water quality restoration plans. These planning area designations have been used in this report for purposes of organizing the watershed characterization information. The terms “watershed” and “planning area” are used interchangeably throughout the report.

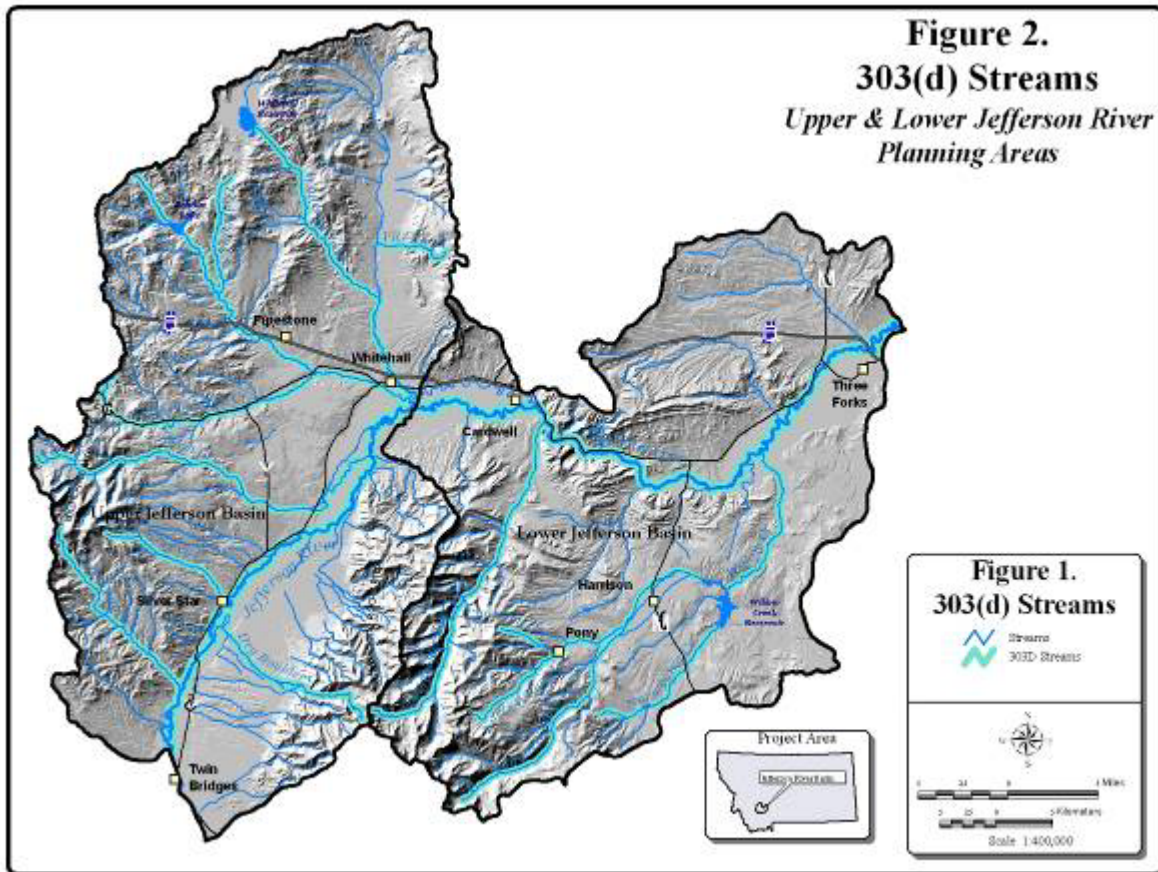
The Upper Jefferson River Planning Area encompasses a geographic area of approximately 469,994 acres, and the Lower Jefferson River Planning Area encompasses approximately 385,649 acres, for a combined total area of 855,643 acres (NRIS 2002). The boundary of the combined planning areas extends from Three Forks, MT at the watershed’s eastern extreme, south along the Madison/Jefferson hydrologic divide, turning east near the Willow Creek Reservoir and following the ridges of the Tobacco Root Mountains to the vicinity of Twin Bridges, MT. From this point, the boundary turns north, following the Big Hole/Jefferson divide through the Highland Mountains, eventually passing just east of Butte, and then north of Whitetail Reservoir. The watershed boundary then roughly follows the Boulder River divide south and east back to Three Forks. The combined planning area includes portions of Jefferson, Madison, Broadwater, Gallatin, and Silver Bow counties, and has diverse federal, state, and private ownership (**Figure 1**).

Major rivers and streams within the planning area include the Jefferson River, which is approximately 83.5 miles in length, flowing north from Twin Bridges to Whitehall, then east to Cardwell and eventually to the Missouri River at Three Forks, as well as its larger tributaries including Pipestone Creek, Whitetail Creek, the South Boulder River, and Willow Creek. The tributary watersheds originate high in the Tobacco Root and Highland Mountains in the Beaverhead and Deerlodge National Forests and traverse a relatively wide, flat expanse of agricultural and range land before terminating at their confluence with the Jefferson River.

Seventeen streams or stream segments within the Jefferson watershed planning area have appeared on DEQ's *Montana 303(d) List: A Compilation of Impaired and Threatened Waterbodies in Need of Water Quality Restoration*. Waters placed on this list are suspected of failing to meet state-designated water quality standards, and restoration plans are required to be developed. Ten of these streams are located in the Upper Jefferson River Planning Area, including Big Pipestone Creek, Cherry Creek, Dry Boulder Creek, Fish Creek, Fitz Creek, Halfway Creek, Hells Canyon Creek, Little Pipestone Creek, Whitetail Creek, and the Jefferson River from its headwaters to its confluence with Big Pipestone Creek. The remaining seven streams are in the Lower Jefferson River Planning Area and include Charcoal Creek, North Willow Creek, Norwegian Creek, the South Boulder River, South Willow Creek, Willow Creek, and the Jefferson River from Big Pipestone Creek to the Missouri River (MDEQ 2002a, MDEQ 2002b) (Figure 2).



**Figure 1.** Location Map Upper and Lower Jefferson River Planning Areas.



**Figure 2. 303(d) Streams**

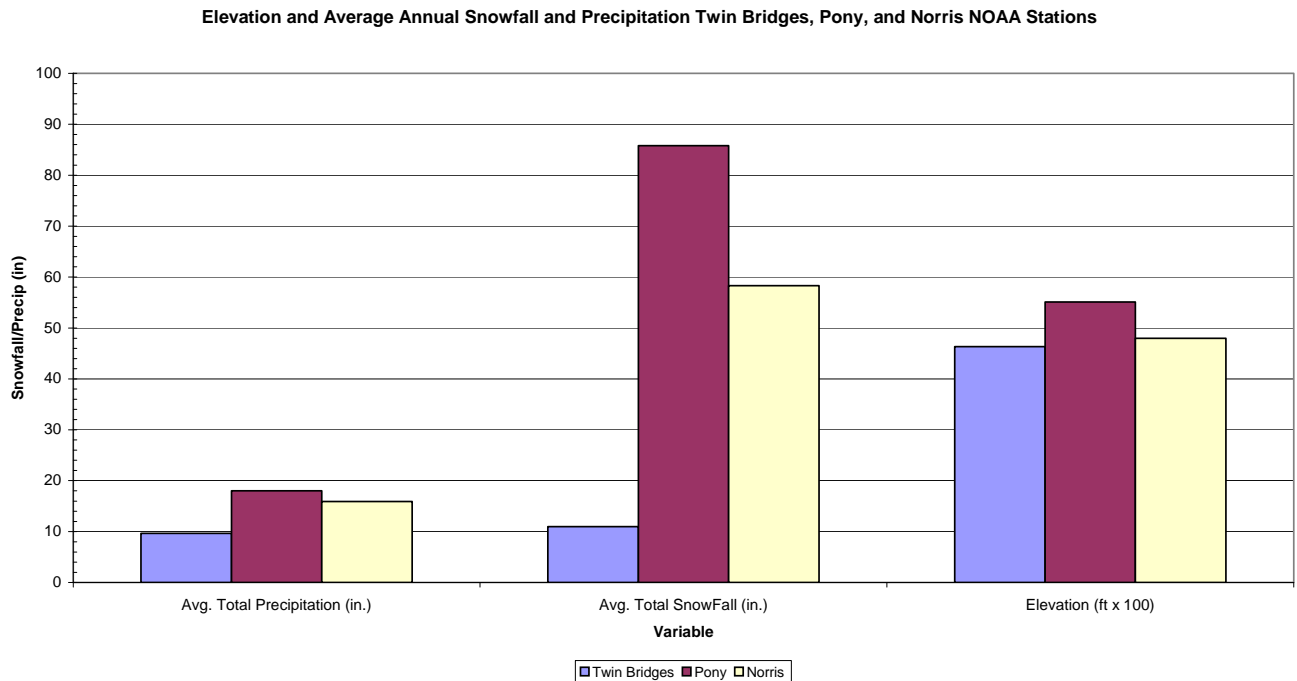
### 1.1.2 Climate

Three National Oceanic and Atmospheric Administration (NOAA) stations were selected to represent climatic conditions in the Jefferson watershed (Twin Bridges #248430, Pony #246655, and Norris #246153). The Norris station is located just outside of the southeastern boundary of the watershed; the stations at Twin Bridges and Pony are within the watershed. The period of record differs at the three stations: Norris (1957 to 1982), Pony (1959 to 1998), Twin Bridges (1950 to 2002).

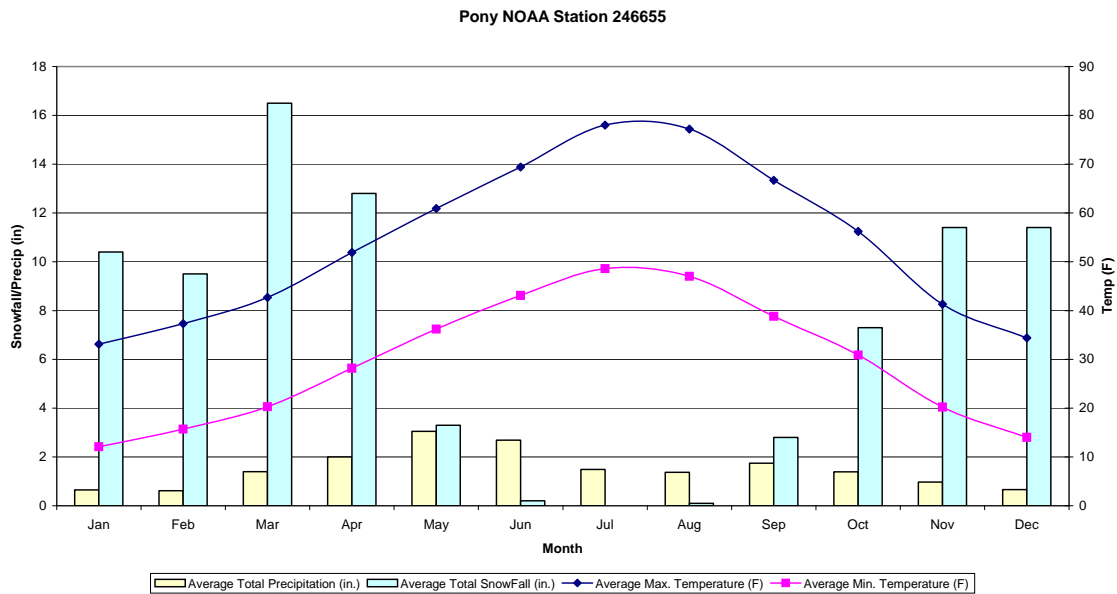
Unfortunately, the elevation range covered by the NOAA stations extends only from 4,630 feet at Twin Bridges to 5,510 feet at Pony. It should be noted that elevations in the Jefferson River Planning Area extend beyond 10,000 feet, and that the selected stations do not fully represent meteorological conditions in higher elevation portions of the mountainous region. However, precipitation shows strong orographic effects even across this relatively small elevation change. Annual precipitation at 4,630 feet in Twin Bridges averages 9.65 inches/year with 11 inches of annual snowfall. Average annual precipitation at the mid-elevation station in Norris (4,800 ft) increases to 15.91 inches/year with 58.3 inches of annual snowfall; and average annual

precipitation increases further at the Pony site (5,510 feet), where average annual precipitation is 18.02 inches/year with 85.8 inches of snowfall (**Figure 3**). While elevation differences undoubtedly account for some of the variability in precipitation between these sites, weather patterns are also strongly influenced by surrounding mountain peaks, which exceed 10,000 feet in the Tobacco Roots. NOAA climate data were obtained from the Western Regional Climate Center at <http://www.wrcc.dri.edu/summary/climsmmt.html>.

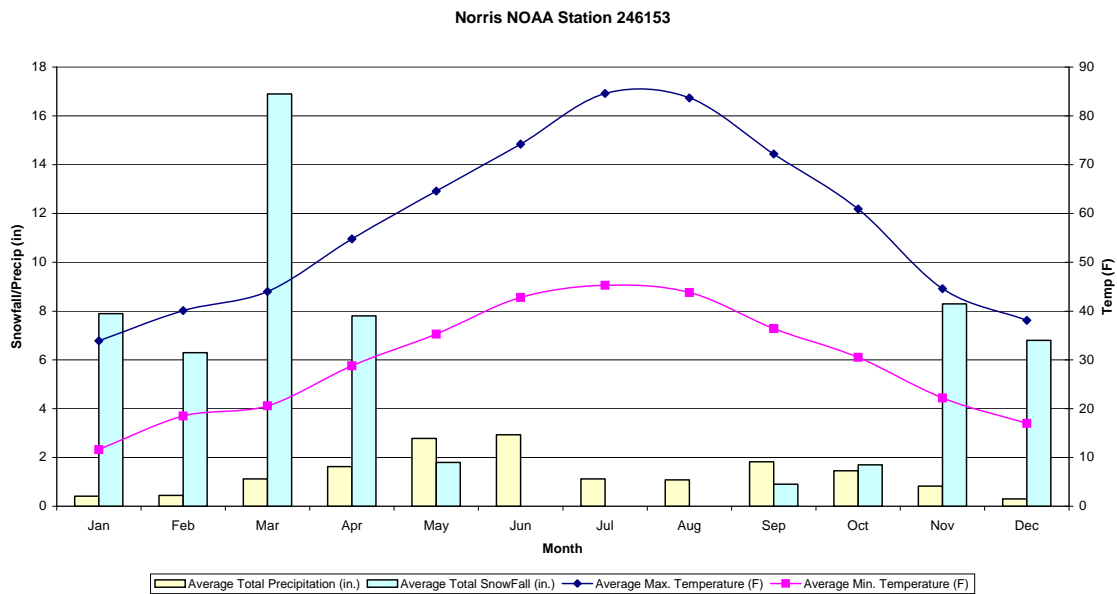
**Figure 3. Average Annual Precipitation**



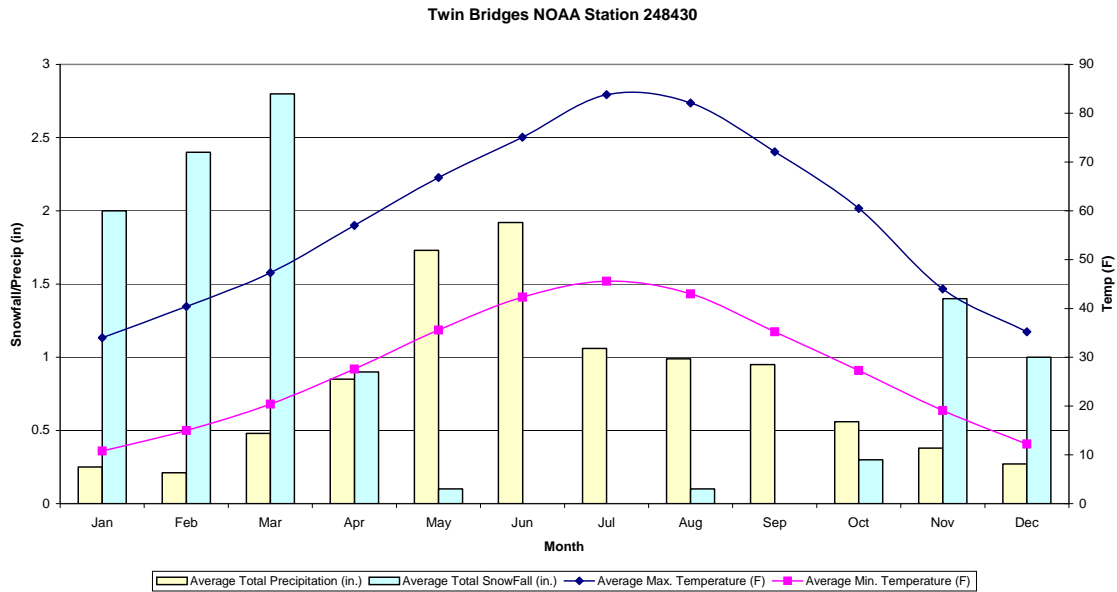
Average annual precipitation and temperature patterns for the three selected stations are presented in **Figures 4, 5, and 6**. Temperature patterns are similar for all three stations, with July the warmest month and January the coldest at all stations. Summertime highs are typically in the high seventies to low eighties F, and winter lows fall to approximately 11 degrees F (**Table 1**). Precipitation patterns also reveal a high degree of consistency between the three NOAA stations, with May and June being the wettest months at all sites and winter precipitation dominated by snowfall. A complete summary of NOAA climatic data for the selected stations is presented in **Appendix A**.



**Figure 4. Average Annual Precipitation and Temperature Patterns for Pony**



**Figure 5. Average Annual Precipitation and Temperature Patterns for Norris**



**Figure 6. Average Annual Precipitation and Temperature Patterns for Twin Bridges**

**Table 1. Average January, July, and Annual Minimum and Maximum Temperatures at the Twin Bridges, Pony, and Norris NOAA Climate Stations (degrees F)**

Station	Average January Min/Max Temperatures	Average July Min/Max Temperatures	Av Annual Min/Max Temperatures
Twin Bridges	10.8/34.0	45.6/83.8	27.8/58.2
Pony	12.1/33.1	47.0/77.2	29.6/54.1
Norris	11.6/33.9	45.3/84.6	29.4/58.0

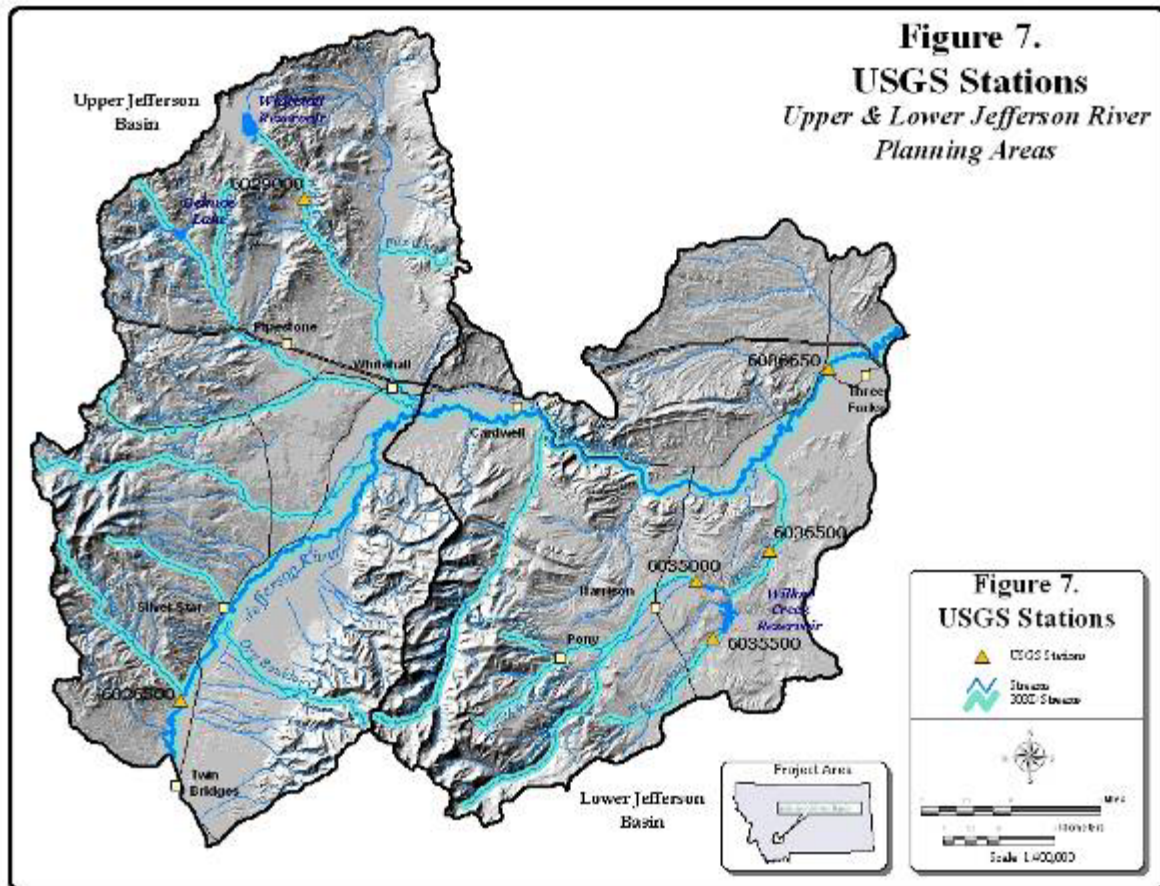
### 1.1.3 Hydrology

The U.S. Geological Survey (USGS) Montana water resources information database (<http://montana.usgs.gov/>) lists 24 stream flow gauging stations with current and historical flow data in the Jefferson River Planning Areas (**Appendix B**). Long-term flow data were selected for six stations on 303(d)-listed streams to obtain a general understanding of seasonal stream flow characteristics in the Jefferson watershed. These stations included the Jefferson River near Twin Bridges, Jefferson River near Three Forks, Whitetail Creek near Whitehall, Willow Creek near Harrison, Willow Creek near Willow Creek, and Norwegian Creek near Harrison (**Table 2** and **Figure 7**).



**Table 2. Selected USGS Stream Gauges in the Jefferson River Planning Areas**

USGS #	Station ID	Period of Record	Drainage Area (mi <sup>2</sup> )
06026500	Jefferson River near Twin Bridges	1940-1943, 1958-1972, 1994-present	7,632
06036650	Jefferson River near Three Forks	1978-present	9,532
06029000	Whitetail Creek near Whitehall	1949-1968	30.8
06035000	Willow Creek near Harrison	1938-present	83.8
06036500	Willow Creek near Willow Creek	1919-1933, 1946-1953, 1955-1957	165
06035500	Norwegian Creek near Harrison	1938-1943, 1946-1951	22.4



**Figure 7. USGS Stations**

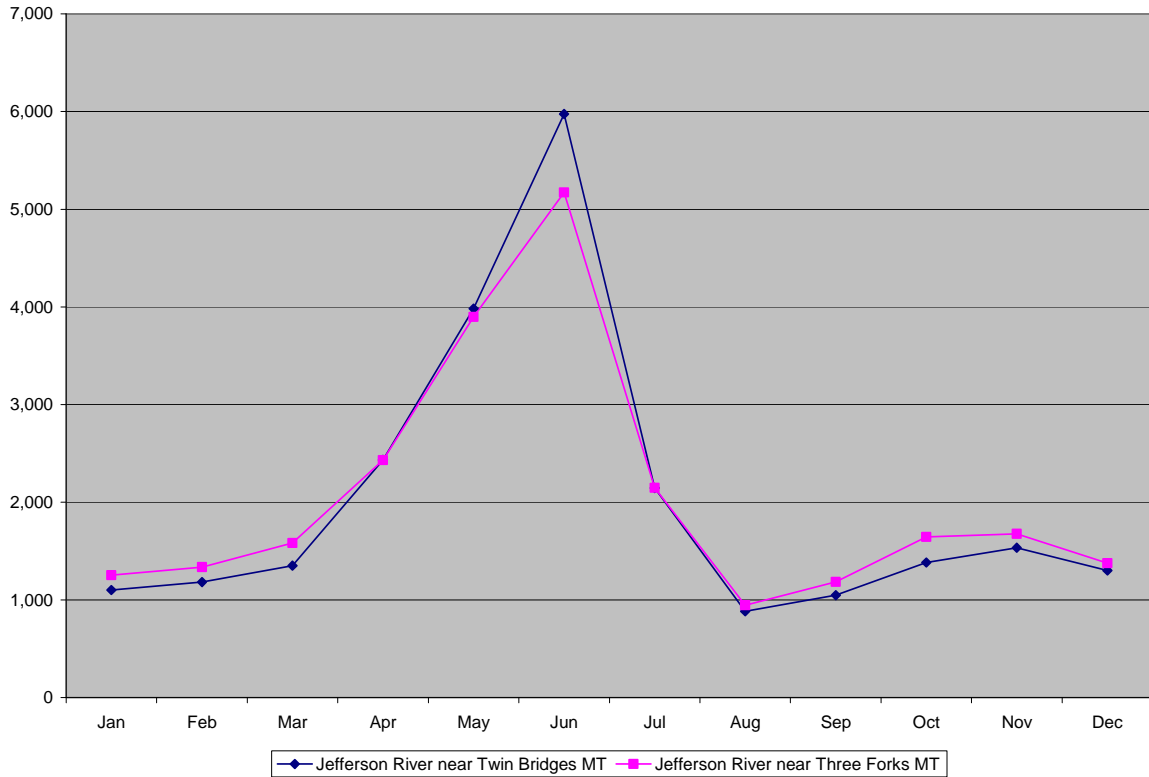
Average discharge patterns for the two Jefferson River gaging sites are presented in **Figure 8**. The period of record for the two stations differs as described in **Table 2**. Average monthly flows for the two stations show similar seasonal patterns, with relatively constant flows of between 1,000 and 1,700 cubic feet per second (cfs) during the fall and winter months. Observed

increases in stream flows in September and October probably reflect decreasing irrigation water withdrawals or possibly irrigation return flows in these months. Spring high flows begin in March, the hydrographs peak in June, and the recessional limbs begin in late June/early July. Since about 1980, recurring drought has resulted in summer stream flows that are considerably lower than those represented by the long-term average, with flows as low as 59 cfs recorded at Three Forks in August of 1988.

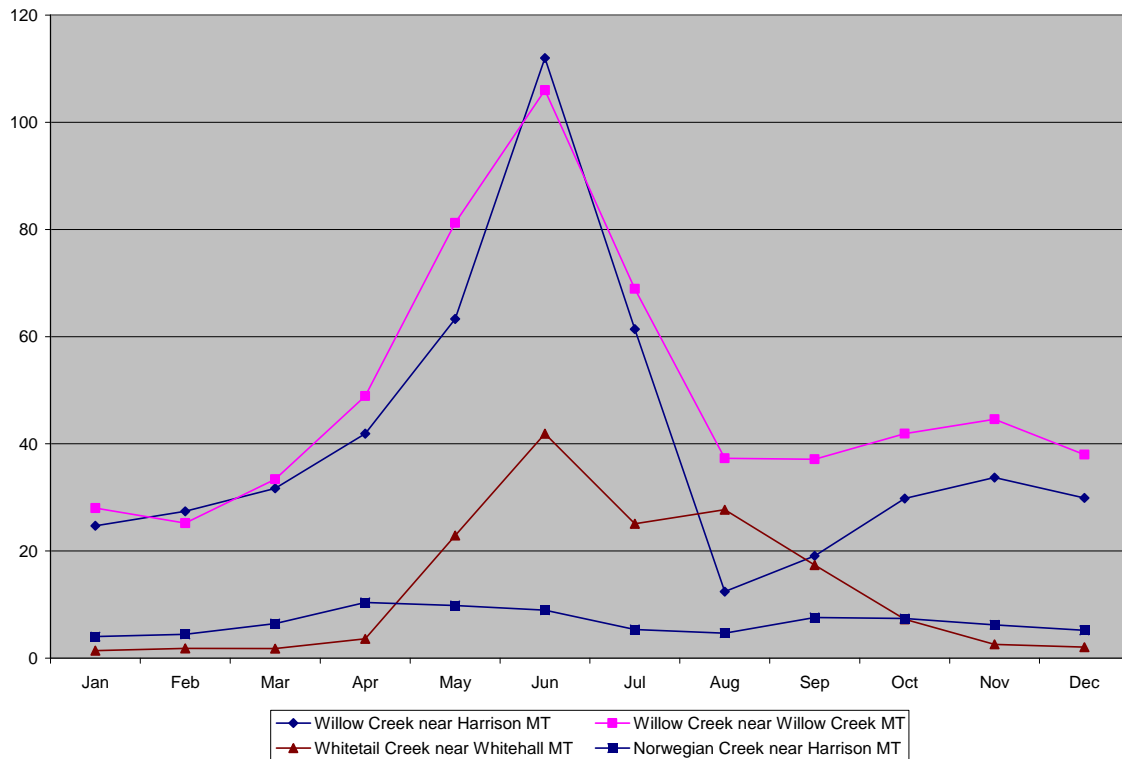
Average monthly stream flows for the four tributary stations are presented in **Figure 9**. Base flows in Whitetail Creek during the fall and winter average between 1.5 and 2.5 cfs. In April, flows begin to increase, peaking in June at 41.9 cfs and then declining through the summer and early fall, with a small increase in flow in August. The Whitetail Creek hydrograph is influenced to some degree by flows released from Whitetail Reservoir, which is located in the headwaters.

Norwegian Creek is one of the primary sources of water for the Willow Creek Reservoir. The Norwegian Creek hydrograph reveals relatively little variation in flow, with baseflows of approximately 4 cfs and peak flows of about 10 cfs, reflecting a small drainage area and, perhaps, the influence of springs. However, the Norwegian Creek data is at least 50 years old, and may not accurately represent current conditions. The two Willow Creek sites show similar seasonal patterns with flows increasing in the spring in conjunction with melting snows and increasing precipitation, peaking in June at both sites and receding through July and August. Baseflows are higher at the downstream site near Willow Creek, MT, reflecting the contribution of water from Willow Creek's tributaries and a larger drainage area at this site. However, the data from this site is at least 50 years old and may not accurately reflect current water supply and stream flow conditions (**Figure 9**).





**Figure 8. Average Monthly Flows at 2 USGS Jefferson River Gauging Stations**



**Figure 9. Average Monthly Flows at 4 USGS Gauging Stations on 303(d)-listed Streams**

### 1.1.4 Irrigation Practices

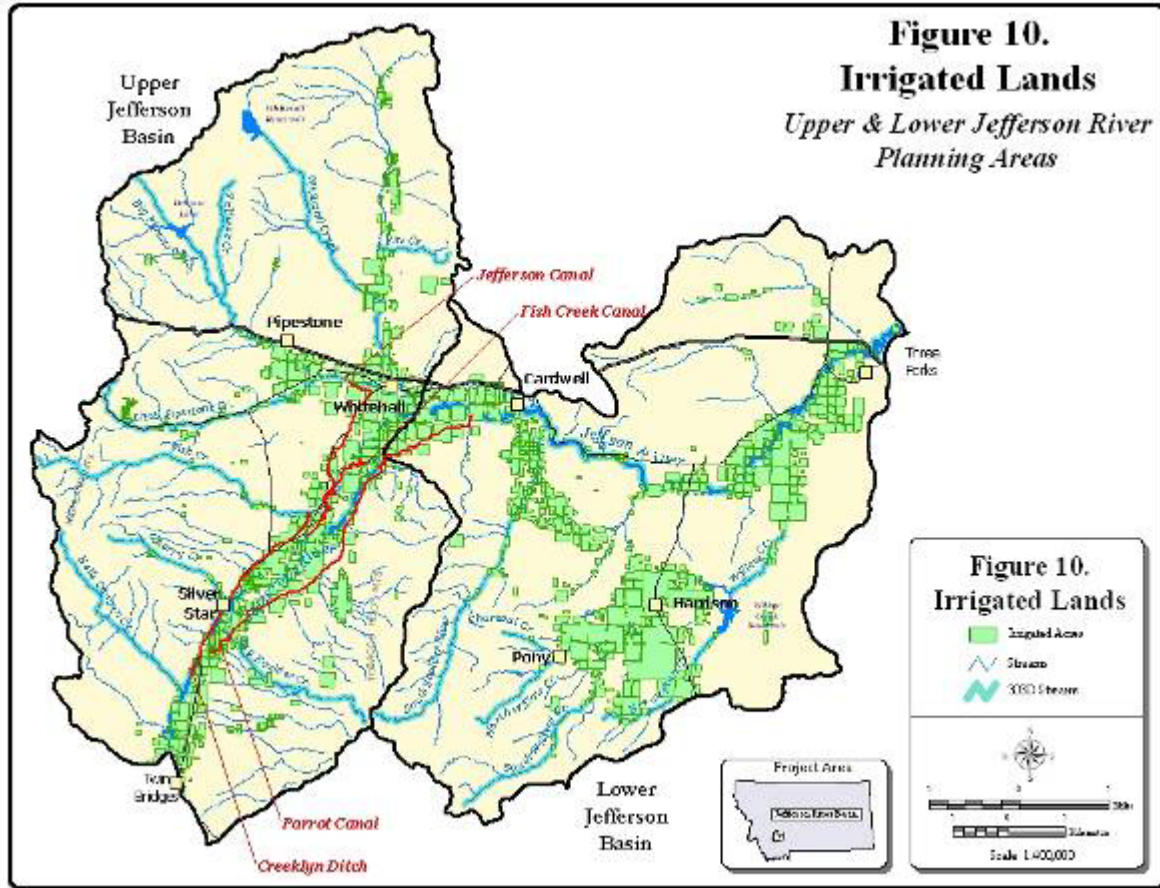
The locations of irrigated lands within the Jefferson River watershed were recently compiled by the Montana Department of Natural Resources and Conservation (DNRC). These data are presented in **Figure 10**. The data consist of the estimated locations of recorded points of diversion and points of use for all active water rights within the DNRC water rights database. The shaded polygons were generated from legal land descriptions associated with water rights in the database and do not represent actual field boundaries (Horton 2003). Also presented are irrigation reservoirs and the major ditches for which mapping data are currently available from the DNRC. Within the Upper Jefferson Planning Area, 42,384 acres, or 9 percent of the total land area, is irrigated. In the Lower Jefferson Planning Area, 58,544 acres, or 15 percent of the total land area, is irrigated. In the two planning areas combined, 100,928 acres, or 12 percent of the total land area, is irrigated.

Nearly 85 percent of all irrigation in the Jefferson River Planning Areas occurs in Madison and Jefferson counties, which account for 86 percent of the total land area (**Table 3**). Madison County represents 46 percent of the Jefferson watershed land area and 56 percent of the basin’s irrigated lands. Jefferson County represents 40 percent of the watershed land area, and 28 percent of the irrigated lands.

**Table 3. Irrigation by County in the Jefferson River Planning Areas**

County	Irrigated Acres	% of Irrigated Lands	Total Acres in Planning Area	% of County Irrigated	% of Land in Planning Area
Madison	56,795	56%	393,484	14%	46%
Jefferson	28,510	28%	340,834	8%	40%
Gallatin	12,400	12%	4,9295	25%	6%
Broadwater	2,639	3%	32,282	8%	4%
Silver Bow	585	1%	39,730	1%	5%
<b>Total in Planning Area</b>	<b>100,929</b>	<b>100%</b>	<b>855,625</b>	<b>12%</b>	<b>100%</b>

The Montana Water Resources Surveys for Silver Bow (1955), Madison (1965), Broadwater (1956), Gallatin (1961), and Jefferson (1956) counties were reviewed to provide a summary of major irrigation projects in the Jefferson River Planning Area (**Table 4**). While some of the data may be outdated, the table provides a useful comparison of some of the more important components of the irrigation water distribution systems.



**Figure 10. Irrigated Lands**

**Table 4. Major Irrigation Projects in the Jefferson River Planning Areas**

Project Name	Counties	Source	Date Complete	Capacity (CFS)	Length (mi)	Irrigated Acres
Willow Creek Storage Project	Madison, Gallatin	Willow Cr. Res	1938	Not avail.	Not avail.	12000
Parrot Ditch Co.	Madison	Jefferson River nr Silver Star	1888	Not avail.	26	4000
Pipestone Ditch Co. and Pipestone Water Users Assn.	Jefferson	Delmoe Lake, Big Pipestone Cr.	1908	200	9	3500
Fish Creek Ditch Co. and Pleasant Valley Ditch	Jefferson, Silver Bow	Jefferson River nr Waterloo	1885	200	12	3000
Old Hale Ditch Co.	Jefferson, Broadwater	Jefferson River nr Sappington	1898	50	7.5	1500
Jefferson Canal Co.	Jefferson	Jefferson River nr Waterloo	1906	50	8	1200

Six major irrigation projects account for about 25 percent (approximately 25,000 acres) of the total irrigated acreage in the Jefferson Watershed Planning Area. The remaining 75 percent of

irrigated lands in the planning area are served by numerous smaller irrigation projects (<1000 acres) and private ditches. The largest irrigation project in the planning area, the Willow Creek Storage Project, has one main storage reservoir: Willow Creek Reservoir; known locally as Harrison Lake. The reservoir has a capacity of 17,000 acre-feet of water with the potential to irrigate 12,000 acres in the Willow Creek Valley near Harrison and Willow Creek.

Another significant irrigation project is the Parrot Ditch Co., which has the potential to irrigate approximately 4000 acres in the planning area. This 26-mile long ditch parallels the Jefferson River from Silver Star to Cardwell, and intercepts a large portion of flow from the west and north slopes of the Tobacco Root Mountains. This project provides irrigation water to the bench areas south of Whitehall from Waterloo to Cardwell.

### **1.1.5 Channel Morphology**

Channel morphology data for streams in the Jefferson River watershed are limited. The primary source of data on channel morphology located for this report was the U.S. Forest Service's draft of the Jefferson River Water Quality Restoration Plan (Salo 2002), which summarized channel morphology conditions based primarily on Rosgen Level II stream assessments. Because the primary focus of the USFS report was to address water quality impacts on federal lands, channel morphology on private lands may differ from what is described here. For the purposes of their assessment, the USFS divided the Jefferson Watershed into five hydrologic units (5<sup>th</sup> code HUCs): Big Pipestone, Hells Canyon, South Boulder River, and South and North Willow Creeks. Information contained in the USFS report and other available references are summarized in the following paragraphs:

#### **Big Pipestone 5<sup>th</sup> code HUC (1002000502)**

Most streams within this HUC (hydrologic unit code) lie within the granitic Boulder Batholith and are therefore nutrient poor, coarse-grained, and highly susceptible to erosion. Management activities within the watershed include roads and trails, timber harvest, mining, and grazing. Reservoir management affects the timing and magnitude of streamflow and sediment routing on Big Pipestone and Whitetail Creeks (Salo 2002). Streams within this HUC that appear on the 303(d) list include Big Pipestone Creek, Little Pipestone Creek, Halfway Creek, Whitetail Creek, and Fitz Creek, which appear in bold in **Table 5**. The USFS provided no data on Fitz Creek, so information was obtained from a 1994 riparian inventory conducted by the University of Montana's Riparian and Wetland Research Program (available at [www.nris.state.mt.us](http://www.nris.state.mt.us)).

**Table 5. Stream Morphology and Functional Status Summary for Selected Streams in the Big Pipestone 5<sup>th</sup> Code HUC**

(303(d)-listed streams appear in bold type)

Stream	Existing Stream Type	Potential Stream Type	Function Status	Support for Function Status (listed in order of importance)
Beaver	B5	E5	NF	Grazing, roads, timber harvest
Beefstraight	F5, E5	E5	NF, F@R	Grazing, roads, placer mining
Bigfoot	B4, G4	B4	F@R	Roads, timber harvest, grazing
<b>Big Pipestone (BLM)</b>	<b>B5c</b>	<b>B5c, C5</b>	<b>F@R</b>	<b>Roads and Trails, Reservoir management</b>
<b>Big Pipestone (below Res.)</b>	<b>F4</b>	<b>B4</b>	<b>NF</b>	<b>Reservoir management</b>
Dearborn	C4	E4a	NF	Grazing, timber harvest
<b>Fitz<sup>1</sup></b>	<b>C4, B4</b>	<b>?</b>	<b>NF</b>	<b>Grazing</b>
Grouse	E5	E5	F	Presently functioning, but vulnerable
Halfway (down)	B5	E5	NF	Grazing, roads, placer mining
Halfway (up)	E6	E5	F@R	Grazing
Haney	B4c	B4c	F	Within Roadless
International	B4	E4	NF	Placer mining
<b>Little Pipestone</b>	<b>G4c</b>	<b>E4</b>	<b>NF</b>	<b>Highway, Railroad, placer mining</b>
Moose	E6	E6	F	None Provided
NF Little Pipestone	B4c	E4	NF	Grazing, Roads
O'Neil	G5c	E5	NF	Bank instability, entrenchment – causes not known
Pappas (down)	F4/G4	E4	NF	Roads, timber harvest, grazing
Pappas (up)	G4	E4	NF	Channel entrenchment causes not known
State (BLM)	G5	E5	NF	Grazing, roads, timber harvest
Toll Canyon	G4	E4	NF	Grazing, roads/trails
<b>Whitetail</b>	<b>B5c</b>	<b>E5</b>	<b>F@R</b>	<b>Grazing, reservoir management</b>
<b>Whitetail</b>	<b>B4c</b>	<b>C4</b>	<b>NF</b>	<b>Grazing, reservoir management, roads</b>

<sup>1</sup> Data for Fitz Creek were obtained from a 1994 RWRP inventory, not from the USFS.  
NF = not functioning; F@R = functioning at risk; F = functioning

**Hells Canyon 5<sup>th</sup> code HUC (1002000501)**

The Hells Canyon/Fish Creek area includes glaciated belt rock and stream dissected granitics, while glaciated and stream dissected schists, gneiss and associated metamorphics dominate watersheds in the Tobacco Roots and slopes are steep in many areas. Many of the streams flowing from the Tobacco Roots go subsurface as they leave the confinement of the mountains, which may result in part from the existence of coarse grained alluvial fans in this area. Many streams in this HUC experience little management activity on federal lands due to steep, rugged landscapes with little access, particularly in the upper reaches of Cherry, and Hells Canyon Creeks, as well as portions of Fish Creek. Grazing and roads have contributed to sediment

loading and channel morphology degradation on portions of Hells Canyon and Fish Creeks, and portions of Fish Creek have been heavily altered by placer mining (Salo 2002). Four streams in the Hells Canyon 5<sup>th</sup> code HUC appear on the 303(d) list, including Cherry Creek, Dry Boulder Creek, Fish Creek, and Hells Canyon Creek (**Table 6**). A summary of stream types is presented in **Appendix G**.

**Table 6. Stream Morphology and Functional Status Summary for Selected Streams in the Hells Canyon 5<sup>th</sup> Code HUC**

(303(d)-listed streams appear in bold type)

Stream	Existing Stream Type	Potential Stream Type	Function Status	Support for Function Status (listed in order of importance)
Bear Gulch	E4b	E4b	F@R	Placer mining, grazing, roads
<b>Cherry Creek</b>	<b>?</b>	<b>?</b>	<b>?</b>	<b>?</b>
<b>Dry Boulder</b>	<b>A3</b>	<b>A3</b>	<b>F</b>	<b>None provided</b>
EF Hells Canyon	E4b, B4	E4b	F@R	Grazing
<b>Fish</b>	<b>B4</b>	<b>E4</b>	<b>NF</b>	<b>Grazing, roads, placer mining</b>
<b>Hells Canyon</b>	<b>C4b, B4</b>	<b>C4</b>	<b>F@R</b>	<b>Grazing</b>
<b>Hells Canyon (lower)</b>	<b>C4b</b>	<b>C4</b>	<b>F@R</b>	<b>Roads, grazing</b>
Horse	A4	B4	NF	Placer mining
Mill	B4a	B4	F@R	Roads, grazing, timber harvest

NF = not functioning; F@R = functioning at risk; F = functioning

**South Boulder River 5<sup>th</sup> code HUC (1002000505)**

The lower South Boulder watershed consists mainly of stream dissected schists and gneiss, while the upper portion is valley glaciated schists and gneiss dominated by steep slopes. Land use activities in the area are dominated by grazing and mining, with some road building and housing development in the valley bottom (Salo 2002). Morphology and functional status of select streams in this HUC are summarized in **Table 7**. The South Boulder River is the only stream in the HUC that appears on the 303(d) list, but it was not surveyed by the USFS. A summary of stream types is presented in **Attachment G**.

**Table 7. Stream Morphology and Functional Status Summary for Selected Streams in the South Boulder River 5<sup>th</sup> Code HUC**

Stream Reach	Existing Stream Type	Potential Stream Type	Function Status	Support for Function Status (listed in order of importance)
Carmichael	B5a	A4	NF	Grazing
EF South Boulder	E4	E4	F	Roadless
NF McGovern	E4	E4	F@R	Grazing
Park	B4c, E4	E4	NF	Grazing, mining
Pole Canyon	B4	E4b	NF	Grazing

NF = not functioning; F@R = functioning at risk; F = functioning

### **South and North Willow Creeks 5<sup>th</sup> code HUC (1002000506)**

Landforms and geology in this area include glaciated granitics on both South and North Willow Creeks, with valley glaciated schists/gneiss in the lower basins. Although mining impacts exist, and roads, trails, and livestock grazing affect water quality on a localized basis, most of the upper basin is within inventoried roadless areas (Salo 2002). In the lower basin, however, streams are more heavily impacted. 303(d) listed streams within this HUC include Charcoal Creek, North Willow Creek, South Willow Creek, Willow Creek, and Norwegian Creek. The USFS has not yet conducted stream morphology surveys in the Willow Creek hydrologic units, but it is their judgment that streams located on federal lands in this area can be classified as functioning (Salo 2000).

### **1.1.6 Topography, Slope, and Relief**

**Figure 11** displays the topography of the Jefferson River Planning Areas, **Figure 12** displays the distribution of slope, and a shaded relief map is presented in **Figure 13**. Relief in the Jefferson River Planning Areas ranges from about 4000 feet in the Jefferson River Valley to over 10,000 feet in the Tobacco Root Mountains (**Table 8**).

Slightly less than half of the combined planning area (40.91%) is between 4,000 and 5,000 feet in elevation, with this lowest of the elevation categories comprising a slightly larger fraction of the Lower Jefferson River Planning Area (53.94%) than of the Upper Jefferson River Planning Area (30.22%). Approximately 94 percent of the combined planning area is below 8,000 feet in elevation.

The slope in the Jefferson River Planning Areas ranges from less than 1 percent to over 100 percent, with the largest fraction of both planning areas in the 10 to <25 percent slope category (**Table 9, Figure 12**). Approximately 90 percent of the combined planning area has a slope of <45 percent.

Topography and relief data were obtained from the United States Geological Survey's National Elevation Dataset for Montana, available at: <http://nris.state.mt.us/nsdi/nris/ned.html>.

**Table 8. Elevation in the Jefferson River Planning Areas**

Category (ft)	Upper Jefferson		Lower Jefferson		Combined Total		
	Acres	% of area	Acres	% of area	Acres	% of area	Cum %
4,000-5,000	142,086	30.22	207,929	53.94	350,015	40.91	40.91
5,000-6,000	129,971	27.65	98,995	25.68	228,966	26.76	67.67
6,000-7,000	103,443	22.00	26,036	6.75	129,480	15.13	82.80
7,000-8,000	71,560	15.22	23,796	6.17	95,356	11.14	93.94
8,000-9,000	17,775	3.78	18,202	4.72	35,977	4.20	98.14
9,000-10,000	5,031	1.07	9,488	2.46	14,519	1.70	99.84
10,000-11,000	249	0.05	1062	0.28	1,310	0.15	100.00
<b>Totals</b>	470,115	100.00	385,508	100.00	855,622	100.00	

**Table 9. Slope in the Jefferson River Planning Areas**

Category (ft)	Upper Jefferson		Lower Jefferson		Combined Total		
	Acres	%	Acres	%	Acres	%	Cum %
<1%	24,272	5.16	25,228	6.54	49,500	5.79	5.79
1 to <5%	86,175	18.33	78,295	20.31	164,470	19.22	25.01
5 to <10%	69,574	14.80	75,900	19.69	145,474	17.00	42.01
10 to <25%	133,413	28.38	103,998	26.98	237,411	27.75	69.76
25 to <45%	104,679	22.27	63,020	16.35	167,699	19.60	89.36
45 to <100%	51,827	11.02	38,603	10.01	90,430	10.57	99.93
>100%	176	0.04	463	0.12	638	0.07	100.00
<b>Totals</b>	470,115	100.00	385,507	100.00	855,622	100.00	



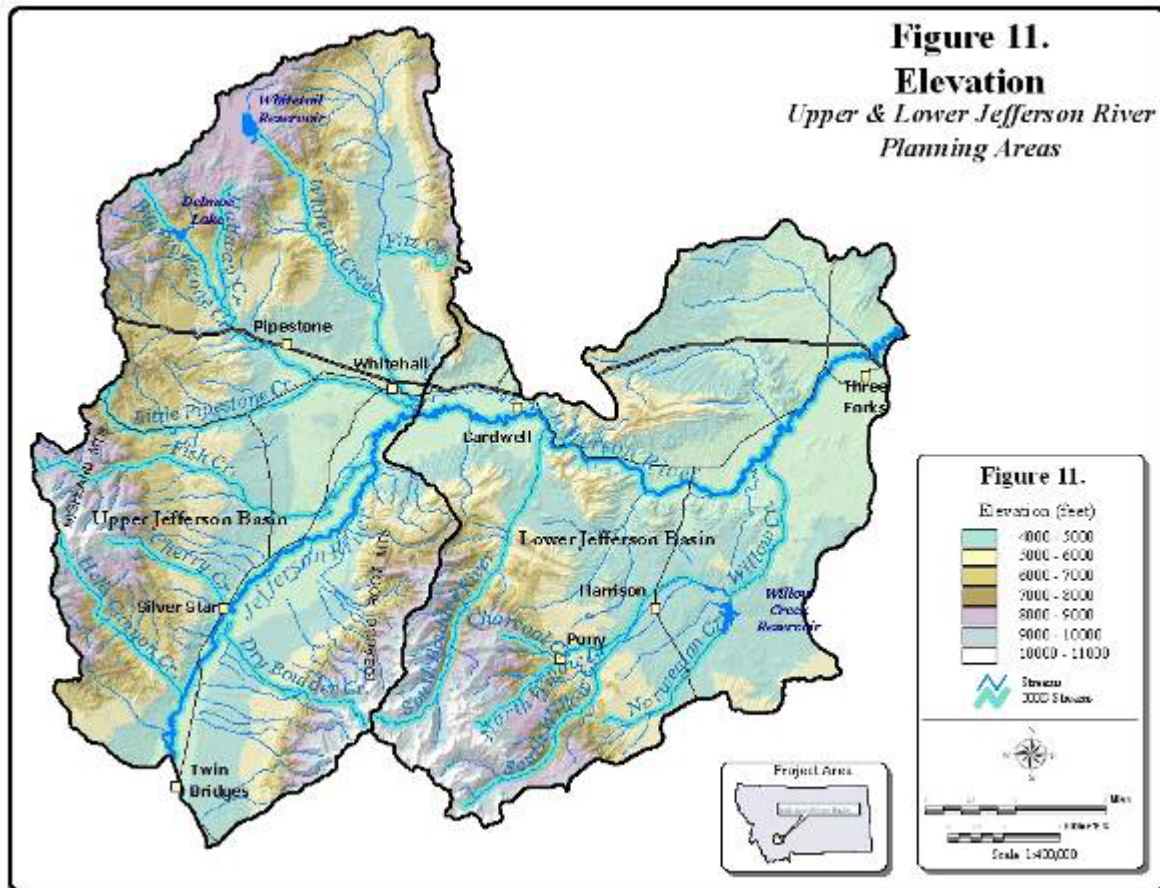


Figure 11. Elevation

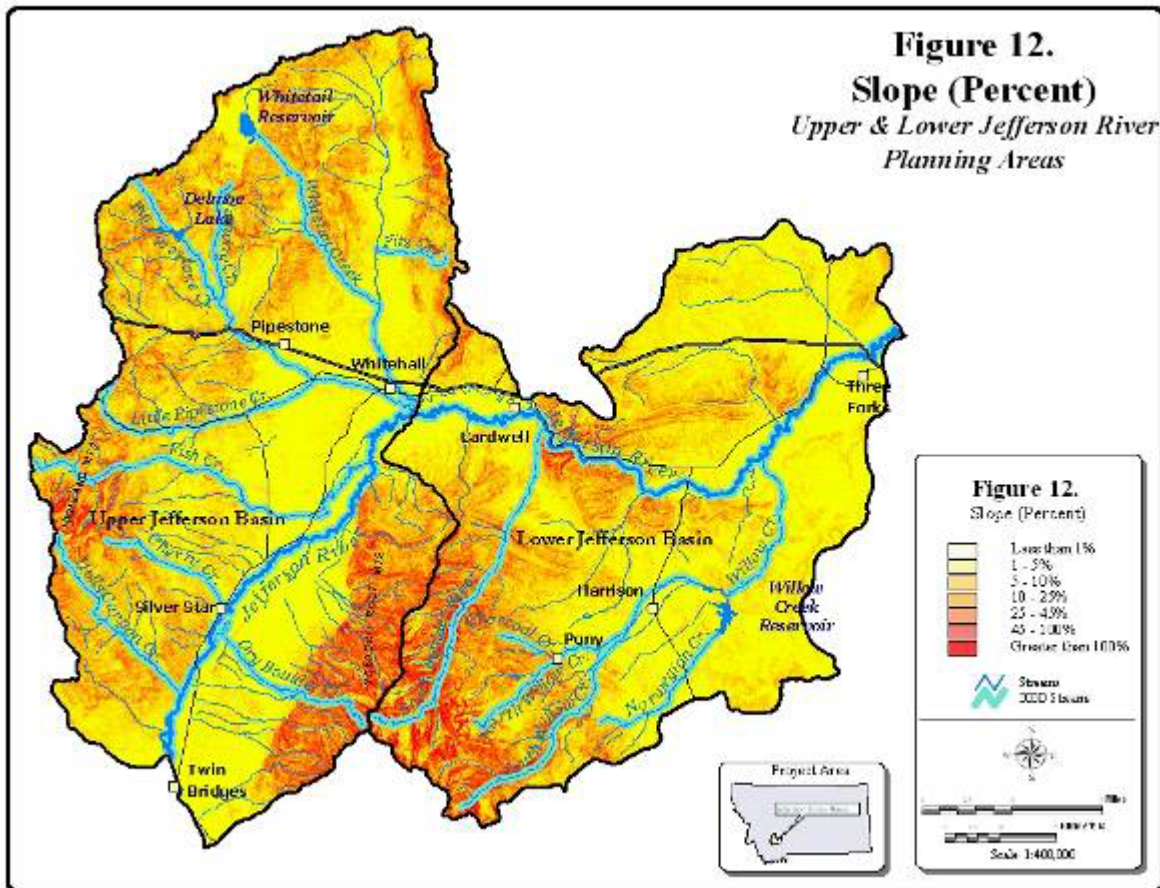
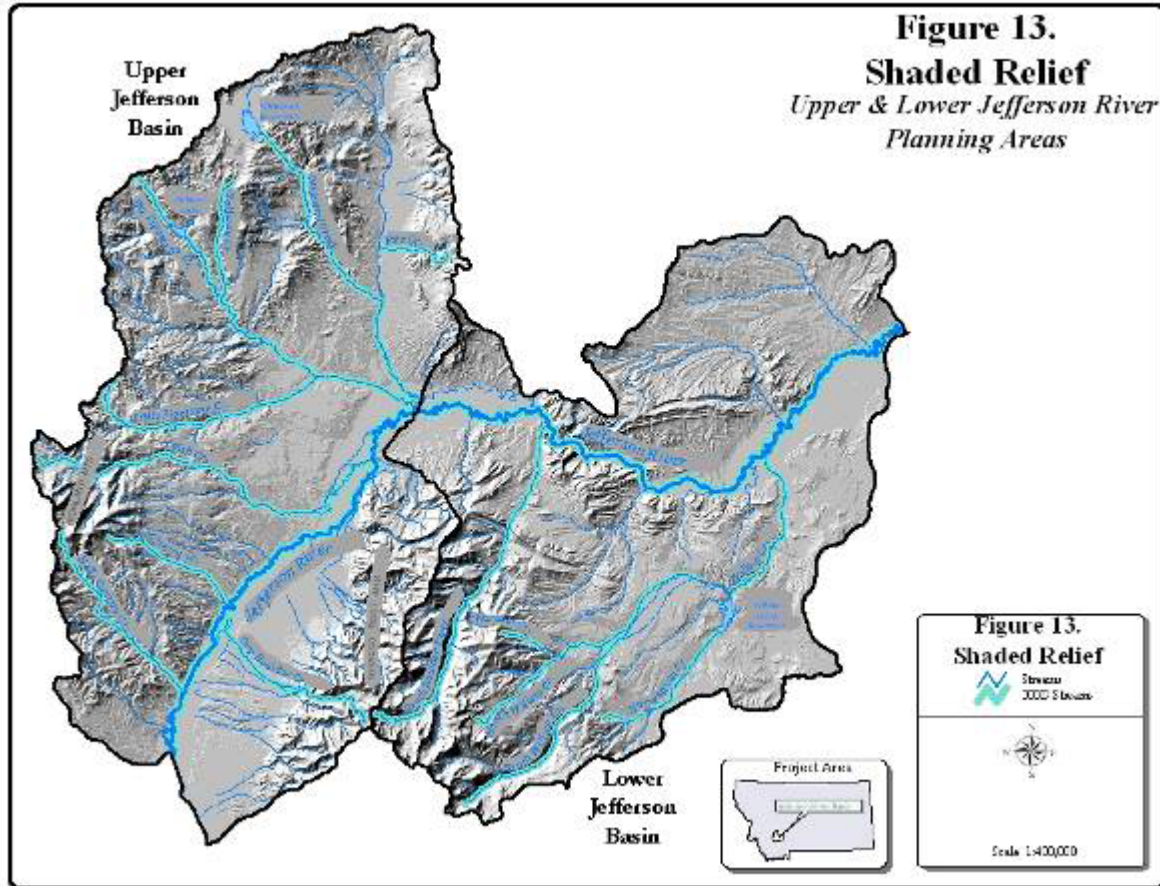


Figure 12. Slope (percent)



**Figure 13. Shaded Relief**

### 1.1.7 Major Land Resource Areas

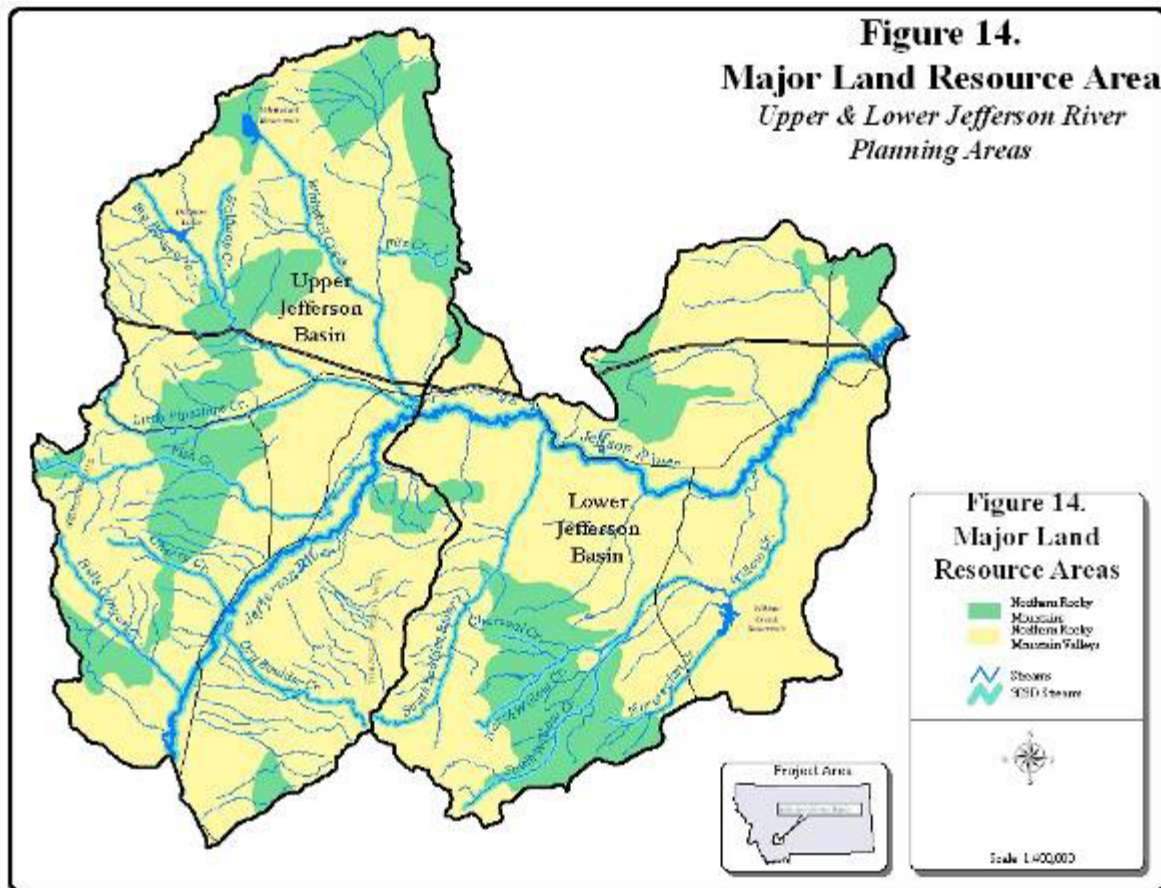
The U.S. Department of Agriculture (USDA) has established Major Land Resource Areas (MLRAs) for the United States. The MLRAs are large area land resource units geographically associated according to the dominant physical characteristics of topography, climate, hydrology, soils, land use, and potential natural vegetation. Two MLRAs are found in the Jefferson watershed area and each is characterized by unique physiography, geology/soil types, climate, potential natural vegetation, and land use (**Table 10** and **Figure 14**). The majority of the Jefferson River Planning Area is classified as Northern Rocky Mountain Valleys (78% of the Upper Jefferson, 81% of the Lower Jefferson, 80% of the combined area). The Northern Rocky Mountains unit comprises the remainder of the planning areas. Complete descriptions of the MLRAs are found in **Attachment C**.

MLRA data was obtained from the USDA's State Soil Geographic Database, available at: <http://water.usgs.gov/GIS/metadata/usgswrd/ussoils.html>.



**Table 10. Major Land Resource Areas of the Jefferson River Planning Areas**

Classification		Acres	Square Miles	% of Planning Area
Upper Jefferson	Northern Rocky Mt. Valleys	366,917	573	78
	Northern Rocky Mts.	103,194	161	22
Lower Jefferson	Northern Rocky Mt. Valleys	313,514	490	81
	Northern Rocky Mts.	71,999	112	19
Combined Jefferson	Northern Rocky Mt. Valleys	175,193	274	20
	Northern Rocky Mts.	680,431	1063	80



**Figure 14. Major Land Resource Area**

### 1.1.8 Land Ownership

The Jefferson River Planning Areas comprise approximately 855,618 acres, including 470,110 acres in the Upper Jefferson and 385,508 acres in the Lower Jefferson. Private lands dominate the ownership pattern in both planning areas, with 49.9 percent of the Upper Jefferson and 72.6 percent of the Lower Jefferson in private ownership, for a total of 57.2 percent of private

ownership across the combined planning areas. The U.S. Forest Service (USFS) controls 28.2 percent of the combined Jefferson River Planning Areas, and owns a larger portion of the upper planning area (38.6%) than the lower (15.6%). Eight percent of the combined planning areas is controlled by the U.S. Bureau of Land Management, and another 5.5 percent (including water) is controlled by the State of Montana. The remaining 0.7 percent of the combined planning areas is a mix of Montana Fish, Wildlife and Parks and U.S. Fish and Wildlife Service ownership (**Figure 15** and **Table 11**). Land ownership information was obtained from the Land Ownership and Managed Areas of Montana Database, available at: <http://nris.state.mt.us/nsdi/nris/ms4.html>.

**Table 11. Land Ownership within the Jefferson River Planning Areas**

Category (ft)	Upper Jefferson		Lower Jefferson		Combined Total		
	Acres	%	Acres	%	Acres	%	Cum %
Private Lands	209,911	44.7	279,792	72.6	489,703	57.2	57.2
U.S. Forest Service	181,325	38.6	60,229	15.6	241,554	28.2	85.4
U.S. Bureau of Land Management	54,101	11.5	17,157	4.5	71,258	8.3	93.7
Montana State Trust Lands - DNRC	21,585	4.6	23,136	6.0	44,721	5.2	98.9
Water	1,522	0.3	1,931	0.5	1,715	0.3	99.2
Montana Fish, Wildlife, & Parks	63	0.01	3,263	0.8	3,326	0.4	99.6
U.S. Fish and Wildlife Service	1,603	0.3	0	0	1,603	0.3	100.00
<b>Totals</b>	470,110	100.00	385,508	100.00	855,618	100.00	

### 1.1.9 Vegetative Cover

Vegetative data was summarized from Gap Analysis Program (GAP) information for the Jefferson River Planning Areas. GAP vegetation classifications were developed by the U.S. Geological Survey from satellite imagery collected in the 1990s (**Table 12** and **Figure 16**). This vegetation classification is highly detailed and attempts to differentiate individual species within general community types (i.e. Ponderosa Pine vs. Coniferous Forest). Ground truthing indicates that GAP data have limitations and the classification of individual species of polygons may be of variable quality. Nevertheless, GAP data represent the best available vegetation classification on a landscape scale. GAP data were obtained from the Montana 90-Meter Land Cover Database, available from the Montana State Library Natural Resource Information System at: <http://nris.state.mt.us/nsdi/nris/gap90/gap90.html>.

Eleven GAP vegetation classifications account for approximately 90 percent of the combined planning areas: grasslands are the primary vegetation type (44.7% including both low/moderate and very low cover grasslands), with grassland slightly more prevalent in the Lower Jefferson Planning Area than in the Upper. A mix of several forest types, including Douglas-fir, mixed

xeric forest, lodgepole pine, and mixed subalpine and whitebark pine accounts for 26.8 percent of the combined planning area, with forests slightly more common in the higher elevations of the upper planning area than in the lower; 7.52 percent of the combined planning area is sagebrush; irrigated and dry agricultural land combined account for 7.27 percent of the area; and 3.17 percent is comprised of montane parklands and subalpine meadows. The remaining 10 percent of the planning area is comprised of minor amounts of 21 additional GAP vegetation types.

**Table 12. Vegetation Classification (GAP) within the Jefferson River Planning Areas**

<b>Gap Vegetation Type</b>	<b>Upper (% of Planning Area)</b>	<b>Lower (% of Planning Area)</b>	<b>Combined (% of Planning Area)</b>	<b>Combined Cum %</b>
Low/Moderate Cover Grasslands	28.46	42.09	34.60	34.60
Very Low Cover Grasslands	11.57	10.52	11.10	45.70
Douglas-fir	12.75	7.32	10.30	56.00
Sagebrush	6.60	8.64	7.52	63.52
Mixed Xeric Forest	9.50	3.66	6.87	70.39
Lodgepole Pine	7.80	0.86	4.67	75.06
Agricultural Lands – Irrigated	2.71	4.86	3.68	78.73
Agricultural Lands – Dry	1.90	5.66	3.59	82.32
Montane Parklands and Subalpine Meadows	3.22	3.10	3.17	85.49
Mixed Subalpine Forest	3.11	2.28	2.74	88.23
Mixed Whitebark Pine Forest	2.31	2.20	2.26	90.48
Douglas-fir/Lodgepole Pine	3.13	0.16	1.79	92.28
Rock	0.92	1.75	1.29	93.57
Shrub Riparian	0.93	1.04	0.98	94.55
Limber Pine	0.82	1.04	0.92	95.47
Mixed Riparian	0.91	0.85	0.88	96.35
Mixed Mesic Shrubs	0.39	0.61	0.49	96.84
Conifer Riparian	0.47	0.33	0.41	97.25
Mixed Broadleaf Forest	0.37	0.45	0.41	97.66
Water	0.35	0.43	0.39	98.05
Moderate/High Cover Grasslands	0.25	0.49	0.35	98.40
Mines, Quarries, Gravel Pits	0.13	0.45	0.28	98.68
Broadleaf Riparian	0.21	0.34	0.27	98.94
Mixed Xeric Shrubs	0.38	0.08	0.25	99.19
Alpine Meadows	0.09	0.43	0.25	99.44
Mixed Barren Sites	0.35	0.06	0.22	99.66
Mixed Broadleaf and Conifer Riparian	0.22	0.14	0.19	99.84
Urban or Developed Lands	0.06	0.14	0.10	99.94
Standing Burnt Forest	0.04	0.00	0.02	99.96
Ponderosa Pine	0.03	0.00	0.02	99.98
Rocky Mountain Juniper	0.02	0.00	0.01	99.99
Snowfields or Ice	0.00	0.02	0.01	100.00
<b>Totals</b>	100.00	100.00	100.03	

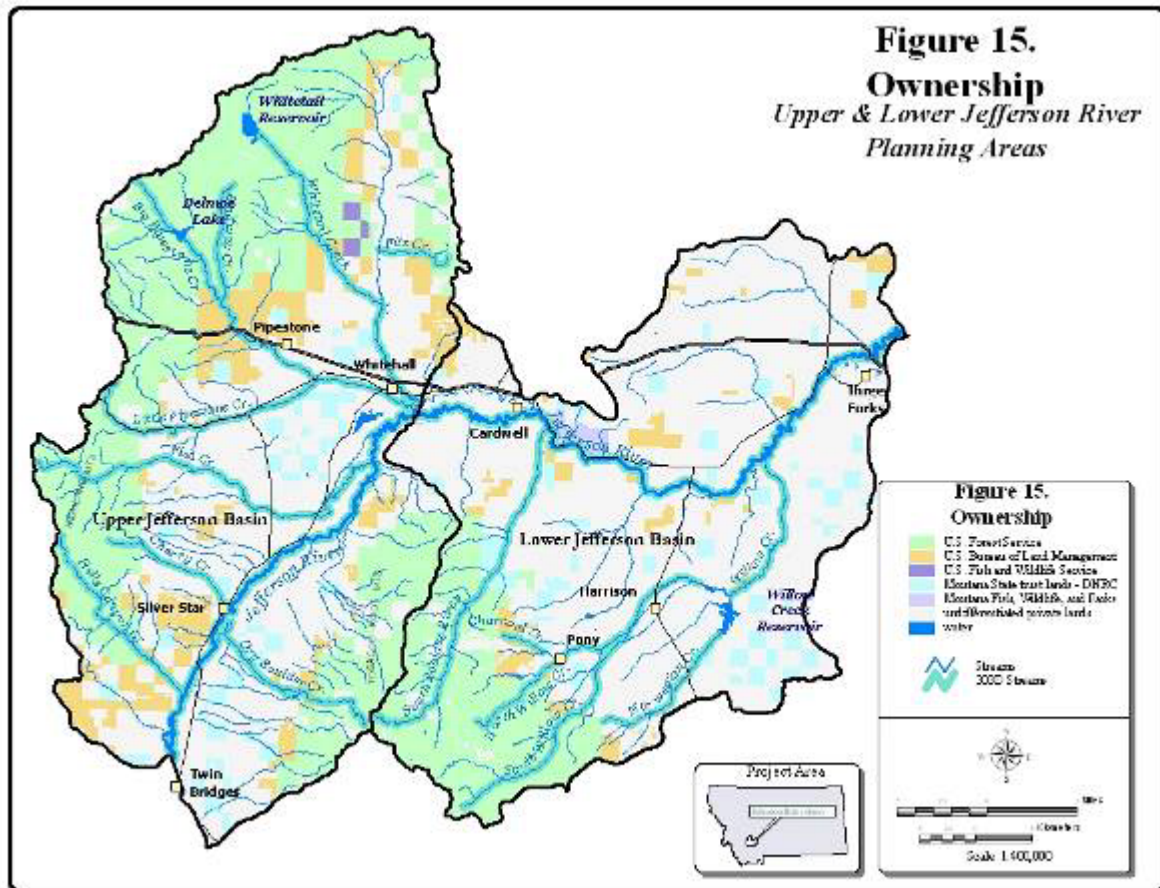
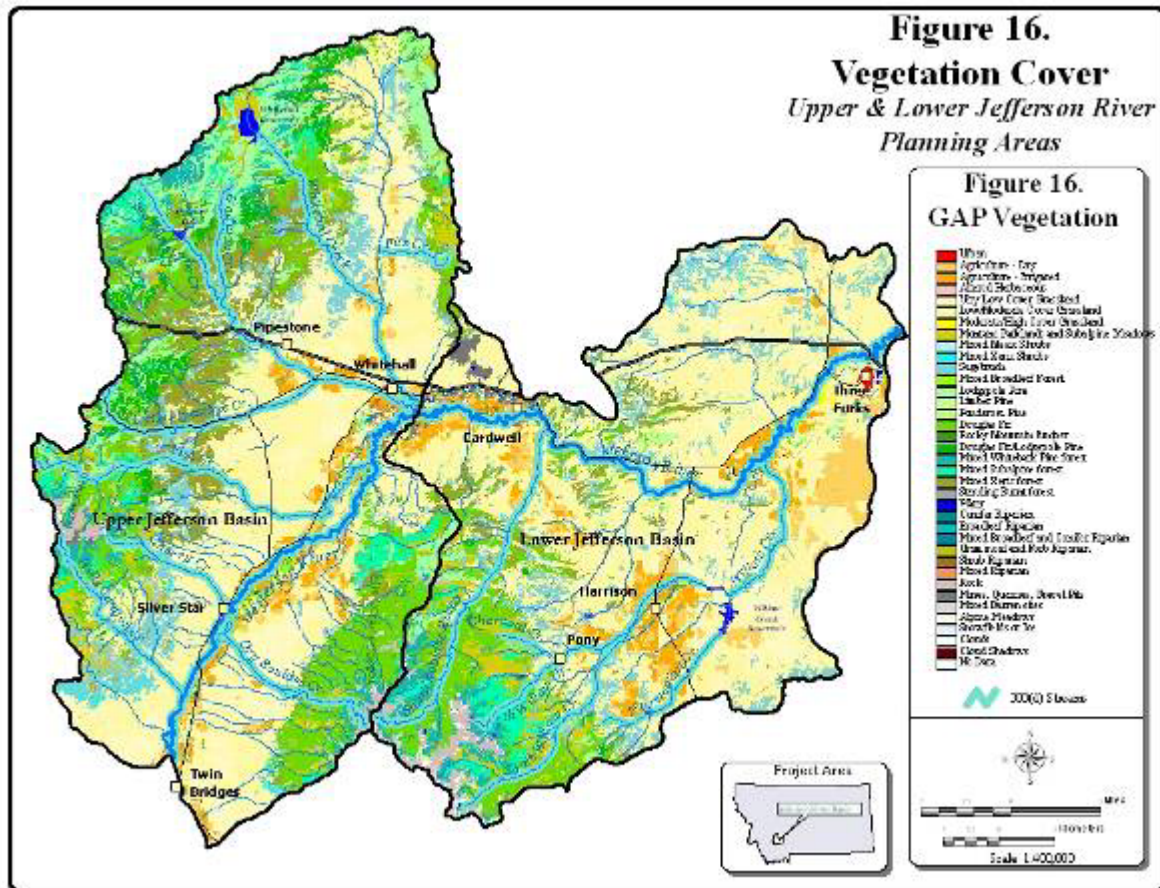


Figure 15. Ownership





**Figure 16. Vegetation Cover**

### 1.1.10 Land Use and Land Cover

General land use and land cover data for the Jefferson River Planning Areas were derived from the Montana 90-Meter Land Cover Database, available at <http://nris.state.mt.us/nsdi/nris/gap90/gap90.html>, (Table 13 and Figure 17). The Land Use and Land Cover (LULC) data files describe the vegetation, water, natural surface, and cultural features on the land surface.

The combined Jefferson River Planning Area is dominated by Grass Rangeland, which comprises 46.39 percent of the total area. Other major LULC types in the combined planning area include Evergreen Forest (29.72%) and Crop/Pasture (15.03%).

The same three LULC types that dominate the planning areas also comprise the majority of the Upper and Lower Jefferson Planning Areas individually; however the upper and lower planning areas differ slightly in the distribution of LULC types. The Upper Jefferson is dominated by Evergreen Forest (40.83%), which tends to occur at higher elevations in the watershed. Grass Rangeland comprises an additional 37.76 percent of the Upper Jefferson, and Crop/Pasture represents an additional 11.86 percent of the area. The Lower Jefferson Planning Area is



dominated by Grass Rangeland (56.92%), with an additional 18.90 percent made up of Crop/Pasture and 16.16 percent of Evergreen Forest.

**Table 13. Land Use and Land Cover in the Jefferson River Planning Areas**

LULC Category	Upper Jefferson		Lower Jefferson		Combined Total		
	Acres	%	Acres	%	Acres	%	Cum %
Grass rangeland	177,529	37.76	219,439	56.92	396,968	46.39	46.39
Evergreen forest	191,974	40.83	62,308	16.16	254,282	29.72	76.11
Crop/pasture	55,737	11.86	72,856	18.90	128,593	15.03	91.14
Brush rangeland	14,597	3.10	19,159	4.97	33,756	3.95	95.08
Mixed forest	13,124	2.79	0	0.00	13,124	1.53	96.62
Mixed rangeland	12,554	2.67	336	0.09	12,890	1.51	98.12
Grass tundra	0	0.00	3,483	0.90	3,483	0.41	98.53
Shrub tundra	1,055	0.22	2,424	0.63	3,479	0.41	98.94
Bare tundra	540	0.11	1,847	0.48	2,388	0.28	99.22
Transportation/util	1,221	0.26	843	0.22	2,064	0.24	99.46
Reservoir	294	0.06	915	0.24	1,209	0.14	99.60
Wetland	0	0.00	765	0.20	765	0.09	99.69
Lake	590	0.13	84	0.02	675	0.08	99.77
Residential	330	0.07	224	0.06	554	0.06	99.83
Mines/quarries	58	0.01	266	0.07	324	0.04	99.87
Mixed urban/built-up	0	0.00	276	0.07	276	0.03	99.90
Exposed rock	214	0.05	0	0.00	214	0.03	99.93
Other urban/built-up	46	0.01	138	0.04	184	0.02	99.95
Commercial/services	124	0.03	60	0.02	184	0.02	99.97
Transitional	148	0.03	0	0.00	148	0.02	99.99
Confined feeding	0	0.00	94	0.02	94	0.01	100.00
Other ag	6	0.00	0	0.00	6	0.00	100.00
<b>Totals</b>	470,142	100.0	385,517	100.0	855,659	100.0	

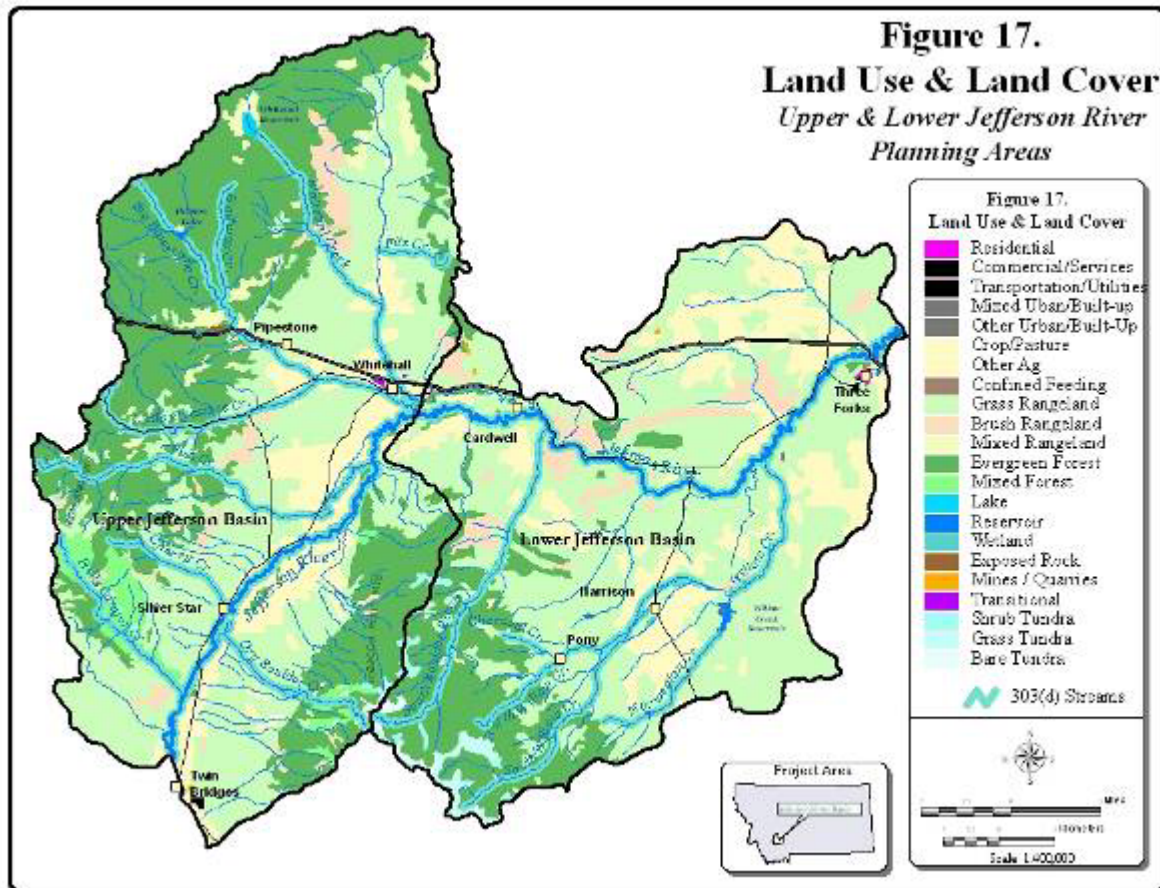


Figure 17. Land Use and Land Cover

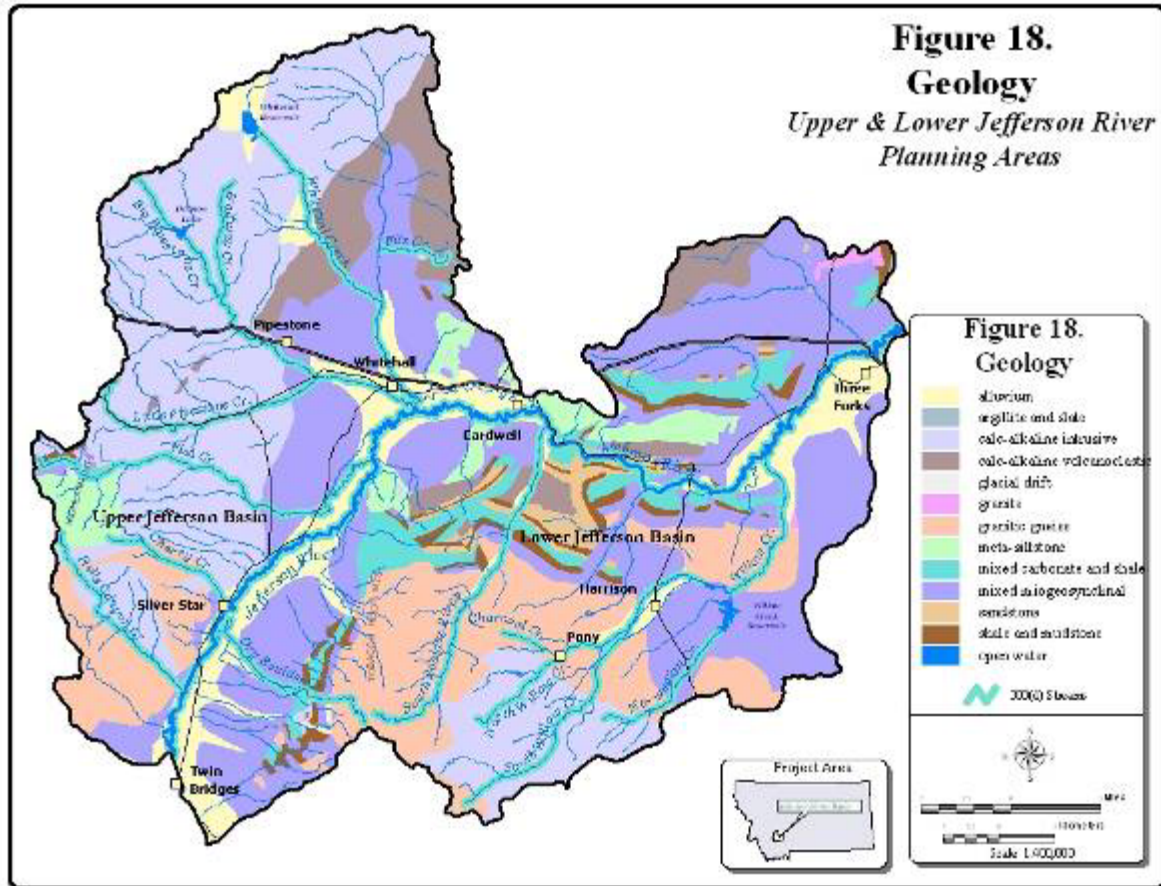
### 1.1.11 Geology

Twelve USGS geologic mapping units occur within the Jefferson River Planning Areas (**Figure 18**). Four of these geologic units comprise more than 80 percent of the combined planning area: mixed miogeosynclinal rocks, calc-alkaline intrusive rocks, granitic gneiss, and alluvium (**Table 14**).

Mixed miogeosynclinal rocks, which are mostly sedimentary in nature, comprise 29.2 percent of the combined planning areas and are a dominant feature in the lower elevations of the watershed through the Jefferson River Valley, the lower reaches of Little Whitetail Creek, and in two large swaths south and west of Three Forks. Calc-alkaline intrusive geology is associated with the Boulder Batholith and is dominant in the higher elevation forested areas of the watershed, including the headwaters of Willow Creek in the Tobacco Root Mountains as well as the headwaters of Hells Canyon, Fish, Little Pipestone, Halfway and Whitetail Creeks in the Deerlodge National Forest. Granitic Gneiss comprises another 15.5 percent of the watershed and occurs mainly west of Silver Star, in the South Boulder River Valley, and north of Willow Creek Reservoir. Alluvium comprises 10.7 percent of the watershed, occurring predominately in the current and historic floodplains of the Jefferson River and its major tributaries.

These four geologic mapping units dominate in both the Upper and Lower Jefferson Planning Areas, individually and collectively for the combined planning areas, although the proportions of each differ slightly as shown in **Table 14**. The remaining 7 percent of the combined planning areas is a mixture of small areas of the several remaining geologic mapping units.

Geologic information was obtained from the USGS Major Lithology Database, available at: <http://www.icbemp.gov/spatial/min/>.



**Figure 19. Geology**

**Table 14. Geology of the Jefferson River Planning Areas**

<b>Geologic Unit Code</b>	<b>Square Miles (% of Planning Area)</b>	<b>USGS Definition</b>
Mixed miogeosynclinal rocks	Upper: 22.6 Lower: 37.2 Combined: 29.2	Mixed sequences of miogeosynclinal sedimentary rocks. Includes interlayered shale, siltstone, lithic sandstone, quartzite, and conglomerate.
Calc-alkaline intrusive rocks	Upper: 39.9 Lower: 10.7 Combined: 26.7	Calc-alkaline suite of intrusive rocks. Generally granodiorite to diorite.
Granitic gneiss	Upper: 10.9 Lower: 21.1 Combined: 15.5	Dominantly granitic gneiss, migmatite, augen gneiss, and hornblende gneiss. Includes subordinate anorthosite, amphibolite, calc-silicate gneiss, schist, marble, and quartzite.
Alluvium	Upper: 11.7 Lower: 9.5 Combined: 10.7	Unconsolidated sediment (clay, silt, sand, gravel). Includes glacial outwash deposits
Calc-alkaline volcanic rocks	Upper: 7.6 Lower: 4.4 Combined: 6.2	Calc-alkaline suite of pyroclastic rocks and volcanic flows. Generally andesite to quartz-latite.
Carbonate and shale	Upper: 2.5 Lower: 5.7 Combined: 3.9	Mixed sequences of carbonate rock and shale with subordinate sandstone and conglomerate
Meta-siltstone	Upper: 3.1 Lower: 3.9 Combined: 3.5	Fine-grained metamorphic rock formed from siltstone
Shale and mudstone	Upper: 1.4 Lower: 3.5 Combined: 2.3	Fine-grained sedimentary rock derived from clay
Sandstone	Upper: 0.2 Lower: 3.4 Combined: 1.6	Medium-grained detrital sedimentary rock derived from sand
Granite	Upper: 0.0 Lower: 0.5 Combined: 0.2	Includes intrusive rhyolitic rocks
Open water	Upper: 0.2 Lower: 0.2 Combined: 0.2	areas of water
Glacial drift	Upper: 0.1 Lower: 0.0 Combined: 0.05	Material deposited by glacial processes. Includes till and moraine (unstratified) as well as outwash (stratified).

### 1.1.12 Soils

Thirty-nine soil groups occur within the Jefferson River Planning Areas, and eleven soil groups account for two thirds of the area (**Table 15** and **Figure 19**). A complete list of soil types is found in **Attachment D**. Soils are predominantly deep, well-drained soils with loamy textures. Soils that form in alluvium tend to be sandy, while those that form in colluvium tend to be coarse. Parent materials vary throughout the planning area and include sedimentary, igneous, and metamorphic rocks. All soils data were obtained from the United States Department of Agriculture’s State Soil Geographic database, available at: <http://water.usgs.gov/GIS/metadata/usgswrd/ussoils.html>.

The major soil series (Cowood-Hanks-Comad) are typically very deep, excessively drained sandy loams formed from gneiss, schist, and granitic rock. The Crago series is a very deep, well-drained loam derived mainly from limestone or conglomerate. The Garlet and Sebud series are very deep, well-drained, stony loam soils formed in till uplands, foot slopes, and in mountain valleys. The Nuley Series are deep, well-drained loamy soils formed on hills and bedrock floored plains.

**Table 15. Major Soil Series within the Jefferson River Planning Areas**

Map Unit Name	Acres	%	Cum %
Cowood-Hanks-Comad (MT140)	111,496.6	13.0	13.0
Sappington-Amesha-Crago Variant (MT012)	72,881.8	8.5	21.5
Varney-Nuley-Rock Outcrop (MT432)	70,441.6	8.2	29.8
Garlet-Rock Outcrop-Cryoborollis (MT485)	46,630.9	5.4	35.2
Orofino-Poin-Sebud (MT434)	45,874.8	5.4	40.6
Scravo-Grago-Musselshell (MT529)	42,410.4	5.0	45.5
Crittenden-Twilight Family-Castner (MT149)	41,964.4	4.9	50.5
Brocko-Kalsted-Crago (MT066)	41,530.3	4.9	55.3
Rivra-Bardwell-Ryell (MT477)	41,345.7	4.8	60.1
Brocko-Amesha-Crago Variant (MT063)	33,432.0	3.9	64.0
Rencot-Lahood-Rock Outcrop (MT469)	31,432.2	3.9	67.7

Soils in the Jefferson River Planning Areas are relatively fine grained, with approximately 78 percent of the combined area having clay contents ranging from 15 to 30 percent (**Table 16**, **Figure 20**). These fine-grained soils are typically found in the valleys and plains areas. An additional 21.1 percent of the combined planning areas have a clay content from 10 to 15 percent, with these areas concentrated in the mountainous regions. Soils with clay contents of 30 to 40 percent account for only 0.8 percent of the combined planning areas, and these are concentrated near the North/South Willow Creek confluence in the Lower Jefferson Planning Area.



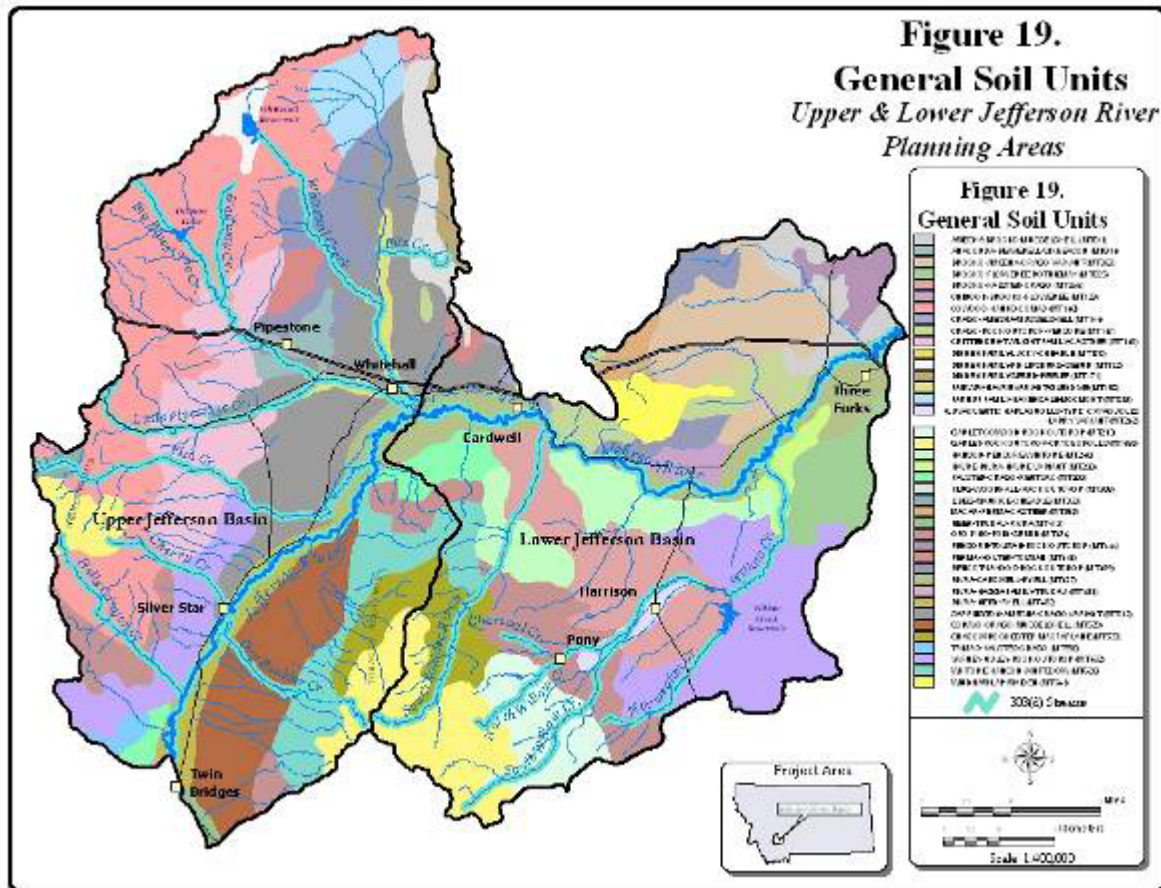
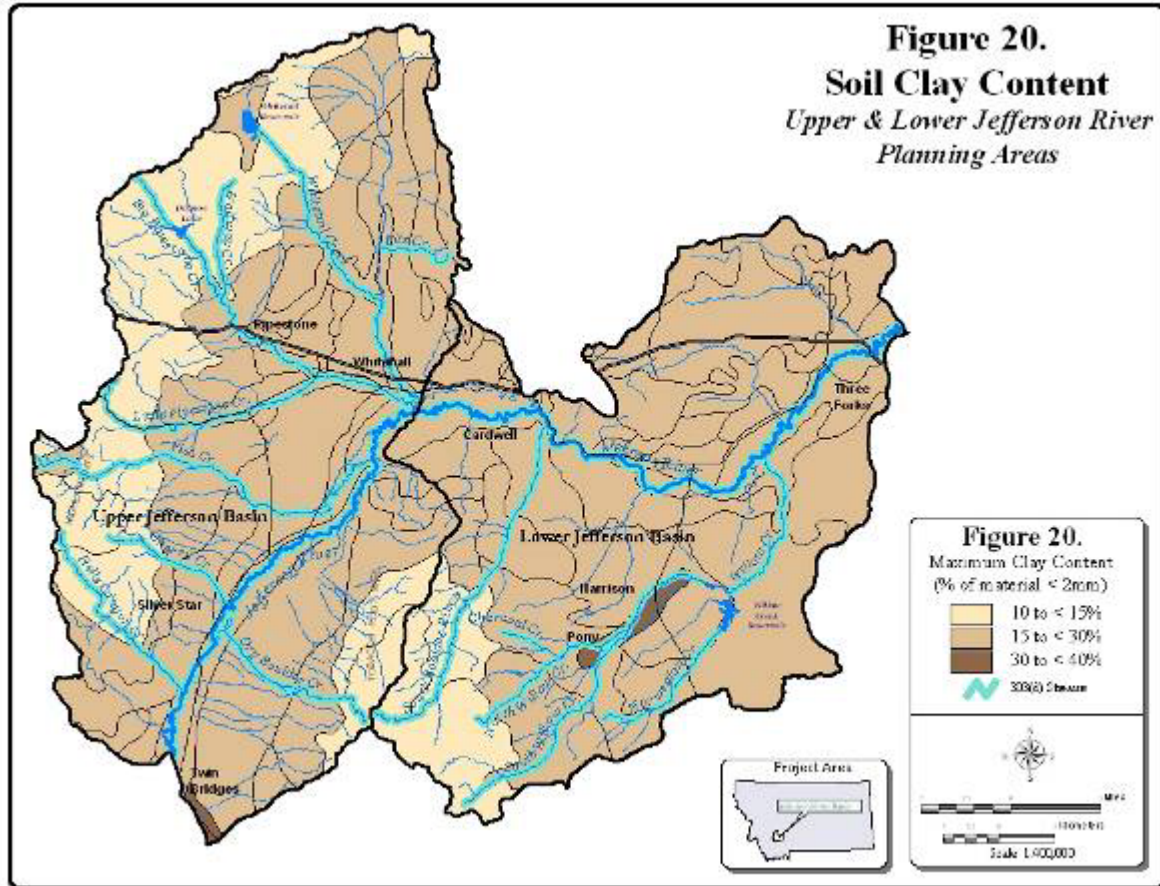


Figure 19. General Soil Units

Table 16. Soil Clay Content in the Jefferson River Planning Areas

Max Clay Content (%)	Upper Jefferson		Lower Jefferson		Combined Total	
	Acres	%	Acres	%	Acres	%
10 to <15	139,520	29.7	41,152	10.7	180,672	21.1
15 to <30	328,960	70.0	339,200	88.0	668,160	78.1
30 to <40	1,446	0.3	5,056	1.3	6,502	0.8
<b>Totals</b>	<b>469,926</b>	<b>100.00</b>	<b>385,408</b>	<b>100.00</b>	<b>855,334</b>	<b>100.00</b>



**Figure 20. Soil Clay Content**

Weighted-average minimum soil permeability was between 0.6 and 2 inches per hour in greater than 64 percent of the combined planning areas (Table 17, Figure 21). Permeability of various soil horizons can be more variable than this average figure, but is generally below 0.6 and 2 in/hr throughout most of the planning area.

**Table 17. Soil Permeability in the Jefferson River Planning Areas**

Minimum Permeability (in/hr)	Upper Jefferson		Lower Jefferson		Combined Total	
	Acres	%	Acres	%	Acres	%
0.2 to < 0.6	79,744	17.0	108,096	28.0	187,840	22.0
0.6 to < 2	274,752	58.4	277,440	72.0	552,192	64.5
2 to < 6	115,648	24.6	0	0	115,648	13.5
<b>Totals</b>	<b>470,144</b>	<b>100.00</b>	<b>385,536</b>	<b>100.00</b>	<b>855,680</b>	<b>100.00</b>

Surface soil salinity is generally low, with the majority of the combined planning area (96.2%) having salinity values of less than 1 mmhos/cm (Table 18, Figure 22). A few areas of higher

salinity occur along the Jefferson River between Twin Bridges and Whitehall, in the lower reaches of Whitetail and Pipestone Creeks, and in the vicinity of lower Willow Creek.

**Table 18. Soil Salinity in the Jefferson River Planning Areas**

Maximum Salinity (mmhos/cm)	Upper Jefferson		Lower Jefferson		Combined Total	
	Acres	%	Acres	%	Acres	%
Less than 1	443,136	94.3	379,776	98.5	822,912	96.2
1 to < 2	122	0.01	0	0.0	122	0.01
2 to < 3	7,424	1.6	63	0.01	7,487	0.9
3 to < 4	0	0.0	0	0.0	0	0.0
4 to < 8	17,920	3.8	5,696	1.5	23,616	2.8
8 or more	1,446	0.3	0	0.0	1,446	0.2
<b>Totals</b>	<b>470,048</b>	<b>100.00</b>	<b>385,535</b>	<b>100.00</b>	<b>855,583</b>	<b>100.00</b>

The Universal Soil Loss Equation K-factor is a measure of a soil's inherent susceptibility to erosion by rainfall and runoff. Values of K range from 0 to 1, with higher numbers indicative of greater erosive potential.

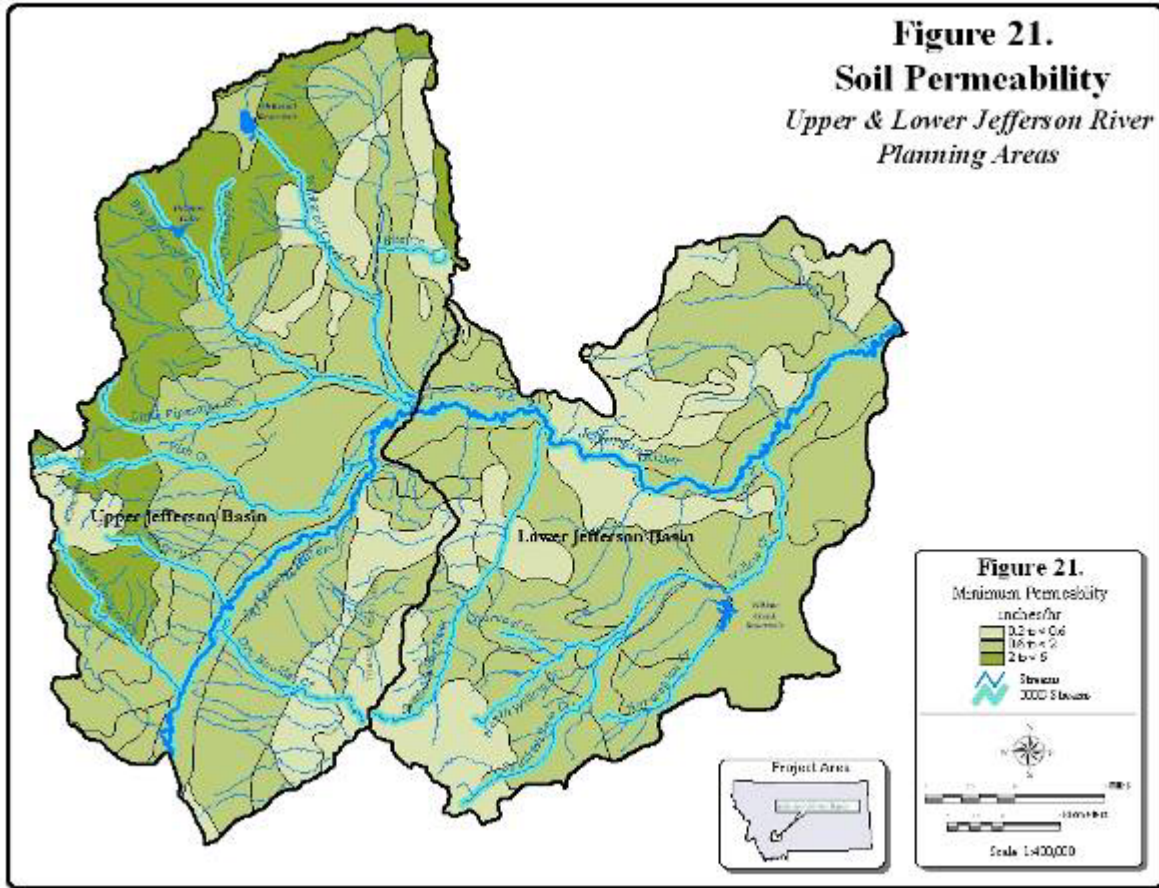
Soils high in clay have low K values, about 0.05 to 0.15, because they are resistant to detachment. Coarse textured soils such as sandy soils have low K values, about 0.05 to 0.2, because of low potential for runoff, even though these soils are easily detached. Medium textured soils such as the silty loam soils have moderate K values, about 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils with high silt content are the most erodible of all soils. They are easily detached and tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4 (Michigan State University 2002).

The soil erosion K factor is moderate throughout most of the Jefferson Planning Area, with 48.7 percent of the area characterized by K factors in the 0.3 – 0.4 range, and 46.0 percent characterized by K factors in the 0.2 – 0.3 range. Soil erosion K factors are slightly higher in the Lower Jefferson area, where the majority of soils (61.6%) are in the 0.3 – 0.4 range, than in the Upper Jefferson area, where the majority of soils (58.0%) are in the 0.2 – 0.3 range (**Table 19, Figure 23**).

**Table 19. Soil Erosion K factor in the Jefferson River Planning Areas**

Weighted K Factor	Upper Jefferson		Lower Jefferson		Combined Total	
	Acres	%	Acres	%	Acres	%
0.1 to < 0.2	18,522	3.9	27,354	7.1	45,876	5.4
0.2 to < 0.3	272,557	58.0	120,621	31.3	393,178	46.0
0.3 to < 0.4	179,027	38.1	237,536	61.6	416,563	48.7
<b>Totals</b>	<b>470,106</b>	<b>100.00</b>	<b>385,511</b>	<b>100.00</b>	<b>855,617</b>	<b>100.00</b>





**Figure 21. Soil Permeability**

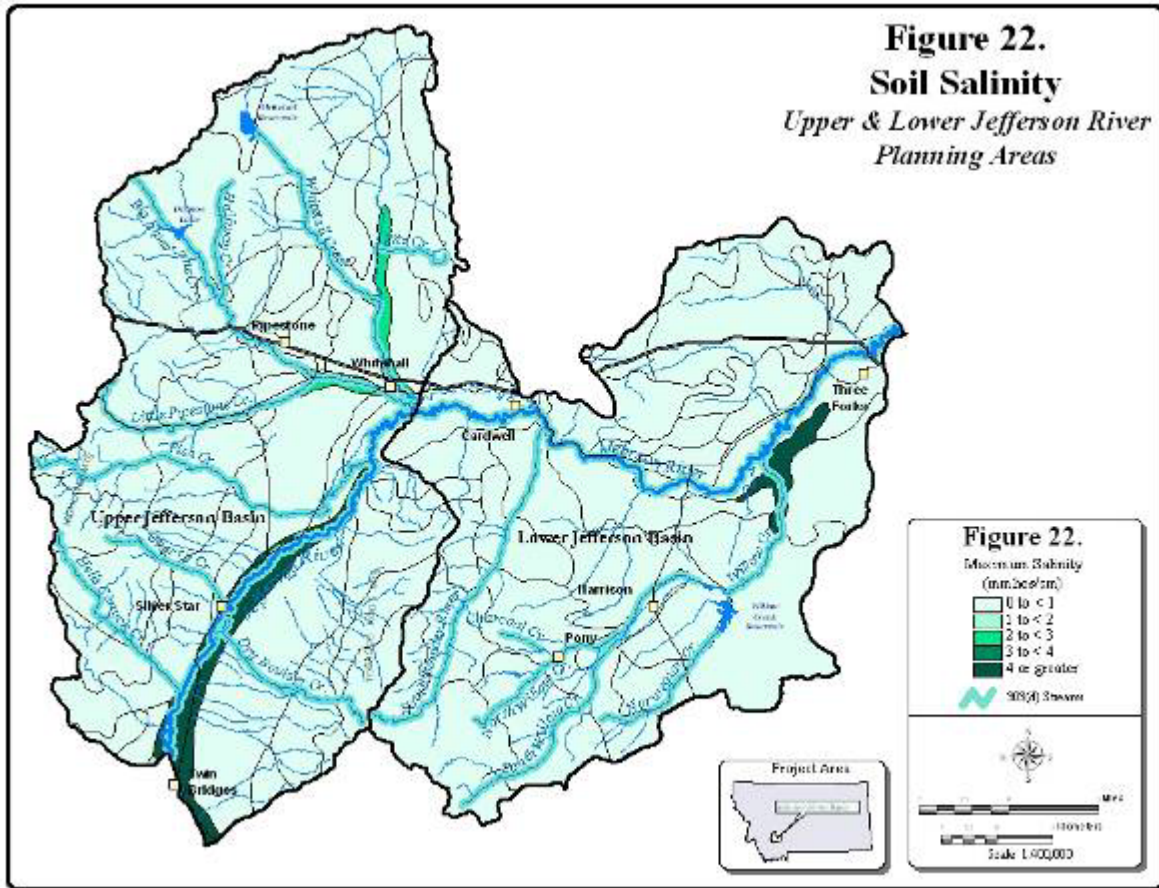
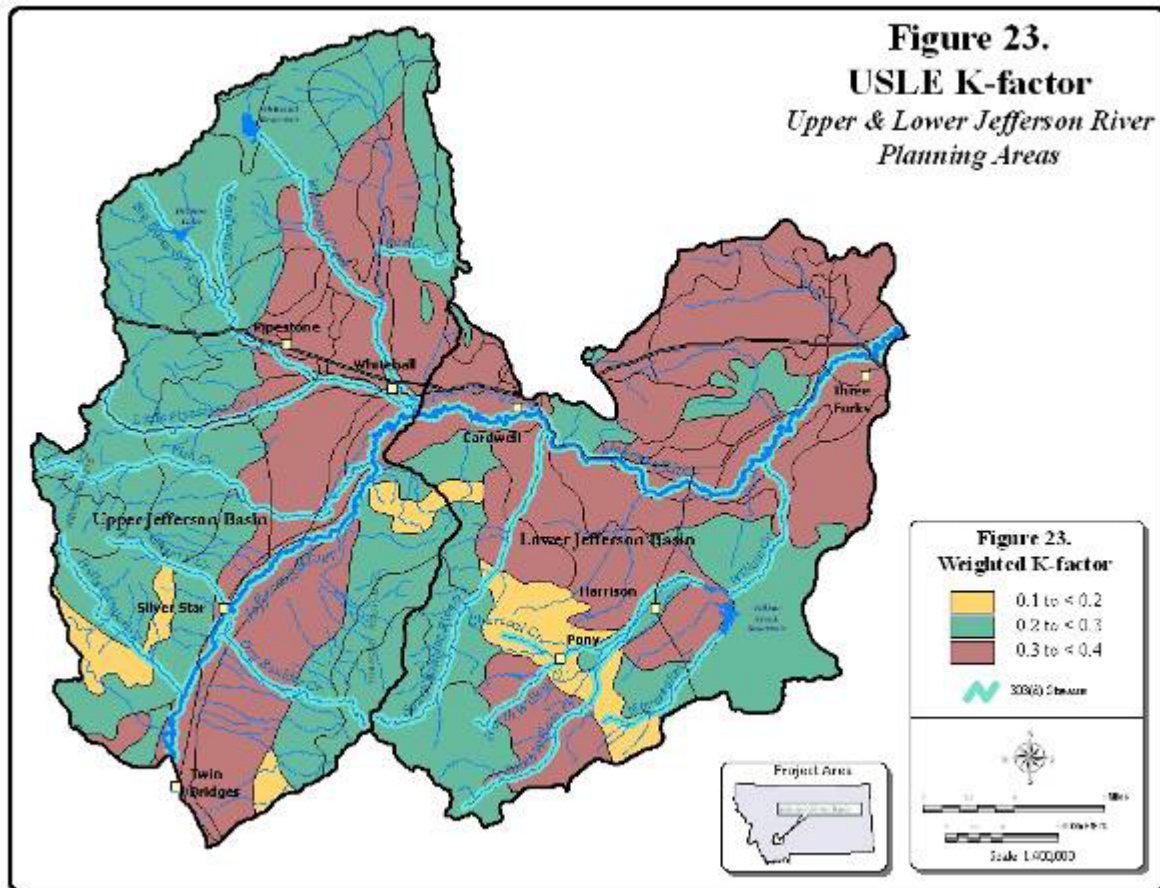


Figure 22. Soil Salinity



**Figure 23. USLE K-factor**

### 1.1.13 Mineral Extraction and Mining

The Montana Bureau of Mines and Geology database (<http://nris.state.mt.us/nsdi/nris/ms4.html>) lists 404 mineral extraction locations within the Jefferson River Planning Areas (**Figure 24**). Gold is the most common type of mine, accounting for slightly more than half of all listed mining operations. Other common mine types include lead, copper, zinc, iron, and tungsten. A complete listing of active and inactive mining locations is found in **Attachment E**.

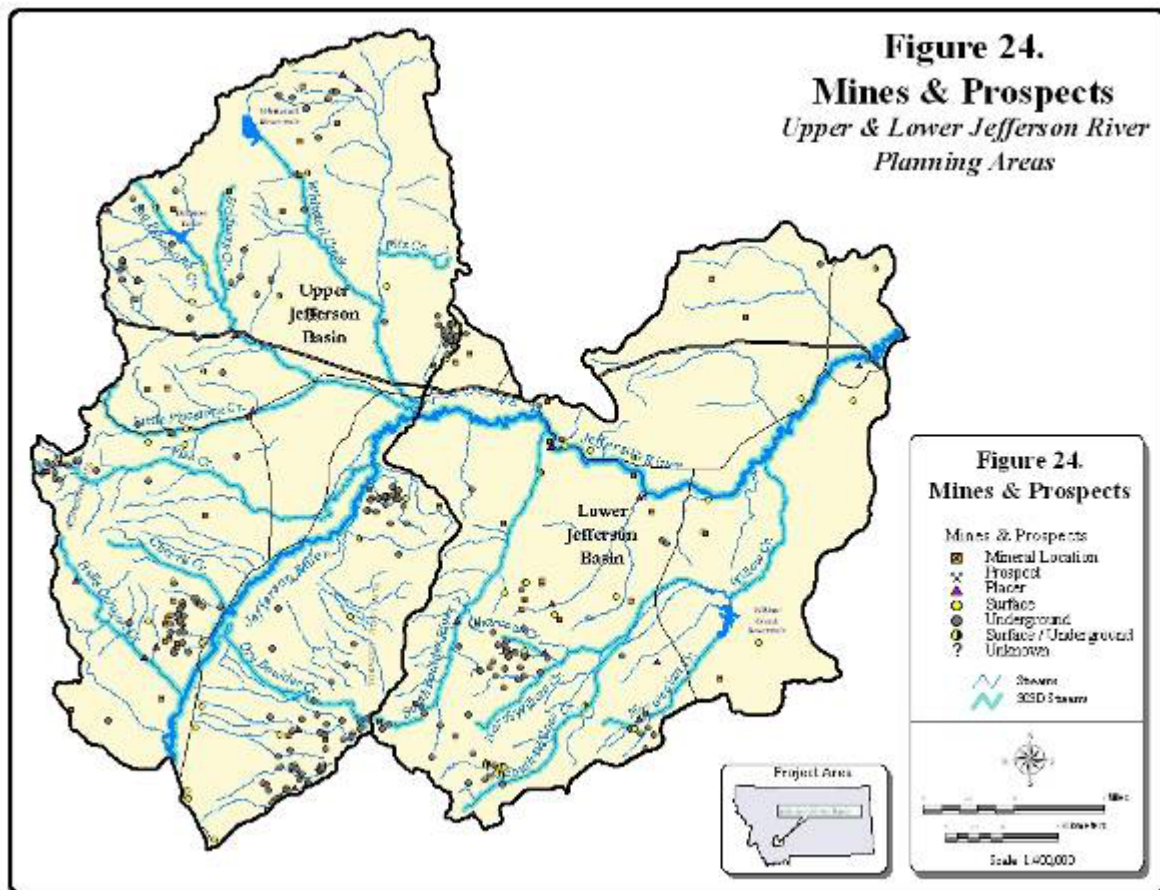
### 1.1.14 Point Source Discharges

Six permitted point source wastewater discharges are located within the Jefferson River Planning Areas, including two municipal wastewater treatment system discharges, one industrial discharge, and three storm water outfalls (**Table 20, Figure 25**).

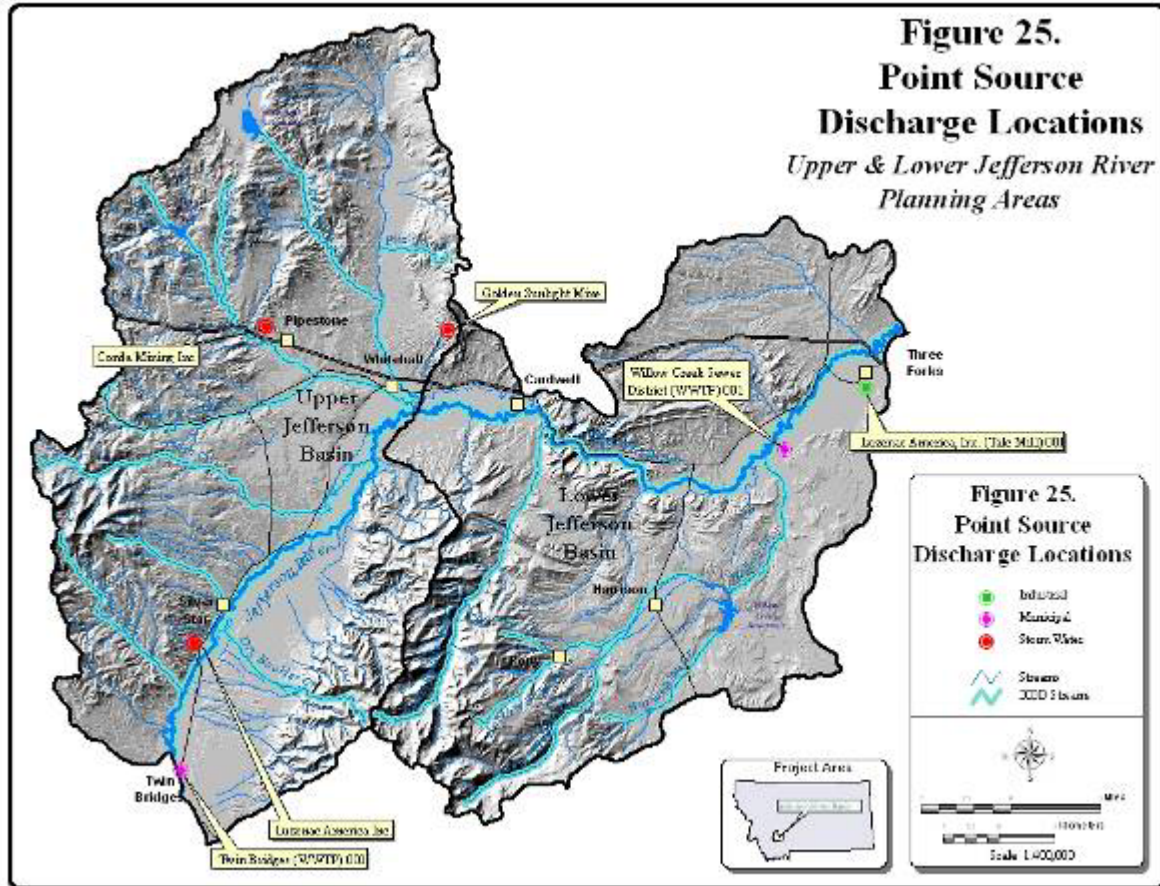


**Table 20. Point Source Discharges**

Permit Name	Type	Receiving Waterbody
Conda Mining, Inc.	Storm water	Pipestone Creek
Luzenac America, Inc.	Storm water	Creeklyn Ditch to Jefferson River
Twin Bridges (WWTP) 001	Municipal	Bayers Ditch to Jefferson River
Golden Sunlight Mine	Storm water	St. Paul Gulch to Whitehall Creek
Willow Creek Sewer District (WWTP) 001	Municipal	Unnamed irrigation ditch
Luzenac America, INC. (Talc Mill) 001	Industrial	Unnamed wetland



**Figure 24. Mines and Prospects**



**Figure 25. Point Source Discharge Locations**

## 1.2 Fisheries

For the Jefferson River Planning Areas, two fish species, the westslope cutthroat trout (*Oncorhynchus clarki lewisi*) and the Montana Arctic grayling (*Thymallus arcticus montanus*) are listed by the State of Montana as species of special concern. According to Montana Fish, Wildlife and Parks fish distribution database, westslope cutthroat are limited to the Upper Jefferson River Planning Area, and are thought to occur in five streams, including four that appear on the 303(d) list. These include: Halfway Creek, Fish Creek, Cherry Creek, and Hells Canyon Creek. Cutthroat trout are also found in Mill Creek, which is not on the 303(d) list (**Figure 26**). Genetically pure populations of westslope cutthroat trout are thought to be limited to Halfway and Fish Creeks (Spoon pers. com. 2003). The present distribution of Montana Arctic grayling in the Jefferson watershed is unknown.

The status of these fish is described by Montana DEQ in the *Preliminary Assessment Report for the Upper Jefferson River* (MDEQ 2002b), excerpted here. *Westslope cutthroat trout (Oncorhynchus clarki lewisi) are present in the Upper Jefferson Planning Area. Westslope cutthroat trout is listed on the State of Montana’s list of Animal Species of Special Concern*

*(Carlson 2001) with a state rank of S2. An “S2” rank is described as “imperiled because of rarity or because of other factors demonstrably making it very vulnerable to extinction throughout its range”. It is also listed as “sensitive” by the USFS (“animal species ... for which population viability is a concern as evidenced by significant downward trend in population or a significant downward trend in habitat capacity”) and “special status” by the BLM (“federally-listed Endangered, Threatened, or Candidate species or other rare or endemic species that occur on BLM lands”).*

*Montana Arctic grayling (*Thymallus arcticus montanus*) might be present in the Jefferson River as a result of an attempt to reestablish a population in the lower Beaverhead River upstream of the confluence of the Beaverhead and Big Hole Rivers. Fluvial grayling are known to move great distances upstream and downstream in response to water temperature increases, seasonal habitat preferences and runoff. The grayling is on the State of Montana’s list of Animal Species of Special Concern with a state rank of S1. An “S1” rank is described as “critically imperiled because of extreme rarity or because of some factor(s) of its biology making it especially vulnerable to extinction”. It is also listed as “sensitive” by the USFS (“animal species ... for which population viability is a concern as evidenced by significant downward trend in population or a significant downward trend in habitat capacity”) and is a candidate species for listing under the federal Endangered Species Act of 1973 (Carlson 2001). Candidate species are described as those that the US Fish and Wildlife Service has sufficient information on biological status and threats to propose to list them as threatened or endangered (MDEQ 2002b).*

The Jefferson River sport fishery is dominated by brown trout. Rainbow trout are also present, comprising an estimated 10% of the of the trout population in 1989; however the proportion of rainbow trout has risen to an estimated 45% of the population in the Jefferson above Whitehall and 10 to 20% below Whitehall in response, at least in part, to improved spawning in Hell’s Canyon and Willow Springs Creeks (MFWP 1989; Rehwinkel pers. com. 2003; Spoon pers. com. 2003). Biologists from the Montana Fish, Wildlife, and Parks have estimated that the Jefferson can support a potential brown trout population of 600 fish two years old and older per mile. However, in recent years, the population has dropped below 200 brown trout per mile. The most likely explanation of the decline is the series of extremely low flow years that have occurred in the Jefferson since the late 1980s, and the elevated stream temperatures that have resulted from these low streamflows (Spoon pers. com. 2003). The Jefferson’s brown trout fishery is also potentially hampered by a lack of suitable spawning habitat, particularly in Jefferson River tributaries. The vast majority of spawning of Jefferson River browns is thought to occur in the lower Ruby and the lower Boulder Rivers. Rainbow trout spawning habitat, while still limited, has improved in recent years in response to restoration efforts in Hells Canyon and Willow Springs Creeks (Rehwinkel pers. com. 2003).

Fortunately, efforts are currently underway to improve the Jefferson’s fishery. For example, the Jefferson River Watershed Council has worked with state and federal agencies and local citizens to develop a drought management plan to reduce the effects of low flow on the Jefferson’s fishery (JRWC 2000), and Trout Unlimited is working with local landowners to improve streamflow spawning habitat in the Willow Creek drainage, a tributary to the Jefferson (Rehwinkel pers. com. 2003).



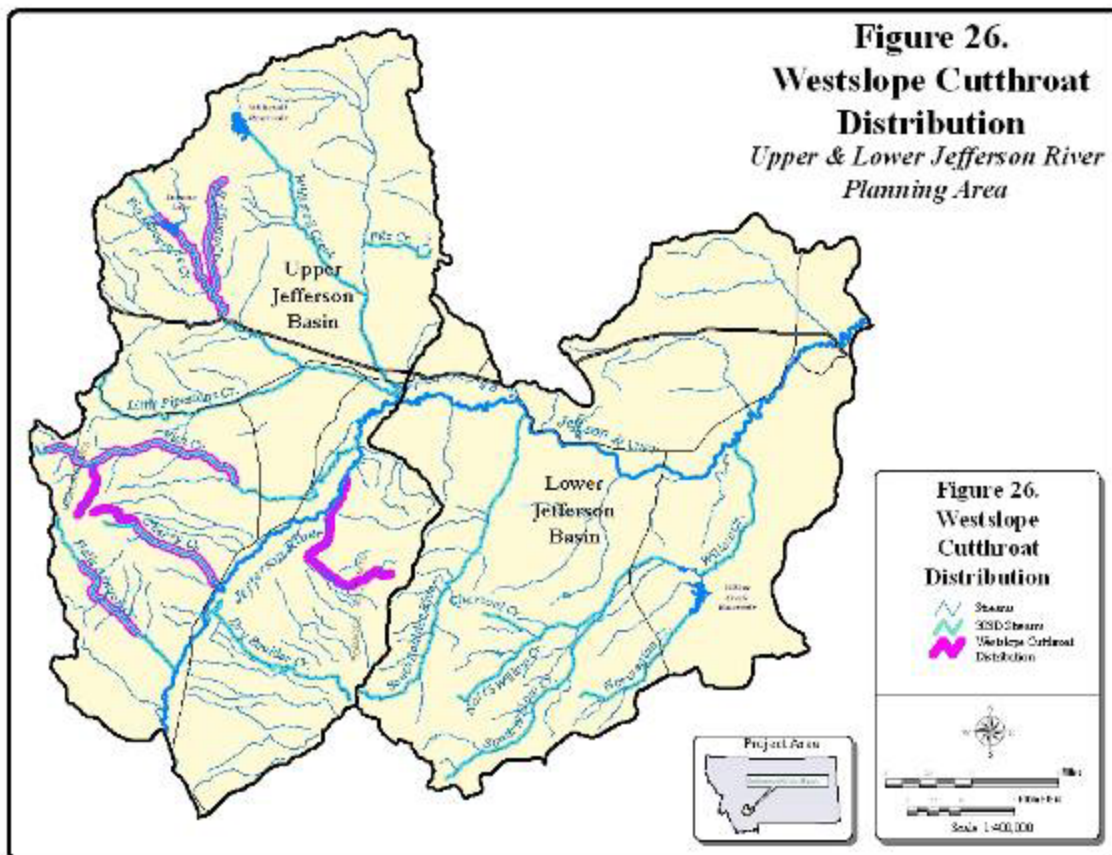
Fisheries mapping information was obtained from the Montana Fish, Wildlife and Parks Fish Distribution Database, available at:  
<http://fwp.state.mt.us/insidefwp/fwplibrary/gis/metadata/Fishdist.htm>.

### 1.3 Orthophoto Quadrangle Maps

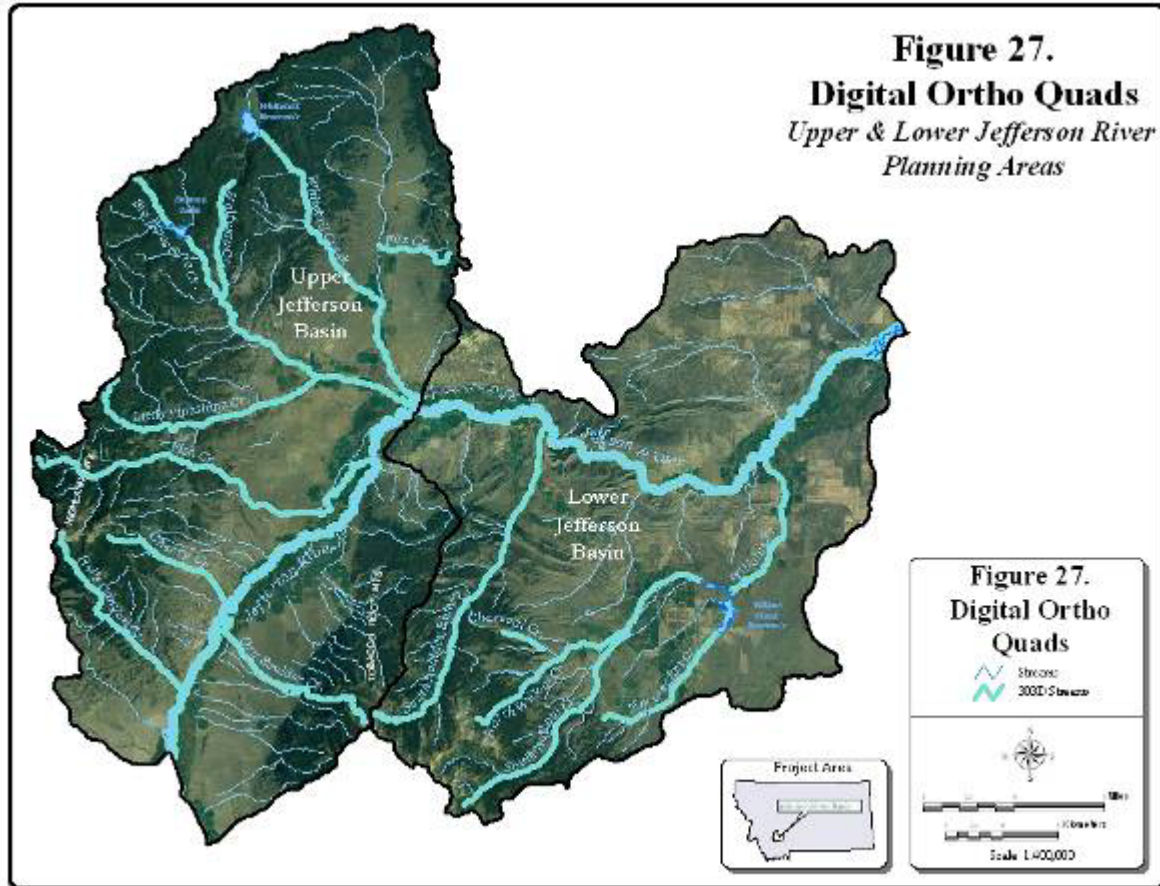
A digital orthophoto quad map for the Jefferson River Planning Areas is presented in **Figure 27**.

### 1.4 Water Quality Monitoring Stations

A map of water quality monitoring locations represented in state and federal water quality databases is presented in **Figure 28** and a list of the station locations is included in **Attachment F**. Databases reviewed for presence of monitoring information in the Jefferson watershed include Montana DEQ's former Storease water quality data system, the USGS National Water Information System, and U.S. EPA's national STORET water quality database. The USGS and STORET databases are available at <http://waterdata.usgs.gov/nwis/> and <http://www.epa.gov/STORET/dbtop.html>. Water quality data for selected Jefferson watershed monitoring locations are summarized in the *Jefferson Watershed Water Quality Status Report*, which is a companion report to this watershed characterization.



**Figure 26. Westslope Cutthroat Distribution**



**Figure 27. Digital Ortho Quads**



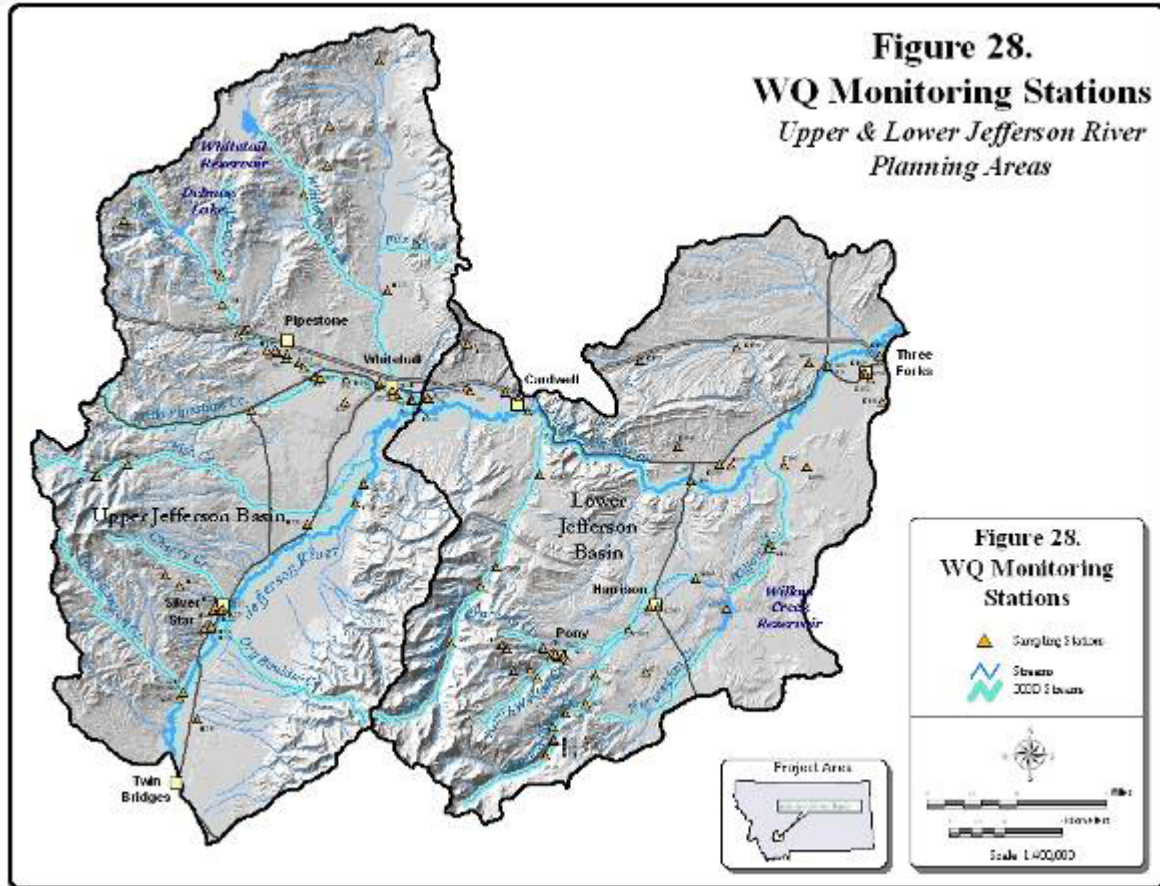


Figure 28. WQ Monitoring Stations



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**ATTACHMENT A**  
**SUMMARY CLIMATIC DATA FOR SELECTED NOAA STATIONS,**  
**JEFFERSON RIVER PLANNING AREAS**



**Summary Climatic Data for Selected NOAA Stations.**

Station	NOAA Station	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Twin Br	248430	Average Max. Temperature (F)	34	40	47	57	67	75	84	82	72	61	44	35	58.2
Pony	246655	Average Max. Temperature (F)	33	37	43	52	61	69	78	77	67	56	41	34	54.1
Norris	246153	Average Max. Temperature (F)	34	40	44	55	65	74	85	84	72	61	45	38	58
Twin Br	248430	Average Min. Temperature (F)	11	15	20	28	36	42	46	43	35	27	19	12	27.8
Pony	246655	Average Min. Temperature (F)	12	16	20	28	36	43	49	47	39	31	20	14	29.6
Norris	246153	Average Min. Temperature (F)	12	19	21	29	35	43	45	44	36	31	22	17	29.4
Twin Br	248430	Average Total Snowfall (in.)	2	2.4	2.8	0.9	0.1	0	0	0.1	0	0.3	1.4	1	11
Pony	246655	Average Total Snowfall (in.)	10	9.5	17	13	3.3	0.2	0	0.1	2.8	7.3	11	11	85.8
Norris	246153	Average Total Snowfall (in.)	7.9	6.3	17	7.8	1.8	0	0	0	0.9	1.7	8.3	6.8	58.3
Twin Br	248430	Average Total Precipitation (in.)	0.3	0.2	0.5	0.9	1.7	1.9	1.1	1	1	0.6	0.4	0.3	9.65
Pony	246655	Average Total Precipitation (in.)	0.7	0.6	1.4	2	3.1	2.7	1.5	1.4	1.7	1.4	1	0.7	18.02
Norris	246153	Average Total Precipitation (in.)	0.4	0.4	1.1	1.6	2.8	2.9	1.1	1.1	1.8	1.5	0.8	0.3	15.91

Period of Record: Norris (1957 to 1982), Pony (1959 to 1998), Twin Bridges (1950 to 2002)





## ATTACHMENT B USGS GAUGING STATIONS, JEFFERSON RIVER PLANNING AREAS

**Table B-1. USGS Gauging Stations in the Jefferson River Planning Areas**

Station Number	Station Name	Drainage Area (mi <sup>2</sup> )	Period of Record
06026500	Jefferson River near Twin Bridges	7632	1940-1943, 1958-1972, 1994-Present
06027000	Jefferson River near Silver Star	7683	1910-1916, 1920-1939
06027200	Jefferson River at Silver Star	7683	1972-1974
06027500	Bell Creek near Waterloo	5.63	1941-1942
06027700	Fish Creek near Silver Star	38.9	1959-1991
06028000	Big Pipestone Creek near Whitehall	108	1910-1911
06028500	Little Pipestone Creek near Whitehall	30.7	1935-1940
06028700	Big Pipestone Creek at Whitehall		
06029000	Whitetail Creek near Whitehall	30.8	1949-1968
06029500	Little Whitetail Creek near Whitehall	91	1911
06030000	Whitetail Creek at Whitehall	179	1911
06030200	Jefferson River tributary near Whitehall	1.85	
06030300	Jefferson River tributary #2 near Whitehall	4.5	
06034000	South Boulder River near Jefferson Island	27.5	1926-1933
06034300	South Boulder River near Cardwell		
06034500	Jefferson River at Sappington	9277	1895-1905, 1938-1969
06034700	Sand Creek at Sappington	9.41	
06034800	Jefferson River tributary #3 near Sappington	1.14	
06035000	Willow Creek near Harrison	83.8	1938-Present
06035500	Norwegian Creek near Harrison	22.4	1938-1943, 1946-1951
06036500	Willow Creek near Willow Creek	165	1919-1933, 1946-1953, 1955-1957
06036600	Jefferson River tributary #4 near Three Forks	0.53	
06036650	Jefferson River near Three Forks	9532	1978-Present
06036700	Jefferson River tributary #5 near Three Forks	3.69	



## ATTACHMENT C

### MAJOR LAND RESOURCE AREAS (MLRAS), JEFFERSON RIVER PLANNING AREAS

#### Northern Rocky Mountains

Idaho, Montana, Oregon, Washington, and Wyoming  
282,650 km<sup>2</sup> (109,130 mi<sup>2</sup>)

**Land use:** Nearly all this area is federally owned and administered by the Forest Service, U.S. Department of Agriculture, and the Bureau of Land Management, Department of the Interior. Most of the privately owned land is controlled by large commercial timber companies. All the forested areas are used as wildlife habitat, for recreation and watershed, and for timber production. Meadows on the upper mountain slopes and crests above timberline provide summer grazing for livestock and big game animals. Mining is an important industry in Idaho and in western Montana. Dairy and livestock farms are important enterprises in the west. Less than 2 percent of the area is cropped. Forage, grain, peas, and a few other crops are grown in some valleys.

**Elevation and topography:** Elevation is mainly 400 to 2,400 m, but it is almost 3,000 m on some mountain peaks. Some areas in Montana and Wyoming are at an elevation of 2,100 to 3,000 m, and mountain peaks are almost 4,300 m. High mountains having steep slopes and sharp crests are cut by narrow valleys, most of which have steep gradients. Lakes are common, especially in glaciated areas.

**Climate:** *Average annual precipitation:* Mainly 625 to 1,525 mm, increasing with elevation, but almost 375 mm in the western part of the area and almost 2,550 mm in high mountains. Most of the precipitation during fall, winter, and spring is snow. Summers are dry. *Average annual temperature:* 2 to 7 C in most of the area, but it is 8 C or more at low elevations. *Average freeze-free period:* 45 to 120 days, decreasing with elevation, and as long as 140 days in low valleys of Washington. Frost occurs every month of the year on high mountains; some peaks have a continuous cover of snow and ice.

**Water:** Moderate precipitation and many perennial streams and lakes provide ample water. Streams and reservoirs supply water to adjoining MLRA's for irrigation and other uses. Springs and shallow wells in the valleys provide water for domestic use and for livestock. Elsewhere, ground-water supplies are small and mostly untapped.

**Soils:** Most of the soils are Ochrepts and Andepts. They have a frigid or cryic temperature regime. Shallow to moderately deep, medium textured and moderately coarse textured Cryochrepts (Jughandle and Holloway series) and Xerochrepts (Waits and Moscow series) are on mountain slopes. Cryandepts (Huckleberry, Truefissure, and Coerock series) are on ridges with thin layers of volcanic ash. Stony Cryorthents (Tamely series) and areas of rock outcrop are on peaks and ridges above timberline. Detailed soil survey information is lacking in most of the area.

**Potential natural vegetation:** This area supports conifer forests. Forests of western white pine, ponderosa pine, lodgepole pine, western redcedar, western larch, hemlock, Douglas-fir, subalpine fir, and spruce are common. Alpine grasses, forbs, and shrubs and scattered stands of subalpine fir, spruce, and whitebark pine grow on high mountains of Montana and Wyoming.

**Northern Rocky Mountain Valleys**  
Idaho, Montana, and Washington  
32,320 km<sup>2</sup> (12,480 mi<sup>2</sup>)

**Land Use:** Nearly all this area is in farms and ranches. As much as one-third of the land in some valleys is irrigated. Potatoes, sugar beets, and peas are important cash crops, but a larger acreages in hay, grain, and pasture for livestock feed. In places where precipitation is adequate, the land is dry-farmed to wheat. One-third to one-half of the area is range of native grasses and shrubs. Beef cattle and sheep are the principal livestock, but dairying is an important enterprise near the larger towns. Much of the area in northern Idaho is forested, and elsewhere many steep and stony soils are in woodland. These forests are of value to the lumber industry and are also grazed.

**Elevation and Topography:** Elevation ranges from 600 to as much as 2,100 m; the highest is in south western Montana. The deep valleys bordered by mountains are mostly north-south trending. In the valleys, nearly level, broad flood plains are bordered by gently sloping to strongly sloping terraces and fans. In many places the valleys have been modified somewhat by glaciation, and in the north, lacustrine sediments cover much of the valley floors.

**Climate:** Average annual precipitation 300 to 400 mm in most of the area, less than 250 mm in Montana, and 850 mm in northern Idaho. Precipitation is fairly evenly distributed throughout fall, winter, and spring but is low in summer. Most of the precipitation in winter is snow. Average annual temperature 4 to 8 C. Average freeze-free period--100 to 120 days in much of the area, but it is 80 days or less at the highest elevations and 130 days or more at the lowest.

**Water:** Perennial streams flowing into the area from surrounding mountains are the principal source of water. The amount usually is adequate but depends on the snow accumulation in the mountains. Ground water is abundant in the deeper unconsolidated fill materials, and some is used for irrigation. Precipitation is adequate for some dryfarming at higher elevations and throughout the area in northern Idaho.

**Soils:** The dominant soils are mostly Orthids, Borolls, and Argids. They are medium textured to fine textured and mainly well drained and have a frigid or, at higher elevations, a cryic temperature regime. At the lower elevations, deep and moderately deep Calciorthids (Crago and Musselshell series), Haploborolls (Bitterroot and Grantsdale series), and Argiborolls (Martinsdale series) are on alluvial fans and terraces. Natrargids (Round Butte series) are on lacustrine fans and terraces, and Fluvents are on alluvial flood plains and low terraces. At the higher elevations, mostly deep, well drained to somewhat poorly drained Cryoborolls (Amsterdam, Bozeman, Bridger, and Gallatin series) are on alluvial terraces and fans, and Aquepts and Aquepts are adjacent to drainageways and in undrained depressions.

**Potential Natural Vegetation:** This area supports conifer forests and grassland vegetation. Bluebunch wheatgrass, rough fescue, Idaho fescue, and bearded wheatgrass are the major species of the grassland in the valleys and foothills. Douglas-fir, ponderosa pine, grand fir, western redcedar, western hemlock, pinegrass, common snowberry, mallow ninebark, and white spirea are the major forest species.



**ATTACHMENT D**  
**SOIL SERIES OF THE JEFFERSON RIVER PLANNING AREAS,**  
**JEFFERSON RIVER PLANNING AREAS**

**Table D-1 Soil Series of the Jefferson River Planning Areas**

<b>Soil Mapping Unit</b>	<b>Lower Jefferson (mi<sup>2</sup>)</b>	<b>Lower Jefferson (%)</b>	<b>Upper Jefferson (mi<sup>2</sup>)</b>	<b>Upper Jefferson (%)</b>	<b>Total (mi<sup>2</sup>)</b>	<b>Total (%)</b>
COWOOD-HANKS-COMAD (MT140)			174.21	23.7%	174.21	13.0%
SAPPINGTON-AMESHA-CRAGO VARIANT (MT012)	8.89	1.5%	104.99	14.3%	113.88	8.5%
VARNEY-NULEY-ROCK OUTCROP (MT432)	73.70	12.2%	36.36	5.0%	110.06	8.2%
GARLET-ROCK OUTCROP-CRYOBOROLLS (MT485)	43.42	7.2%	29.44	4.0%	72.86	5.4%
ORO FINO-POIN-SEBUD (MT434)	42.74	7.1%	28.94	3.9%	71.68	5.4%
SCRAVO-CRAGO-MUSSELSHELL (MT529)			66.27	9.0%	66.27	5.0%
CRITTENDEN-TWILIGHT FAMILY-CASTNER (MT149)			65.57	8.9%	65.57	4.9%
BROCKO-KALSTED-CRAGO (MT066)	64.89	10.8%			64.89	4.9%
RIVRA-CARDWELL-RYELL (MT477)	52.76	8.8%	11.84	1.6%	64.60	4.8%
BROCKO-AMESHA-CRAGO VARIANT (MT063)	52.24	8.7%			52.24	3.9%
RENCOT-LAHOOD-ROCK OUTCROP (MT469)	18.08	3.0%	31.03	4.2%	49.11	3.7%
WHITORE-HANSON-WHITECOW (MT628)	8.54	1.4%	38.25	5.2%	46.79	3.5%
HANSON-PENSORE-WHITORE (MT240)	43.13	7.2%			43.13	3.2%
SHADOW-ROCHESTER-MACFARLANE (MT533)	20.89	3.5%	14.55	2.0%	35.44	2.7%
GARLET-COWOOD-ROCK OUTCROP (MT213)	34.18	5.7%			34.18	2.6%

**Table D-1 Soil Series of the Jefferson River Planning Areas**

<b>Soil Mapping Unit</b>	<b>Lower Jefferson (mi<sup>2</sup>)</b>	<b>Lower Jefferson (%)</b>	<b>Upper Jefferson (mi<sup>2</sup>)</b>	<b>Upper Jefferson (%)</b>	<b>Total (mi<sup>2</sup>)</b>	<b>Total (%)</b>
RIVRA-NEEN-RYELL (MT482)			28.04	3.8%	28.04	2.1%
BROCKO-FLOWEREE-ROTHIEMAY (MT065)	24.64	4.1%			24.64	1.8%
CRAGO-ROCK OUTCROP-PENSORE (MT147)	22.33	3.7%	1.09	0.1%	23.42	1.8%
FARNUF FAMILY-BAXENDALE-MOCMONT (MT033)			21.68	3.0%	21.68	1.6%
KLUG-WOODHALL-ROCK OUTCROP (MT308)	1.13	0.2%	19.27	2.6%	20.40	1.5%
AMESHA-BROCKO-MUSSELSHELL (MT011)	18.79	3.1%			18.79	1.4%
KALSTED-CRAGO-RENTSAC (MT300)	10.55	1.8%	7.82	1.1%	18.36	1.4%
WINDHAM-LAP-MAIDEN (MT641)	13.37	2.2%			13.37	1.0%
PENSORE-TOLMAN-ROCK OUTCROP (MT444)	11.98	2.0%			11.98	0.9%
FAIRWAY-HAVRE VARIANT-GLENDIVE (MT192)	0.10	0.0%	11.64	1.6%	11.74	0.9%
ANACONDA-BEAVERELL-SIXBEACON (MT014)			11.33	1.5%	11.33	0.8%
PERMA-HOLTER-TOLMAN (MT448)	2.21	0.4%	8.15	1.1%	10.36	0.8%
HAVRE-RIVRA-HAVRE VARIANT (MT260)	8.90	1.5%			8.90	0.7%
CHINOOK-BROCKO-FLOWEREE (MT129)	8.11	1.3%			8.11	0.6%
DINNEN FAMILY-PHILIPSBURG-SEBUD (MT172)			7.91	1.1%	7.91	0.6%
FLUVAQUENTIC HAPLAQUOLLS-TYPIC CRYAQUOLLS-LARRY VARIANT (MT242)	7.90	1.3%			7.90	0.6%



**Table D-1 Soil Series of the Jefferson River Planning Areas**

<b>Soil Mapping Unit</b>	<b>Lower Jefferson (mi<sup>2</sup>)</b>	<b>Lower Jefferson (%)</b>	<b>Upper Jefferson (mi<sup>2</sup>)</b>	<b>Upper Jefferson (%)</b>	<b>Total (mi<sup>2</sup>)</b>	<b>Total (%)</b>
MACAR-PERMA-CASTNER (MT363)	6.89	1.1%			6.89	0.5%
DINNEN FAMILY-SEBUD-PEELER (MT171)			6.45	0.9%	6.45	0.5%
TRIMAD-KALSTED-CRAGO (MT580)			3.99	0.5%	3.99	0.3%
LIBEG-MAURICE-CHEADLE (MT333)			3.28	0.4%	3.28	0.2%
NEEN-TRUDAU-RIVRA (MT413)			2.26	0.3%	2.26	0.2%
CRAGO-AMESHA-MUSSELSHELL (MT144)	1.98	0.3%			1.98	0.1%
RIVRA-HAGGA FAMILY-TRUDAU (MT481)			0.19	0.0%	0.19	0.0%
DINNEN FAMILY-LUCKY-CHEADLE (MT170)			0.00	0.0%	0.00	0.0%
<b>Combined</b>	602.36	100.0%	734.55	100.0%	1336.9	100.0%



**ATTACHMENT E**  
**MINERAL PROSPECTS AND OPERATIONS, JEFFERSON RIVER**  
**PLANNING AREAS**



Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
INGLESIDE QUARRY	Surface	Unknown	1	N	1	W	33	Three forks	Stone
UNNAMED LOCATION	Mineral loc	Unknown	3	S	6	E	22	Bozeman pass	Asbestos
UNNAMED LOCATION	Mineral loc	Unknown	2	S	6	E	4	Bozeman pass	Phosphate
GRAVEL PIT	Surface	Unknown	1	N	1	E	2	Three forks	Sand & gra
PLACER	Placer	Exp prospect	2	N	1	E	26	Three forks	Gold
SAPPINGTON JUNCTION CHERT	Prospect	Raw prospect	1	N	2	W	36	Jefferson island	
MONTANA TALC COMPANY	Proc plant	Past producer	1	N	1	W	32	Jefferson island	Talc
THREE FORKS MILL	Proc plant	Producer	1	N	1	E	25	Three forks	Talc
PIESTONE HOT SPRINGS	Hot spring	Producer	2	N	5	W	28	Dry mountain	Geothermal
PROSPECTOR'S DREAM	Mineral loc	Exp prospect	1	N	2	W	18	Jefferson island	Asbestos
WAR EAGLE & LEROY MINES	Underground	Exp prospect	1	N	6	W	18	Pipestone pass	Copper iron
LA HOOD GYPSUM DEPOSIT	Surf-underg	Past producer	1	N	2	W	23	Jefferson island	Gypsum
INSPIRATION CLAIM	Underground	Past producer	2	N	3	W	19	Black butte	Copper lead gold silv
SURPRISE CLAIM	Underground	Past producer	2	N	3	W	18	Black butte	Lead silver gold zinc
PARROT	Surf-underg	Past producer	2	N	3	W	18	Black butte	Lead silver gold zinc co
SHIELDS-IRONSIDES	Surf-underg	Past producer	2	N	4	W	13	Black butte	Lead copper gold silver
SILVER BELL	Surf-underg	Past producer	3	N	5	W	3	Boulder	Lead
SOUTH VIEW	Underground	Past producer	2	N	4	W	24	Black butte	Silver gold lead zinc
WHITEHALL	Underground	Past producer	2	N	4	W	12	Black butte	Lead zinc silver
SUMMIT MINE	Underground	Past producer	4	N	5	W	16	Boulder	Lead
BLACKWELL	Underground	Past producer	3	N	7	W	36	Homestake	Gold
GOLDEN SUNLIGHT	Surface	Producer	2	N	3	W	19	Black butte;mt	Gold silver
LUCKY HIT	Underground	Past producer	2	N	3	W	19	Black butte	Gold lead silver copper
MOUNTAIN CHIEF	Underground	Past producer	3	N	7	W	36	Homestake	Gold
JUPITOR	Underground	Past producer	2	N	6	W	36	Delmoe lake	Gold
GOLD BUG	Underground	Past producer	2	N	6	W	6	Homestake	Gold
SUNNY CORNER	Underground	Past producer	2	N	4	W	24	Black butte	Gold silver copper
UNNAMED QUARTZ	Mineral loc	Unknown	4	N	5	W	10	Boulder	Quartz cry
BLUEBELL	Surface	Past producer	3	N	6	W	35	Delmoe lake	Lead silver zinc copper
CARBONATE	Underground	Past producer	2	N	4	W	24	Black butte	Lead zinc silver gold
MIDNIGHT	Underground	Past producer	2	N	3	W	18	Black butte	Lead silver gold copper
BIG MAJOR MINE	Underground	Producer	4	N	5	W	4	Boulder	Gold silver
EAST RIDGE GROUP	Surf-underg	Exp prospect	3	N	7	W	12	Elk park	Gold copper lead zinc
HUMBOLT	Underground	Producer	3	N	6	W	9	Elk park	Gold silver
MOUNTAIN QUEEN MINE	Underground	Past producer	4	N	5	W	27	Boulder	Copper silver lead uranium
NEW BALD EAGLE MINE	Surface	Past producer	4	N	5	W	16	Boulder	Gold silver
STREAK OF LUCK; SUNNYSIDE GROUP	Surf-underg	Producer	2	N	3	W	18	Black butte	Gold silver
SILVER QUEEN MINE	Underground	Past producer	2	N	5	W	6	Delmoe lake	Gold silver
BLACK CANYON PLACER	Placer	Producer	3	N	7	W	14	Elk park	Gold
MOSCOW MINE	Mineral loc	Past producer	1	N	6	W	16	Grace	Silver copper
FLAG PLACER	Placer	Past producer	2	N	7	W	1	Homestake	Gold

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
LEWIS KOUNTZ RANCH	Mineral loc	Raw prospect	1	N	5	W	8	Grace	Pumice
PIPESTONE SPRINGS DEPOSIT	Prospect	Raw prospect	2	N	5	W	14	Dry mountain	Pumice
HOPE	Mineral loc	Unknown	1	N	3	W	1	Jefferson island	Copper silver gold
BIG CHIEF	Underground	Devel deposit	3	N	6	W	28	Delmoe lake	Silver gold
SIXTEEN TO ONE	Surf-underg	Exp prospect	2	N	6	W	35	Delmoe lake	Gold
UNNAMED URANIUM	Mineral loc	Unknown	2	N	3	W	30	Black butte	Uranium
EXAMINER	Underground	Exp prospect	2	N	4	W	13	Black butte	Lead manganese
DUNBAR CALCITE	Mineral loc	Exp prospect	3	N	1	W	33	Three forks	Calcium
UNNAMED BRICK CLAY	Mineral loc	Raw prospect	2	N	4	W	25	Black butte	Clay
LIMESPUR DEPOSIT	Surface	Past producer	2	N	4	W	4	Black butte	Gypsum
LIMESPUR QUARRY	Surface	Past producer	1	N	2	W	19	Jefferson island	Stone
POHNDORF AMETHYST	Mineral loc	Past producer	1	N	6	W	4	Grace	Gemstone silicon
TREVILLION-JOHNSON MEMORIAL CO.	Surface	Past producer	1	N	6	W	15	Grace	Stone
DUMOS	Surface	Past producer	1	N	6	W	22	Grace	Stone
WELCH PLACER QUARRY	Surface	Past producer	2	N	6	W	10	Delmoe lake	Stone
BIG PIPESTONE CREEK	Placer	Devel deposit	2	N	5	W	19	Delmoe lake	Gold
LITTLE PIPESTONE CREEK PLACER	Placer	Devel deposit	1	N	5	W	8	Grace	Gold
BIGFOOT CREEK PLACE	Placer	Devel deposit	4	N	5	W	1	Boulder	Gold
AJAX	Underground	Unknown	4	N	5	W	14	Boulder	Lead copper zinc
UNNAMED LEAD & COPPER	Underground	Unknown	4	N	5	W	12	Boulder	Lead copper zinc
UNNAMED GYPSUM	Surface	Past producer	1	N	2	W	21	Jefferson island	Gypsum
UNNAMED QUARTZ	Mineral loc	Unknown	4	N	5	W	24	Boulder	Quartz cry
UNNAMED KAOLIN	Mineral loc	Unknown	1	N	2	W	26	Jefferson island	Clay
UNNAMED SILVER & COPPER	Mineral loc	Unknown	3	N	6	W	13	Elk park	Silver copper
UNNAMED GOLD & SILVER	Mineral loc	Unknown	3	N	5	W	16	Boulder	Gold silver copper zinc lead
BI-METALLIC	Underground	Producer	3	N	5	W	15	Boulder	Gold silver lead copper zinc
BIG FOUR	Underground	Past producer	4	N	5	W	12	Boulder	Lead zinc silver gold copper
BIG FOOT	Mineral loc	Unknown	4	N	5	W	15	Boulder	Lead gold silver
BIG FOOT CREEK	Placer	Unknown	4	N	4	W	7	Boulder	Gold
BLUE JAY	Underground	Unknown	4	N	5	W	15	Boulder	Lead zinc copper silver gold
EASTER LILLIE	Underground	Past producer	2	N	5	W	9	Dry mountain	Lead silver gold copper z
EVENING STAR	Mineral loc	Unknown	3	N	7	W	36	Homestake	Silver gold
FLORENCE GROUP	Underground	Devel deposit	2	N	3	W	18	Black butte	Gold silver
GEM MINE	Underground	Unknown	2	N	4	W	13	Black butte	Lead zinc silver copper gold
GLOWING STAR PLACER	Placer	Unknown	2	N	6	W	6	Homestake	Gold
HARRIET MINE	Underground	Unknown	2	N	7	W	1	Homestake	Gold silver
HOMESTAKE CREEK & TRIBUTARIES	Mineral loc	Unknown	2	N	6	W	7	Homestake	Gold silver
HUDSON	Underground	Raw prospect	2	N	3	W	18	Black butte	Lead

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
JACK MINE	Mineral loc	Unknown	4	N	5	W	27	Boulder	Lead uranium
JIM JR. CLAIM	Mineral loc	Unknown	3	N	6	W	16	Elk park	Gold silver copper
LAST CHANCE	Underground	Unknown	4	N	5	W	15	Boulder	Gold silver copper
LENA MINE	Underground	Unknown	2	N	6	W	15	Delmoe lake	Gold lead
LOST CABIN MINE	Underground	Unknown	4	N	5	W	15	Boulder	Lead gold silver copper
MINERVA MINE	Underground	Unknown	2	N	4	W	13	Black butte	Lead gold silver zinc copper
MONTANA MINE	Underground	Exp prospect	2	N	6	W	6	Homestake	Gold silver
MORNING GLORY	Mineral loc	Unknown	2	N	6	W	6	Homestake	Gold
NANNIE BROWN MINE	Mineral loc	Unknown	3	N	7	W	36	Homestake	Gold silver
NIKI MINE	Mineral loc	Unknown	3	N	6	W	18	Elk park	Molybdenum tungsten
PAY ROCK MINE	Underground	Unknown	2	N	6	W	6	Homestake	Gold silver copper gold
PERHAPS MINE	Underground	Unknown	2	N	3	W	18	Black butte	Lead zinc gold copper silver
STATE MINE	Underground	Past producer	4	N	5	W	16	Boulder	Gold silver copper lead
ST. ANTHONY MINE	Underground	Past producer	3	N	5	W	3	Boulder	Gold silver lead
TOLL MOUNTAIN	Mineral loc	Unknown	1	N	6	W	5	Pipestone pass	Quartz cry
WOODVILLE DEPOSIT	Mineral loc	Unknown	3	N	6	W	6	Elk park	Tungsten
UNNAMED MINE	Underground	Past producer	3	N	6	W	18	Elk park	Gold silver lead
KING MINE	Underground	Past producer	3	N	5	W	30	Delmoe lake	
NORTH SUNLIGHT GROUP	Underground	Devel deposit	2	N	3	W	19	Black butte	Gold silver copper lead
LUCKY KAREN PLACER	Placer	Past producer	3	N	7	W	16	Elk park	Gold
BUTTE TUNGSTEN	Surf-underg	Devel deposit	3	N	6	W	17	Elk park	Tungsten
TWOHY PROPERTY	Mineral loc	Exp prospect	3	N	5	W	3	Boulder	Lead zinc
OGLE PROPERTY	Underground	Past producer	2	N	4	W	16	Black butte	Lead manganese
MINNIE WILSON	Surf-underg	Exp prospect	2	N	5	W	9	Dry mountain	Gold silver
NEW DEAL	Underground	Unknown	2	N	5	W	4	Dry mountain	Gold silver
GOLDEN VALLEY	Underground	Unknown	2	N	5	W	4	Dry mountain	Gold silver copper lead
LOST HATCHET	Underground	Unknown	2	N	5	W	4	Dry mountain	Gold silver copper
BLUE MOOSE	Mineral loc	Unknown	2	N	3	W	29	Black butte	Gold
TOWNSEND VALLEY	Mineral loc	Unknown	2	N	1	W	11	Three forks	Uranium
BUTTE CARDWELL	Underground	Past producer	1	N	3	W	1	Jefferson island	Copper silver gold
CONNIE JO	Underground	Past producer	2	N	6	W	1	Delmoe lake	Gold silver
GOLD VALLEY	Underground	Past producer	1	N	5	W	19	Grace	Gold
GOLD STAR	Underground	Past producer	2	N	4	W	25	Black butte	Lead gold silver copper
IRENE	Underground	Past producer	3	N	7	W	36	Homestake	Gold silver copper
MARY LUCILLE	Underground	Past producer	2	N	3	W	9	Black butte	Lead gold
OHIO	Underground	Past producer	2	N	3	W	19	Black butte	Gold silver copper
SAPPINGTON CANYON	Unknown	Unknown	1	N	2	W	25	Jefferson island	Phosphate



Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
THREE FORKS	Unknown	Unknown	2	N	1	W	24	Three forks	Silver
PAY DAY GROUP	Surf-underg	Producer	2	N	3	W	18	Black butte	Gold silver
ALUISE LODE	Unknown	Unknown	3	N	6	W	35	Delmoe lake	Gold
BLUE ROCK LODE	Unknown	Unknown	3	N	6	W	26	Delmoe lake	Gold silver
19 MILE NICKEL DEPOSIT	Unknown	Unknown	1	N	6	W	16	Grace	Nickel
IRON KING CLAIM	Underground	Past producer	1	S	4	W	5	Whitehall	Manganese
IRON BLOSSOM NO 1 CLAIM	Surface	Unknown	1	S	4	W	3	Whitehall	Manganese
IRON BLOSSOM NUMBER 3	Surface	Unknown	1	S	4	W	3	Whitehall	Iron manganese
JACKMAN-OGLE	Underground	Exp prospect	1	S	4	W	5	Whitehall	Manganese
BARCEL'S HOT SPRINGS	Hot spring	Producer	2	S	6	W	1	Twin bridges	Geothermal
CLARK'S WARM SPRINGS	Hot spring	Raw prospect	3	S	2	W	7	Harrison	Geothermal
FLORIDA GIANT	Underground	Devel deposit	3	S	4	W	6	Waterloo	Gold silver
GREEN CAMPBELL	Underground	Past producer	2	S	6	W	3	Twin bridges	Gold copper
SAILOR LAKE MINE	Mineral loc	Exp prospect	2	S	4	W	35	Waterloo	Copper lead molybdenum
BESSIE AND GOLDEN WAVE MINE	Underground	Producer	2	S	2	W	14	Harrison	Gold silver copper tungsten
MOFFET JOHNSON	Surf-underg	Past producer	3	S	5	W	2	Waterloo	Copper gold silver
MAYFLOWER	Underground	Past producer	1	N	3	W	32	White hall	Gold silver tellurium
MAMMOTH AND STELLA MINES	Underground	Past producer	2	S	6	W	9	Twin bridges	Copper silver lead
ATLANTIC & PACIFIC MINE	Underground	Past producer	2	S	3	W	20	Harrison	Gold silver copper
GRANITE PEAK	Surface	Raw prospect	3	S	3	W	30	Waterloo	Molybdenum tungsten
CARMICHAEL CLAIMS	Surface	Exp prospect	1	S	3	W	34	Harrison	Iron
RASPBERRY MINE	Underground	Past producer	2	S	3	W	14	Harrison	Lead gold
TEXAS LODE MINE	Surf-underg	Past producer	3	S	5	W	26	Waterloo	Lead gold silver zinc
BLUE ROCK AND MAY BASKET	Surf-underg	Exp prospect	2	S	2	W	33	Harrison	Lead molybdenum silver
RAINBOW	Underground	Past producer	3	S	4	W	5	Waterloo	Lead zinc silver gold
SUNBEAM	Underground	Devel deposit	1	S	4	W	5	Whitehall	Manganese
QUARTZ CITY MINE	Underground	Exp prospect	2	S	4	W	35	Waterloo	Molybdenum
GRIGG GROUP	Surf-underg	Exp prospect	3	S	3	W	16	Harrison	Molybdenum lead tungsten
PRESIDENTIAL GROUP	Surf-underg	Devel deposit	3	S	3	W	16	Harrison	Tungsten
CRYSTAL BUTTE	Mineral loc	Raw prospect	3	S	4	W	4	Waterloo	Silicon
PERRY CANYON	Surf-underg	Exp prospect	1	S	4	W	17	Vendome	Tungsten
STRAWBERRY MINE	Surface	Past producer	2	S	3	W	14	Harrison	Tungsten gold silver copper
NOW PROPERTY	Underground	Exp prospect	3	S	2	W	2	Harrison	Tungsten manganese uranium
NORTH WILLOW CREEK TUNGSTEN DEPOSIT	Underground	Past producer	2	S	3	W	24	Harrison	Tungsten molybdenum
NEVADA GROUP CLAIMS	Surf-underg	Exp prospect	3	S	3	W	15	Harrison	Tungsten
MOUNTAIN ROSE CLAIM	Underground	Exp prospect	3	S	3	W	15	Harrison	Tungsten

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
STASNOS	Underground	Exp prospect	3	S	3	W	15	Harrison	Tungsten
WILLIAM FLY	Surf-underg	Exp prospect	3	S	3	W	22	Harrison	Tungsten lead
GREEN JACKET	Surf-underg	Exp prospect	3	S	3	W	16	Harrison	Tungsten copper
CROWN POINT CLAIMS	Underground	Exp prospect	3	S	3	W	17	Harrison	Tungsten copper silver
DEMOS GROUP	Surf-underg	Exp prospect	3	S	3	W	16	Harrison	Tungsten copper manganese lead
KEYSTONE CLAIM	Surface	Exp prospect	3	S	3	W	15	Harrison	Tungsten copper
U.S. GOLD CORP.	Underground	Past producer	3	S	4	W	8	Waterloo	Copper gold lead silver
PETE AND JOE	Underground	Producer	3	S	4	W	8	Waterloo	Gold silver copper lead
BEVERLY GROUP	Surface	Past producer	2	S	6	W	8	Twin bridges	Gold silver
DIVIDEND LODE MINE	Underground	Exp prospect	2	S	3	W	15	Harrison	Gold silver
FRIDA MARIE CLAIM	Underground	Past producer	2	S	6	W	10	Twin bridges	Silver gold
JUMPER CLAIMS	Underground	Past producer	2	S	3	W	27	Harrison	Gold silver copper
SCALDED CAT MINE	Underground	Exp prospect	2	S	3	W	14	Harrison	Gold silver copper tungsten
VICTORIA MINE	Underground	Past producer	2	S	6	W	2	Twin bridges	Gold silver lead copper
IRON ROD	Underground	Past producer	2	S	6	W	22	Twin bridges	Gold lead
UNNAMED MINE	Surface	Unknown	2	S	1	W	12	Norris	
BUFFALO	Underground	Unknown	2	S	7	W	33	Twin bridges	Gold
BROADWAY	Underground	Past producer	2	S	6	W	2	Twin bridges	Gold silver
HIGH RIDGE	Underground	Past producer	3	S	5	W	27	Waterloo	Gold silver
AURORA	Underground	Past producer	2	S	6	W	3	Twin bridges	Gold lead silver
ANYTHING MINE	Underground	Past producer	2	S	7	W	33	Twin bridges	Gold copper lead
BOULDER-COBALT MINE	Underground	Past producer	3	S	4	W	5	Waterloo	Gold silver copper lead c
WHITE PINE	Underground	Past producer	2	S	3	W	9	Harrison	Gold silver copper zinc
HAZEL MINE	Underground	Exp prospect	3	S	3	W	22	Harrison	Silver
BLUE JAY GROUP	Prospect	Exp prospect	2	S	6	W	10	Twin bridges	Copper
LUCKY SILVER	Unknown	Producer	3	S	5	W	16	Waterloo	Silver
SILVER CREEK MINE	Underground	Past producer	2	S	3	W	32	Harrison	
TIDAL WAVE	Underground	Past producer	3	S	5	W	28	Waterloo	Gold silver lead zinc
RICHMOND GROUP	Underground	Past producer	3	S	5	W	22	Waterloo	Gold silver copper zinc lead
UNNAMED GRAVEL PIT	Surface	Unknown	3	S	6	W	11	Twin bridges	Sand & gra
UNNAMED GRAVEL PIT	Surface	Unknown	3	S	6	W	26	Twin bridges	Sand & gra
HAMILTON	Underground	Exp prospect	3	S	5	W	1	Waterloo	Gold copper manganese
UNNAMED GRAVEL PIT	Surface	Unknown	3	S	6	W	35	Twin bridges	Sand & gra
CRYSTAL LAKE	Underground	Past producer	3	S	5	W	26	Waterloo	Gold
ELENORA	Underground	Past producer	3	S	5	W	26	Waterloo	Gold silver lead
CAROLINA MINE	Underground	Past producer	3	S	5	W	23	Waterloo	Gold silver zinc lead copper
LOTTIE MINE	Underground	Past producer	3	S	5	W	23	Waterloo	Gold silver zinc
CORNCRACKER MINE	Underground	Past producer	3	S	5	W	34	Waterloo	Gold silver lead

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
BRYZANT MINE	Surf-underg	Past producer	3	S	5	W	33	Waterloo	Lead zinc silver
SUNFLOWER 1	Underground	Exp prospect	3	S	5	W	27	Waterloo	Gold silver lead zinc
UNNAMED GRAVEL PIT	Surface	Unknown	4	S	6	W	12	Twin bridges	Sand & gra
MAINSTREET	Underground	Exp prospect	3	S	5	W	26	Waterloo	Gold copper iron
COP PROSPECT	Underground	Past producer	3	S	5	W	27	Waterloo	Gold zinc
ELLA MINE	Underground	Past producer	3	S	5	W	26	Waterloo	Gold silver lead
LONE STAR PROSPECT	Underground	Exp prospect	3	S	5	W	26	Waterloo	Gold silver zinc copper
UNNAMED MINE	Underground	Unknown	3	S	7	W	12	Twin bridges	
DULLEA ADIT 1	Underground	Exp prospect	3	S	5	W	26	Waterloo	Gold silver lead copper zinc
UNNAMED MINE	Surface	Unknown	3	S	6	W	2	Twin bridges	
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	15	Twin bridges	
ARGENTA ADIT 1	Underground	Exp prospect	3	S	5	W	26	Waterloo	Lead gold
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	15	Twin bridges	
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	9	Twin bridges	
KRUEGER NORTH ADIT	Underground	Exp prospect	3	S	5	W	16	Waterloo	Gold silver copper lead zi
JULIA LEE MINE	Underground	Unknown	2	S	6	W	7	Twin bridges	Silver gold
CRICKET MINE	Underground	Past producer	2	S	6	W	10	Twin bridges	
BEAR GULCH ADIT	Underground	Past producer	3	S	5	W	10	Waterloo	Gold silver copper iron zinc
UNNAMED SURFACE PIT	Surface	Exp prospect	3	S	5	W	10	Waterloo	Gold silver zinc copper
BISMUTH PROSPECT	Underground	Exp prospect	3	S	5	W	22	Waterloo	Gold silver zinc copper iron
UNNAMED PROSPECT	Underground	Exp prospect	3	S	5	W	33	Waterloo	Gold
NEW YORK PROSPECT	Underground	Exp prospect	3	S	5	W	27	Waterloo	Gold silver
FORK PROSPECT	Underground	Devel deposit	3	S	5	W	34	Waterloo	Silver lead
PEARSON PROSPECT	Underground	Exp prospect	3	S	5	W	34	Waterloo	Gold silver lead copper
BULLIDICK PROSPECT	Underground	Exp prospect	3	S	5	W	27	Waterloo	Gold silver copper zinc ir
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	9	Twin bridges	
BISMARCK-NUGGET ADITS	Underground	Past producer	3	S	5	W	26	Waterloo	Gold silver lead copper
URHANE	Underground	Past producer	3	S	5	W	22	Waterloo	Gold silver
SCHMIDT PROSPECTS NORTH	Surf-underg	Exp prospect	3	S	5	W	24	Waterloo	Zinc
RED BELL	Underground	Exp prospect	3	S	5	W	24	Waterloo	Gold silver
EMPIRE STATE	Underground	Exp prospect	3	S	5	W	27	Waterloo	Gold silver copper lead zinc
PLAINVIEW	Underground	Exp prospect	3	S	5	W	28	Waterloo	Gold silver
WALKER MINE	Underground	Past producer	3	S	5	W	34	Waterloo	Gold silver
CLANCY MINE	Surface	Unknown	1	S	6	W	33	Twin bridges	Gold silver copper
COLORADO MINE	Underground	Past producer	1	S	4	W	3	Whitehall	Gold silver
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	4	Twin bridges	
LEODORA	Underground	Exp prospect	3	S	5	W	4	Waterloo	Gold silver lead
STRAWW MINE	Underground	Past producer	2	S	4	W	18	Waterloo	Gold silver antimony

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
UNNAMED PROSPECTS	Mineral loc	Unknown	2	S	6	W	4	Twin bridges	
NICHOLSON MINE	Underground	Past producer	3	S	3	W	7	Waterloo	Gold silver
BISMARCK MINE	Underground	Past producer	2	S	4	W	36	Waterloo	Molybdenum iron copper
SNYDER'S MINE	Underground	Past producer	3	S	4	W	4	Waterloo	
GARNET GOLD MINE	Underground	Past producer	2	S	3	W	23	Harrison	Gold silver lead copper
BOSS TWEED AND CLIPPER	Underground	Past producer	2	S	3	W	15	Harrison	Gold silver copper
KEYSTONE	Underground	Past producer	2	S	6	W	3	Twin bridges	Gold silver tungsten
MONTANA 1 MINE	Underground	Exp prospect	1	S	4	W	5	Whitehall	Iron
IRON OCCURRENCE	Mineral loc	Raw prospect	1	N	4	W	32	Whitehall	Iron
BEAR GULCH PLACER	Placer	Past producer	3	S	5	W	11	Waterloo	Gold
GOODRICH GULCH PLACER	Placer	Past producer	3	S	5	W	24	Waterloo	Gold
DRY GEORGIA GULCH	Placer	Past producer	3	S	5	W	26	Waterloo	Gold
RED MOUNTAIN PLACER	Placer	Past producer	1	S	7	W	34	Twin bridges	Gold
SILVER STAR PLACER	Placer	Past producer	2	S	6	W	20	Twin bridges	Gold
FIRST CREEK PLACER	Placer	Raw prospect	2	S	6	W	17	Twin bridges	Gold
DAIZY NO. 1	Mineral loc	Unknown	3	S	4	W	15	Waterloo	Gold silver lead
SOUTH BOULDER RIVER PLACER	Placer	Past producer	2	S	3	W	6	Waterloo	Gold
JEFFERSON RIVER PLACERS	Placer	Past producer	1	N	3	W	13	Jefferson island	Gold
BIG ANTELOPE CREEK - NORTH PLACERS	Placer	Past producer	1	N	2	W	35	Jefferson island	Gold
BIG ANTELOPE CREEK- SOUTH PLACERS	Placer	Past producer	1	S	3	W	36	Harrison	Gold
PONY CREEK PLACER	Placer	Past producer	2	S	3	W	13	Harrison	Gold
NORWEGIAN CREEK	Placer	Past producer	2	S	2	W	36	Harrison	Gold
BEN HARRISON FRACTURE	Underground	Past producer	2	S	3	W	21	Harrison	Gold silver
LONE WOLF AND CATARACT	Underground	Past producer	2	S	3	W	16	Harrison	Gold silver
BOZEMAN MINE	Underground	Past producer	2	S	3	W	15	Harrison	Gold silver
NORWEGIAN	Underground	Past producer	3	S	2	W	1	Harrison	Gold silver
SILVER STAR CHROMITE	Surf-underg	Past producer	2	S	6	W	10	Twin bridges	Chromium
LEAD QUEEN	Underground	Unknown	3	S	5	W	15	Waterloo	Gold silver iron
SURPRISE MINE	Surf-underg	Past producer	1	N	3	W	25	Jefferson island	Gold silver
CHILE	Underground	Past producer	1	S	1	W	18	Jefferson island	Gold
WHIPPOORWILL	Underground	Past producer	1	S	1	W	18	Jefferson island	Gold
OLD JOE	Underground	Past producer	2	S	3	W	23	Harrison	Gold
WILLOW CREEK CLAIM	Underground	Past producer	2	S	3	W	15	Harrison	Gold
NED	Underground	Past producer	2	S	3	W	14	Harrison	Gold
MOUNTAIN CLIFF	Underground	Past producer	2	S	3	W	15	Harrison	Gold silver lead

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
COPPER QUEEN	Underground	Past producer	2	S	5	W	35	Waterloo	Copper
DEMOCRAT	Underground	Past producer	3	S	5	W	26	Waterloo	Gold silver
TOPEKA	Underground	Past producer	3	S	5	W	24	Waterloo	Gold silver
LITTLE GOLDIE	Underground	Past producer	3	S	5	W	24	Waterloo	Gold silver
NETTIE	Underground	Past producer	3	S	5	W	24	Waterloo	Gold silver
MOGULLIAN	Underground	Past producer	3	S	4	W	1	Waterloo	Silver
UNNAMED DEPOSIT	Mineral loc	Unknown	3	S	5	W	34	Waterloo	Gold silver copper lead zinc
UNNAMED RARE EARTH DEPOSIT	Mineral loc	Unknown	1	S	2	W	1	Jefferson island	Rare earth
UNNAMED DEPOSIT	Mineral loc	Unknown	3	S	5	W	10	Waterloo	Gold silver copper zinc lead
UNNAMED DEPOSIT	Mineral loc	Unknown	3	S	5	W	33	Waterloo	Gold silver lead copper zinc
IRON OCCURRENCE	Mineral loc	Unknown	2	S	2	W	6	Harrison	Iron
UNNAMED RARE EARTH DEPOSIT	Mineral loc	Unknown	2	S	1	W	22	Norris	Rare earth thorium
UNNAMED PHOSPHORUS DEPOSIT	Mineral loc	Unknown	1	S	4	W	1	Whitehall	Phosphate
UNNAMED DEPOSIT	Mineral loc	Unknown	1	S	3	W	35	Harrison	Feldspar mica asbestos kyanite gr talc
UNNAMED DEPOSIT	Mineral loc	Unknown	1	S	3	W	25	Harrison	Feldspar mica asbestos kyanite gr talc
ANTELOPE CHROMITE DEPOSIT	Mineral loc	Unknown	1	S	3	W	35	Harrison	Chromium
BACCHARAT MINE	Underground	Unknown	2	S	6	W	15	Twin bridges	Gold iron copper
MINERAL HILL	Underground	Past producer	1	S	3	W	26	Harrison	Talc
BLUE GROUSE MINE	Underground	Unknown	1	S	4	W	4	Whitehall	Gold silver lead copper
BROWN MINE	Underground	Unknown	2	S	6	W	16	Twin bridges	Gold silver zinc
CLIPPER MINE	Underground	Past producer	2	S	6	W	15	Twin bridges	Gold lead copper
DRY BOULDER IRON	Underground	Raw prospect	3	S	4	W	5	Waterloo	Iron titanium
EDGERTON MINE	Underground	Unknown	2	S	6	W	3	Twin bridges	Gold
EMMA B GROUP	Underground	Exp prospect	3	S	4	W	13	Waterloo	Gold silver
GALENA MINE	Underground	Past producer	2	S	6	W	3	Twin bridges	Gold lead copper
GERMANIA	Mineral loc	Unknown	3	S	7	W	3	Twin bridges	Gold silver
GILLIAM MINE	Underground	Unknown	1	S	3	W	26	Harrison	Vermiculit
GOLDEN ROD	Underground	Unknown	2	S	6	W	1	Twin bridges	Gold lead copper
GOLDEN LINK	Underground	Unknown	3	S	2	W	1	Harrison	Gold silver
KING SHAFT	Mineral loc	Unknown	2	S	6	W	33	Twin bridges	Gold silver
LEAD ORE MINE	Underground	Exp prospect	3	S	3	W	23	Harrison	Gold silver lead
LITTLE BEAR PROPERTIES	Mineral loc	Unknown	3	S	5	W	12	Waterloo	Lead silver
MACMASTERS MINE	Underground	Unknown	1	S	4	W	3	Whitehall	Gold silver
MADISON C	Mineral loc	Unknown	2	S	1	W	28	Norris	Quartz cry
MAMMOTH	Underground	Past producer	2	S	3	W	18	Waterloo	Gold silver copper
MARY INGABER MINE	Underground	Unknown	1	S	4	W	4	Whitehall	Gold silver copper
MOHAWK MINE	Underground	Unknown	2	S	6	W	10	Twin bridges	Chromium
MONTANA NO 1 MINE	Underground	Raw prospect	1	S	4	W	5	Whitehall	Iron

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
NORWEGIAN GULCH DEPOSIT	Mineral loc	Unknown	2	S	2	W	36	Harrison	Kyanite gr
POLLINGER MINE	Underground	Unknown	2	S	6	W	2	Twin bridges	Gold silver
ARIZONA	Underground	Past producer	2	S	3	W	34	Harrison	Gold silver copper
RANGER MINE	Underground	Unknown	3	S	5	W	22	Waterlay	Gold silver lead
RED CHIEF	Underground	Unknown	3	S	2	W	1	Norris	Gold silver
RHYOLITE MINE	Underground	Unknown	2	S	6	W	3	Twin bridges	Lead silver
RIDGEWAY MINE	Underground	Exp prospect	2	S	3	W	10	Harrison	Gold silver
RIVERSIDE MINE	Underground	Exp prospect	2	S	3	W	22	Harrison	Gold silver
SAPPINGTON MICA MINE	Surface	Unknown	1	S	1	W	9	Three forks	Mica
SHAMROCK MINE	Underground	Past producer	1	S	6	W	33	Twin bridges	Copper silver gold
SILICA BUTTE	Unknown	Unknown	2	S	7	W	1	Twin bridges	Quartz cry
SUNLIGHT MINE	Underground	Unknown	3	S	4	W	23	Waterloo	Gold
VIKING MINE	Underground	Past producer	2	S	3	W	21	Harrison	Gold
WHIP-POOR-WILL GROUP	Underground	Past producer	2	S	3	W	14	Harrison	Gold
WHITE ANGEL QUARRY	Surface	Unknown	3	S	5	W	27	Waterloo	Calcium
WILSON MINE	Underground	Unknown	3	S	4	W	19	Waterloo	Gold silver
SAPPINGTON BERYLLIUM DEPOSIT	Mineral loc	Unknown	1	S	1	W	9	Three forks	Beryllium
BONANZA FRACTION	Underground	Past producer	1	N	4	W	34	Whitehall	Gold silver copper lead
JEFFERSON CANYON PHOSPHORIA	Mineral loc	Exp prospect	1	N	3	W	13	Jefferson island	Phosphate
SOUTH BOULDER CREEK	Mineral loc	Exp prospect	1	S	3	W	10	Jefferson island	Phosphate
AMERICAN PIT	Underground	Past producer	2	S	6	W	22	Twin bridges	Gold silver copper
CLIFFORD MINE	Underground	Past producer	2	S	6	W	9	Twin bridges	Gold silver lead copper
MOONLIGHT-WHITE ELEPHANT	Mineral loc	Past producer	2	S	6	W	16	Twin bridges	Gold
OHIO QUARTZ	Mineral loc	Past producer	2	S	6	W	16	Twin bridges	Gold
SAPPINGTON LIMESTONE DEPOSIT	Mineral loc	Raw prospect	1	N	2	W	35	Harrison	Stone
PONY VERMICULITE	Mineral loc	Unknown	1	S	3	W	25	Harrison	Vermiculit
MOUNTAIN MEADOW	Underground	Exp prospect	2	S	3	W	21	Harrison	
MEADOWLARK	Surface	Exp prospect	1	S	4	W	4	Whitehalle	Gold silver copper
UNNAMED MINE	Underground	Unknown	1	N	4	W	34	Whitehall	
UNNAMED MINE	Underground	Unknown	1	N	4	W	34	Whitehall	
UNNAMED MINE	Underground	Unknown	1	N	4	W	34	Whitehall	
LITTLE NUGGET	Underground	Unknown	1	S	4	W	4	Whitehall	Gold silver
UNNAMED MINE	Underground	Unknown	1	S	4	W	4	Whitehall	
UNNAMED MINE	Underground	Unknown	1	S	4	W	4	Whitehall	
UNNAMED ADIT CLUSTER	Underground	Unknown	1	S	4	W	4	Whitehall	
UNNAMED MINES	Underground	Unknown	1	S	4	W	4	Whitehall	
UNNAMED MINES	Underground	Unknown	1	S	4	W	4	Whitehall	

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
UNNAMED MINES	Underground	Unknown	1	S	4	W	10	Whitehall	
UNNAMED MINES	Underground	Unknown	1	N	4	W	34	Whitehall	
UNNAMED MINE	Underground	Unknown	1	S	4	W	22	Waterloo	
UNNAMED GRAVEL PIT	Surface	Unknown	2	S	4	W	6	Waterloo	Sand & gra
OHIO LODGE MINE	Underground	Unknown	2	S	5	W	25	Waterloo	
GIANT MINE	Mineral loc	Unknown	3	S	5	W	12	Waterloo	Gold
GROUSE MINE	Underground	Past producer	3	S	5	W	13	Waterloo	Gold
UNNAMED MINE	Underground	Unknown	3	S	5	W	23	Waterloo	
UNNAMED MINE	Underground	Unknown	3	S	5	W	23	Waterloo	
UNNAMED ADIT CLUSTER	Underground	Unknown	3	S	4	W	7	Waterloo	
UNNAMED MINE	Underground	Unknown	3	S	5	W	1	Waterloo	
HUDSON MINE	Mineral loc	Unknown	2	S	6	W	2	Twin bridges	Gold silver lead zinc
HARRISON IRON	Surface	Raw prospect	1	S	2	W	34	Harrison	Iron
PONY IRON DEPOSIT	Surface	Raw prospect	2	S	2	W	6	Waterloo	Iron
OREGON	Underground	Exp prospect	2	S	3	W	15	Harrison	Gold
LAKEVIEW	Underground	Unknown	3	S	4	W	3	Waterloo	Gold silver copper lead zinc
INSPIRATION GOLD	Underground	Unknown	3	S	5	W	12	Waterloo	Gold silver
ISABELLE	Underground	Unknown	3	S	5	W	12	Waterloo	Gold silver
MAMMOTH-BUTTE	Underground	Unknown	2	S	5	W	4	Waterloo	Gold silver
BAYARD	Underground	Past producer	2	S	4	W	19	Waterloo	Silver copper lead zinc
DUTCHLAND	Underground	Past producer	3	S	5	W	28	Waterloo	Lead silver copper
EDMOND FOREST	Underground	Past producer	2	S	5	W	16	Waterloo	Gold silver copper
KLONDIKE	Underground	Past producer	3	S	4	W	10	Waterloo	Gold silver
BI-METALIC	Underground	Past producer	3	S	2	W	12	Harrison	Gold silver
FLORENCE	Underground	Devel deposit	1	S	4	W	9	Whitehall	Iron
UNNAMED MICA	Unknown	Unknown	1	S	1	E	9	Three forks	Mica
RY & K MINE	Surface	Exp prospect	3	S	2	W	2	Harrison	Gold silver
ANTLER MINE	Surface	Producer	2	S	6	W	14	Twin bridges	Talc
CONSTELLATION DEPOSIT	Surface	Producer	1	S	3	W	26	Harrison	Vermiculit
ANTELOPE-PONY	Underground	Raw prospect	2	S	3	W	10	Harrison	Platinum g platinum g platinum g
NEVER SWEAT	Underground	Past producer	2	S	3	W	13	Harrison	Silver
NORWEIGEN	Placer	Past producer	2	S	2	W	13	Harrison mont.	Iron
MOUNTAIN VIEW MINE	Underground	Devel deposit	3	S	5	W	2		Gold silver copper lead
SPUHLER GROUP	Underground	Devel deposit	3	S	4	W	20	Waterloo	Gold silver lead
VANGUARD GROUP	Underground	Exp prospect	4	S	3	W	5	Harrison	Gold silver
MOOSE CREEK-FISH CREEK TRAVERSE	Mineral loc	Unknown	1	N	7	W	32	Pipestone pass	Gold silver c
EDNA KIBLER PROSPECT	Surface	Unknown	1	N	6	W	20	Pipestone pass	Iron

Upper Jefferson River Tributary Sediment TMDLs & Framework Water Quality Improvement Plan – Appendix A

NAME	OPTYPE	STATUS	TWN	NS	RNG	EW	SECT	QUAD	COM
DENNY PROSPECT	Underground	Unknown	1	N	7	W	22	Pipestone pass	Tungsten molybdenum
SILVER KING PLACER	Placer	Producer	1	N	7	W	28	Pipestone pass	Gold
MCPHAIL PROSPECT	Underground	Unknown	1	N	7	W	32	Pipestone pass	Gold
OVERLOOK GROUP MINE	Surf-underg	Producer	1	N	7	W	22	Pipestone pass	Gold silver copper
HIGHLANDS MINE	Underground	Past producer	1	N	7	W	31	Butte south	Gold
BALLARAT	Underground	Past producer	1	N	7	W	33	Pipestone pass	Gold
TEMPLEMAN	Underground	Unknown	1	N	7	W	33	Butte north	Gold silver lead zinc
OZARK	Underground	Past producer	1	N	7	W	33	Pipestone pass	Gold
BROOKS	Underground	Past producer	1	N	7	W	29	Pipestone pass	Gold
RED WING	Underground	Past producer	1	N	7	W	28	Pipestone pass	Gold
IRON CLIFF	Underground	Unknown	1	N	7	W	22	Pipestone pass	Gold
HIGHLAND VIEW	Surf-underg	Unknown	1	N	7	W	28	Pipestone pass	Gold
BEAR CAT	Underground	Unknown	1	N	7	W	27	Pipestone pass	Silver copper
READYCASH	Underground	Past producer	1	N	7	W	22	Pipestone pass	Gold copper
EXL	Underground	Past producer	1	N	7	W	35	Pipestone pass	Gold
FISH CREEK MINE	Surf-underg	Past producer	1	N	7	W	31	Butte south	Silver copper
LIMESTONE OCCURRENCE	Mineral loc	Unknown	1	N	7	W	22	Pipestone pass	Abrasive stone
GRACE	Mineral loc	Unknown	1	S	6	W	11	Grace	Silicon
LITTLE JOE-HAZEL CLAIM	Underground	Unknown	1	N	7	W	16	Pipestone pass	Gold silver
HIGHLAND PLACER	Placer	Past producer	1	N	7	W	32	Pipestone pass	Gold
FISH CREEK PLACERS	Placer	Producer	1	N	7	W	28	Pipestone pass	Gold
GLORIA ALICE PLACER	Placer	Past producer	1	N	7	W	2	Pipestone pass	Gold
LAST CHANCE MINE	Underground	Devel deposit	1	N	7	W	28	Pipestone pass	Gold silver
MOONLIGHT MINE	Underground	Devel deposit	1	N	7	W	28	Pipestone pass	Silver gold
STRATTON MINE	Underground	Producer	1	N	7	W	32	Pipestone pass	Gold silver copper
B & N PORTABLE CRUSHER	Surface	Past producer	36	N	1	E	17		Sand & gra
HERBERT DUNBAR	Underground	Devel deposit	3	N	1	E	28	Three forks	Iron
COPPER CITY	Surf-underg	Devel deposit	3	N	1	E	25	Three forks	Copper iron



