

Abandoned Mine Site Pilot Study  
Tenmile and Basin Creek Watershed  
TENMILE  
Rimini, Montana

Draft Report  
Site Inspection and  
Collection and Review of Existing Site Information

Prepared for  
U. S. Army Corps of Engineers

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September 9, 2002

## **Introduction**

The objective of the site inspection and collection and review of existing site information was to identify potential mining-related source areas that may be impacting surface water quality and to document the significant mining sites and disturbances in the Tenmile and Basin Creek Watershed. Identification and documentation of those potential source areas was performed by a site inspection, meetings with groups and organizations familiar with the area, and a review of available reports and other documents related to Tenmile and Basin Creek Watershed.

## **Site Inspection**

A site inspection was performed by the Project Manager, Mr. Tom Boyle, and the lead technical professional, Dr. Merrill Coomes, of Smith River Consulting, Inc. (Smith River). Numerous discharging adits within the Tenmile and Basin Creek watershed release heavy metals into the watershed. The site inspection team focused its inquiry on discharging adits within the Tenmile Creek near Rimini Subarea because the subarea includes Chessman and Scott Reservoirs where the city of Helena obtains its water and the community of Rimini. Within that subarea, the Lee Mountain site, the Susie mine site, the Armstrong site, and the Redwater mine site were identified as potential significant source areas that may be impacting surface water quality.

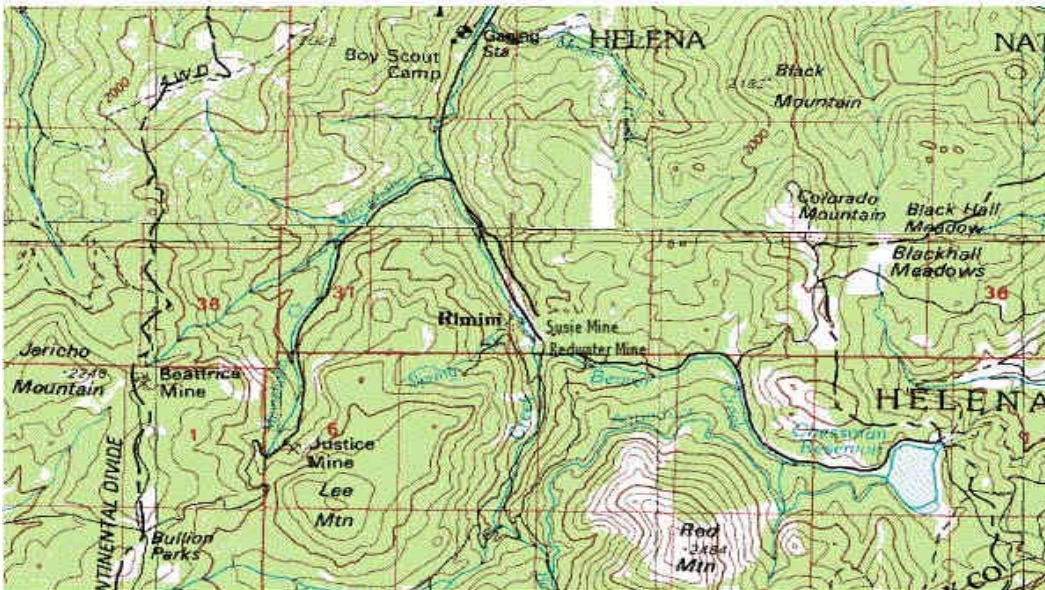
Based on discussions with representatives of the Montana Department of Environmental Quality (MDEQ), the Environmental Protection Agency (EPA), and review of the Record of Decision (EPA, 2002) focused attention on the Susie and Redwater mine sites. The Record of Decision (ROD) (EPA and MDEQ, 2002) identified the top 25 contributors of heavy metals the Tenmile Creek. Arsenic is the focus of this investigation and Table 1 presents the loading of arsenic for the top five arsenic contributors. The percentages have been normalized to total 100 percent, because the total percentages reported in the ROD were greater than 100. It is clear that the Susie mine, which contributes more than one half of the total arsenic to Tenmile Creek, is the most significant arsenic contributor. Red Water Mine adit discharge is one of the top five arsenic contributing sources, but more importantly, is located immediately upstream of the inlet for the Helena municipal water supply. For these reasons, the Susie adit discharge and the Red Water adit discharge are identified as the best candidates for further study. Table 1 also identifies the Susie and Red Water mine adits as significant contributors of zinc, 14 and 10 percent, respectively.

**Table 1. Mine Sites Contributing Arsenic and Zinc to Tenmile Creek.**

Mine Site	Adit Discharge?	Arsenic		Zinc	
		Load (lbs/day)	Percent of Total	Load (lbs/day)	Percent of Total
Susie	Yes	0.41	57.17	1.84	14.44
Lee Mountain	Yes	0.18	25.06	1.6	12.58
National Extension	Yes	0.045	6.31	0.12	0.91
Little Sampson	No	0.032	4.46	3.11	22.71
Red Water	Yes	0.021	2.86	1.22	9.56
Upper Valley Forge	Yes	0.0018	0.26	0.2	0.16
Contribution (Percentage of Total Load)		96.12		45.91	

The Susie Mine adit contributes greater than 66 percent of the arsenic loading to surface water in the Tenmile Creek water basin. Although the Redwater mine adit was the fifth largest arsenic contributor, the adit discharge is immediately upstream of the water intake for the Helena municipal water supply. Both EPA and MDEQ expressed concern over amount of discharge and the proximity to the Helena municipal water intake. Figure 1 presents the locations of the Susie and Redwater mine sites relative to Rimini Montana.

**Figure 1. Susie and Redwater Mine Sites**



The first potential source area investigated was the Redwater mine adit. Some of the waste rock and tailing materials that had high potential to contaminate surface water and soil in the area have been removed, and the remaining waste rock and tailing materials near the mine have been capped (CDM 2001b). The discharge from the Redwater mine adit was not included in the removal action but was piped from the mine adit through the remediated area and now discharges directly into Tenmile Creek. The discharge pipe and the resulting mixing with the stream water are shown in the lower left corner of Figure 2.

The second potential source area investigated was the Susie Mine adit. The circumstances for the Susie Mine adit are similar to those for the Redwater Mine adit. At the Susie Mine, soil and surface mining wastes were removed under a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action. The area of removal has been recontoured, capped and revegetated as part of the removal action. At Redwater Mine, the waste rock was recontoured, covered with topsoil and revegetated. Drainage was designed to divert precipitation and runoff from the capped area (CDM, 2001b). 11,173 cubic yards of waste rock was removed from the Susie Mine. Following the removal, approximately 40 tons/acre of crushed limestone (econo-lime along the bank of Tenmile Creek) was added to the remaining soils on site to raise and stabilize the soil pH, and 500 kg/acre of triple-super-phosphate was added to help reduce the mobility of some of the remaining contaminants and compete with the remaining arsenic for plant uptake. The lime and phosphate were incorporated into the post removal site soils. The site was then backfilled and covered with a minimum thickness of one foot of clean, six-inch-minus fill, and recontoured. The surface was then covered with six inches of clean topsoil to facilitate vegetation growth. The coarse six-inch-minus fill will reduce upward capillary movement of any direct exposure threat to any remaining contaminants, and further stabilize the site. The site was then revegetated. The adit drainage ditch was also modified by installing several settling pools and relining the adit drainage path with geotextile covered with limestone rock and gravel. These modifications to the adit drainage pathway are intended to minimize the impact to Tenmile Creek from the adit drainage until the problem is addressed more permanently by the EPA Remedial Program. The adit discharge was not remediated, although the mine opening was covered with clean six-inch-minus fill and the discharge was piped away from the adit through a pipe. The discharge then flows through a channel into Tenmile creek. Figure 3 shows the adit discharge from the pipe into the drainage channel.



**Figure 2**  
**Redwater Mine Adit Drainage to Tenmile Creek**



**Figure 3**  
**Susie Mine Adit Discharge into a Small Drainage Channel**



## **Interview Summary**

A series of interviews were conducted with stakeholders. The following paragraphs summarize the results of those interviews.

Smith River held several discussions throughout this past year with Craig French, MDEQ's Project Manager for the Upper Tenmile Superfund Site. Mr. French stated that his main objectives for this pilot project would be to identify a technology that has the potential to reduce concentrations of metals in the adit discharges meet the maximum contaminant levels outlined by Montana's WQB-7 standards and to determine what the operating and maintenance expenses would be for the system.

Smith River spoke with Dan Adams on August 17, 2002, Dan is the spokesman for the Trustee of the Basin Creek Mine Site. Mr. Adams stated that he had worked for Pegasus Mining before assuming his current position with the Trustee. His area of responsibility is that of the old Pegasus mining area in the Basin Creek Mine Site. If this project should expand into Basin Creek, Mr. Adams would again be contacted.

Smith River also interviewed Mike Bishop on Friday, August 23, 2002, the EPA's Project Manager for the Upper Tenmile Superfund Site, about his main objectives for this pilot project. Mr. Bishop stated that his main goal for this pilot project would be to identify a technology that has the potential to reduce concentrations of metals in the adit discharges to the minimum contaminant levels outlined by Montana's WQB-7.

On Wednesday, September 4, 2002, Smith River discussed the project with Mr. Leonard Willett, Superintendent of the Helena Public Water Supply System. Mr. Willett did not feel that the pilot project would impact his facility due to the small size of the project. His offer of a tour of the Tenmile and Missouri River Treatment facilities was accepted and scheduling is in progress.

Smith River held several discussions with Rimini residents including attending a May 30, 2002 public meeting of the Upper Tenmile Watershed Steering Group, This group consists up of County, State, and Federal agencies as well as residents of Rimini and other concerned citizens. Minutes of public meetings from May 2002 to July 2002 are attached. Smith River had an opportunity to discuss the issues associated with acid mine drainage and discharges occurring from the Susie and Red Water Adits. We also discussed the eVox® technology that we used in Rimini earlier in the month. A two-day pilot/bench scale test of the technology was conducted (May 28-29, 2002) to ascertain technology effectiveness in very high metal loading discharges. Analytical data from this two-day test are not available due to a mix up in sample bottles, although this data may be available in the near future. Smith River determined that the overall consensus of the Rimini residents was that they were initially excited that the EPA would install a drinking water system in their area. Their excitement turned to concern when the EPA said that their funding would only cover the installation expenses for the system and not the operating expenses. The citizens of Rimini do not want the installation of this system to

lead to a dramatic increase in their water rates. Smith River is associated with the Lower Tenmile Working Group Committee and will attend a September 10, 2002 public meeting. Leonard Willet, Superintendent of the Helena Public Water Supply System, will be discussing issues concerning the Tenmile Watershed and drinking water concerns at the treatment plant.

Discussions with local residents of Rimini are ongoing. On August 24, 2002 Smith River met with Phil Maynard, the unofficial Mayor of the community, he expressed interest and a willingness to assist any way he could. Mr. Maynard gave us permission to use a parcel of land that belongs to him and is adjacent to the Susie. Use of this land greatly assists site access and minimizes activities on the road. Also on August 24, 2002 we met with Jim Martin, a resident of Rimini in which he gave us permission to utilize an access road that leads to the Red Water Adit discharge point. The use of the access road facilitates performing onsite tests.

**Review of Existing Data**

The References section below lists the reports that were reviewed to obtain analytical data and histories of actions that have taken place in the area surrounding Tenmile Creek. Those that contained analytical data for adits and surface water were examined in detail.

Table 2 presents a summary of total metal concentrations for the Redwater adit drainage and Table 3 presents a summary of dissolved metal concentrations for the Redwater adit drainage (CDM 2001b).

**Table 2  
Total Recoverable Metal Concentrations (µg/l) Redwater Mine Adit**

Date	Discharge						
	CFS	Arsenic	Cadmium	Copper	Lead	Zinc	Iron
MCLs <sup>1</sup>	---	10	5	1.3	10	---	---
WQB-7 <sup>2</sup>	---	18	0.163	5.2	3.2	673	1000
4-Oct-95	0.0223	153	53.2	13.3	3.8	9670	6538
25-Jan-96	0.0334	99.3	68.6	17.7	0.73	12100	5990
9-May-96	0.0223	99.4	68.2	19	0.41	12000	6180
26-Aug-96	0.0345	163	50.7	16.9	2.3	9390	6400
22-Jun-00	---	123	31.5	6.7	0.58	7270	4800

µg/l – micrograms per liter

1. Maximum Contaminant Level (EPA)

2. WQB-7 is, Circular WQB-7 Montana Numeric Water Quality Standards. Value is the lowest of Aquatic Life Chronic or Human Health for Surface Water. (December 2001).

3. Value is hardness dependent.

Analyses of these data do not identify trends in concentration over time.

**Table 3**  
**Dissolved Metal Concentrations (µg/l) Redwater Mine Adit**

Date	Discharge						
	CFS	Arsenic	Cadmium	Copper	Lead	Zinc	Iron
MCLs <sup>1,4</sup>	---	---	---	---	---	---	---
WQB-7 <sup>2,4</sup>	---	---	---	---	---	---	---
4-Oct-95	0.0223	52.7	47.4	4.4	0.16	9310	2700
25-Jan-96	0.0334	18.4	63	3.5	0.16	12200	2230
9-May-96	0.0223	19.7	59.7	8.7	1.8	11800	2270
26-Aug-96	0.0345	33.2	55.6	3	1.6	9620	2060
22-Jun-00	---	26.9	28.6	0.84	0.1	7040	2110

µg/l – micrograms per liter

1. Maximum Contaminant Level (EPA)

2. WQB-7 is, Circular WQB-7 Montana Numeric Water Quality Standards. Value is the lowest of Aquatic Life Chronic or Human Health for Surface Water. (December 2001).

3. Value is hardness dependent.

4. Criteria are applicable to “total recoverable” only.

Analyses of these data do not identify concentration trends in the dissolved metals concentrations over time.

The Susie Mine Adit discharge has less available data than the Redwater Mine adit discharge. The available data are provided in Tables 4 and 5 for total and dissolved metals CDM, 2001b.

**Table 4**  
**Total Recoverable Metal Concentrations in the Susie Mine Adit Discharge (µg/l)**

Date	Discharge							
	CFS	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
MCLs <sup>1</sup>	---	--	10	5	1.3	---	10	---
WQB-7 <sup>2</sup>	---	<b>87</b>	18	0.16 <sup>3</sup>	5.2	1000	3.2	67 <sup>3</sup>
5/2/2000	0.01	3000	7600	250	120	110000	14	34000
6/8/2000	---	10000	7600	240	110	--	17	31000
6/20/2000	0.01		9000	240	120	--	11	32000
9/9/1998	---		5400	466	260	147000	7.1	48600
6/20/2002	---	2990	7600	250	120	110000	14	34000
Unknown	---	2260	6140	258	122	112000	6.6	26000

µg/l – micrograms per liter

1. Maximum Contaminant Level (EPA)

2. WQB-7 is, Circular WQB-7 Montana Numeric Water Quality Standards. Value is the lowest of Aquatic Life Chronic or Human Health for Surface Water. (December 2001).

3. Value is hardness dependent.



**Table 5**  
**Dissolved Metal Concentrations in the Susie Mine Adit Discharge (µg/l)**

Date	Discharge							
	CFS	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
MCLs <sup>1,4</sup>	---	--	10	5	1.3	---	10	---
WQB-7 <sup>2,4</sup>	---	<b>87</b>	18	0.16 <sup>3</sup>	5.2	1000	3.2	67 <sup>3</sup>
5/2/2000	0.01	2990	7600	299	156	119000	7.2	32600
6/8/2000	---	--	7300	215	116	--	5.2	23400
6/20/2000	0.01	--	6400	261	101	--	6.6	21800
9/9/1998	---	4870	3550	508	272	143000	3	49900

µg/l – micrograms per liter

1. Maximum Contaminant Level (EPA)

2. WQB-7 is, Circular WQB-7 Montana Numeric Water Quality Standards. Value is the lowest of Aquatic Life Chronic or Human Health for Surface Water. (December 2001).

3. Value is hardness dependent.

4. Criteria are applicable to “total recoverable” only.

Parrett and Hettinger collected water samples from the Susie Mine for the United States Geological Survey (USGS) in 2000 (Parrett and Hettinger, 2000). Camp, Dresser, and McKee (CDM) included this data in Volume III of its February 2001, report to the EPA. Those results indicated arsenic concentrations as high as 10,000 µg/l, iron concentrations as high as 110,000 µg/l, zinc concentrations as high as 34,000 µg/l, and cadmium concentrations as high as 250 µg/l in the adit discharge.

Additional data were identified for Tenmile Creek water upgradient and downgradient of the Susie Mine Adit area. Table 6 presents the average and 95 percent Upper Confidence Limit (95UCL) for dissolved and total metals data (URS, 2001). In every example the downstream concentrations are higher than the upstream concentrations. This indicates that the Susie Mine adit discharge results in an increase of metal concentrations in the surface water in Tenmile Creek. The increase for arsenic (from, 8.5 µg/l to 120 µg/l) results in an exceedence of the EPA Maximum Contaminant Level (MCL).

**Table 6**  
**Total and Dissolved Metal Concentrations**  
**Upstream and Downstream of the Susie Mine Adit (µg/l)**

Sample	Statistic	Aluminum	Arsenic	Cadmium	Copper	Iron	Lead	Zinc
<b>Dissolved</b>								
MCLs <sup>4</sup>	---	---	---	---	---	---	---	---
WQB-7 <sup>4</sup>	---	---	---	---	---	---	---	---
Up Stream	Average	100	8.5	15.5	13.3	60	26.7	2034
Down Stream	Average	580	120	49.2	62	5277	65	7262
Up Stream	95UCL	---	11.3	25	23.1	186.3	52.4	3009
Down Stream	95UCL	853	217	82.3	83.7	7879	111	10515
<b>Total</b>								
MCLs <sup>1</sup>	---	--	10	5	1.3	---	10	---
WQB-7 <sup>2</sup>	---	87	18	0.163	5.2	1000	3.2	673
Up Stream	Average	267	9.8	14	15	175	30	1832
Down Stream	Average	533	240	63.7	50	5735	72	6355
Up Stream	95UCL	524	11.2	20.5	21.8	269.7	43.6	2719
Down Stream	95UCL	719	360	92.2	71.3	8755	101	9360

µg/l – micrograms per liter

1. Maximum Contaminant Level (EPA)

2. WQB-7 is, Circular WQB-7 Montana Numeric Water Quality Standards. Value is the lowest of Aquatic Life Chronic or Human Health for Surface Water. (December 2001).

3. Value is hardness dependent.

4. Criteria are applicable to “total recoverable” only.

## Data Gaps

There are several data gaps concerning mining-related releases to Tenmile Creek. Data are required to address the important question of whether a technology can be identified that will reduce metals concentrations to acceptable health risk concentrations or regulatory criteria. It is assumed that the two mine adits selected at Redwater and Susie Mines are representative of other mine adit discharges in the Tenmile Creek area.

Specific data gaps include the following;

- There is limited analytical data for the Susie Adit discharge. Available information indicates high concentrations of arsenic are released.
- Current analytical data are not available for both the Susie and Redwater Mine adit discharges.
- Data supporting the reduction of heavy metal content in the adit drainage using a treatment process is not available including, but not limited to, pH, turbidity, dissolved oxygen, temperature and specific conductivity.

## References

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