

MONTANA BUREAU OF MINES AND GEOLOGY

ABANDONED - INACTIVE MINES PROGRAM

DEERLODGE NATIONAL FOREST

VOLUME II
CATARACT CREEK DRAINAGE

MBMG 344

JOHN METESH - MBMG
JEFF LONN - MBMG
TED DUAIME - MBMG
RICH MARVIN - MBMG
ROBERT WINTERGERST - USFS

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Appendix I Field Form

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INTRODUCTION

In order to fulfill its obligations under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Northern Region of the United States Forest Service (USFS) desires to identify and characterize the abandoned and inactive mines with environmental, health, and/or safety problems that are on or affecting National Forest System lands. The Northern Region of the USFS administers National Forest System lands in Montana and parts of Idaho and North Dakota. Meanwhile, the Montana Bureau of Mines and Geology (MBMG) collects and distributes information about the geology, mineral resources, and ground water of Montana. Consequently, the USFS and the MBMG determined that an inventory and preliminary characterization of abandoned and inactive mines in Montana would be beneficial to both agencies, and have entered into a series of participating agreements to accomplish this work. The first Forest inventoried was the Deerlodge National Forest. The results of this inventory are presented in five volumes: Volume I - Basin Creek, Volume II - Cataract Creek, Volume III - Flint Creek, Volume IV - Upper Clark Fork River, and Volume V - Jefferson River.

1.1 PROJECT OBJECTIVES

In 1992, the USFS and MBMG entered into the first of these agreements to identify and characterize abandoned and inactive mines on or affecting National Forest System lands in Montana. The objectives of this discovery process, as defined by the USFS, were to:

1. Utilize a formal, systematic program to identify the "Universe" of sites with possible human health, environmental, and/or safety related problems that are either on or affecting National Forest System lands.
2. Identify the human health and environmental risks at each site based on site characterization factors including screening-level soil and water data that has been taken and analyzed in accordance with EPA quality control procedures.
3. Based on site characterization factors, including screening-level sample data where appropriate, identify those sites that are not affecting National Forest System lands, and can therefore be eliminated from further consideration.
4. Cooperate with other State and Federal agencies, and integrate the Northern Region program with their programs.
5. Develop and maintain a data file of site information that will allow the Region to proactively respond to governmental and public interest group concerns.

In addition to the USFS objectives outlined above, the MBMG objectives also included gathering new information on the economic geology and hydrogeology associated with these abandoned and inactive mines. Enacted by the Legislative Assembly of the State of Montana (Section 75-

607, R.C.M., 1947, Amended) the scope and duties of the MBMG include: "...the collection, compilation, and publication of information on Montana's geology, mining, milling, and smelting operations, and ground-water resources; investigations of Montana geology emphasizing economic mineral resources and ground-water quality and quantity."

1.2 ABANDONED AND INACTIVE MINES DEFINED

For the purposes of this study, mines, mills or other processing facilities related to mineral extraction and/or processing are defined as abandoned or inactive as follows:

A mine is considered abandoned if there are no identifiable owners or operators for the facilities, or if the facilities have reverted to federal ownership.

A mine is considered to be inactive if there is an identifiable owner or operator of the facility, but the facility is not currently operating and there are no approved authorizations or permits to operate.

1.3 HEALTH AND ENVIRONMENTAL PROBLEMS AT MINES

Abandoned and inactive mines may host a variety of safety, health, and environmental problems. These may include metals that contaminate ground water, surface water, and soils; airborne dust from abandoned tailings impoundments; sedimentation in surface waters from eroding mine and mill waste materials; unstable waste piles with the potential for catastrophic failure; and physical hazards associated with mine openings and dilapidated structures. Although all problems were examined at least visually (See Appendix I - Field Form), the hydrologic environment appears to be affected to the greatest extent. Therefore, this investigation focused most heavily on impacts from the mines to surface and ground water.

Metals are often transported from a mine by water (ground-water discharges or surface runoff) either by being dissolved, suspended, or carried as part of the bedload. When sulfides are present, acid can form which, in turn, increases the solubility of metals. This condition known as Acid Mine Drainage (AMD) is a significant source of metal releases at many of the mine sites in Montana.

1.3.1 Acid Mine Drainage

Trexler and others (1975) identified six components that govern the formation of metal-laden acid mine waters. They are

- 1) availability of sulfides, especially pyrite,
- 2) presence of oxygen,
- 3) water in the atmosphere,
- 4) availability of leachable metals,
- 5) availability of water to transport the dissolved constituents, and
- 6) mine characteristics, which affect the other five elements.

To this list, most geochemists would add the availability of minerals such as calcite that can neutralize the acidity. These six components occur not only within the mines themselves, but can exist within mine dumps and mill tailings piles, making waste materials sources of contamination as well.

Acid Mine Drainage (AMD) is formed by the oxidation and dissolution of sulfides, particularly iron pyrite (FeS_2) and pyrrhotite (Fe_{1-x}S). Other sulfides play a minor role in acid generation. Oxidation of iron sulfides forms sulfuric acid (H_2SO_4), sulfate (SO_4^{2-}), and reduced iron (Fe^{2+}). Mining of sulfide-bearing rock exposes the sulfide to atmospheric oxygen thereby beginning the first step of acid formation. Subsequent flooding of mines with oxygen-bearing water provides the needed water and additional oxygen.

The rate limiting step of acid formation is the oxidation of the reduced iron. This oxidation rate can be greatly increased by iron-oxidizing bacteria (*Thiobacillus ferrooxidans*). The oxidized iron produced by biological activity is able to promote further oxidation and dissolution of pyrite, pyrrhotite, and marcasite (FeS_2 - a dimorph of pyrite).

Once formed, the acid can dissolve other metal-sulfide minerals such as arsenopyrite (FeAsS), chalcopyrite (CuFeS_2), galena (PbS), tetrahedrite ($[\text{CuFe}]_{12}\text{Sb}_4\text{S}_{13}$), and sphalerite ($[\text{Zn,Fe}]_2\text{S}$) to produce high concentrations of copper, lead, zinc, and other metals. Aluminum can be leached by the dissolution of aluminosilicates common in soils and waste material found in southwestern Montana. The dissolution of any given metal is controlled by the solubility of that metal.

1.3.2 Solubility of Selected Metals

At a pH above 2.2, ferric hydroxide ($\text{Fe}[\text{OH}]_3$) precipitates to produce a brown-orange color in surface waters and forms a similar colored coating on rocks in affected streams. Other metals, such as copper, lead, cadmium, zinc, and aluminum, if present in the source rock, may co-precipitate or adsorb onto the ferric hydroxide (Stumm and Morgan, 1981). Alunite $[\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6]$ and jarosite $[\text{KFe}_3(\text{SO}_4)_2(\text{OH})_6]$ will precipitate at pH less than 4, depending on SO_4^- and K^+ activities (Lindsay, 1979). Once the acid conditions are present, the solubility of the metal governs its fate and transport:

Manganese solubility is strongly controlled by the redox state of the water and is limited by several minerals such as pyrolusite and manganite; under reduced conditions, pyrolusite (MnO_2) is dissolved and manganite ($\text{MnO}[\text{OH}]$) is precipitated. Manganese is found in mineralized environments as rhodochrosite (MnCO_3) and its weathering products.

Aluminum solubility is most often controlled by alunite ($\text{KAl}_3[\text{SO}_4]_2[\text{OH}]_6$) or by gibbsite ($\text{Al}[\text{OH}]_3$) depending on pH. Aluminum is one of the most common elements in rock-forming minerals such as feldspars, micas, and clays.

Silver solubility is strongly affected by the activities of halides such as Cl^- , F^- , Br^- , and I^- . Redox and pH also affect the solubility of silver, but to a lesser degree. Silver substitutes for other cations in common ore minerals such as tetrahedrite and galena, and is found in the less common hydrothermal minerals pyrargyrite (Ag_3SbS_2) and proustite (Ag_3AsS_3).

Arsenic tends to precipitate and adsorb with iron at low pH and de-sorb or dissolve at higher pH. Thus, once oxidized, arsenic will be found in solution in higher pH waters. At pHs between 3 and 7, the dominant arsenic compound is a monovalent arsenate H_2AsO_4^- . Arsenic is abundant in metallic mineral deposits as arsenopyrite (FeAsS), enargite (Cu_3AsS_4), and tennantite ($\text{Cu}_{12}\text{As}_4\text{S}_{13}$), to name a few.

Cadmium solubility data are limited. In soils, the solubility of cadmium is controlled by the carbonate species octavite (CdCO_3) at a soil-pH above 7.5 and by strengite ($\text{Cd}_3[\text{PO}_4]_2$) at a soil-pH below 6. In soils, octavite is the dominant control on solubility of cadmium. In water, at low partial pressures of H_2S , CdCO_3 is easily reduced to CDs.

Copper solubility in natural waters is controlled primarily by the carbonate content; malachite ($\text{Cu}_2[\text{OH}]_2\text{CO}_3$) and azurite ($\text{Cu}_3[\text{OH}]_2(\text{CO}_3)_2$) control solubility when CO_3 is available in sufficient concentrations. In soil, copper complexes readily with soil-iron to form cupric ferrite. Other compounds such as sulfate and phosphates in soil may also control copper solubility in soils. Copper is present in many ore minerals, including chalcopyrite (CuFeS_2), bornite (Cu_5FeS_4), chalcocite (Cu_2S), and tetrahedrite ($\text{Cu}_{12}\text{Sb}_4\text{S}_{13}$).

Mercury readily vaporizes under atmospheric conditions and thus, is most often found in concentrations well below the 25 ug/L equilibrium concentration. The most stable form of mercury in soil is its elemental form. Mercury is found in low temperature hydrothermal ores as cinnabar (HgS), in epithermal (hot springs) deposits as native mercury, and as native mercury in man-made deposits where mercury was used in the processing of gold ores.

Lead concentrations in natural waters are controlled by lead carbonate which has an equilibrium concentration of 50 ug/L at pHs between 7.5 and 8.5. As with other metals, concentrations in solution increase with decreasing pH. In sulfate soils with a pH less than 6, anglesite controls solubility while cerussite, a lead carbonate, controls solubility in buffered soils. Lead occurs in the common ore mineral galena (PbS).

Zinc solubility is controlled by the formation of zinc hydroxide and zinc carbonate in natural waters. At pHs greater than 8, the equilibrium concentration of zinc in waters with a high bicarbonate content is less than 100 ug/L. Franklinite may control solubility at pH less than 5 in water and soils, and is strongly affected by sulfate concentrations. Thus, production of sulfate from AMD may ultimately control solubility of zinc in water affected by mining. Sphalerite (ZnS) is common in mineralized systems.

(References: Lindsay, 1979; Stumm and Morgan, 1981; Hem, 1985; Maest and Metesh, 1993)

1.3.3 The Use of pH and SC to Identify Problems

In similar mine evaluation studies, pH and specific conductance (SC) have been used to distinguish "problem" mine sites from those that had no adverse water-related impacts. The general assumption is that low pH (<6.8) and high SC (variable) indicate a problem, and that neutral or higher pH and low SC indicate no problem.

Limiting data collection only to pH and SC largely ignores the various controls on solubility and can lead to erroneous conclusions. Arsenic, for example, is most mobile in waters with higher pH values (>7) and its concentration is strongly dependent on the presence of dissolved iron. Cadmium and lead may also exceed standards in waters with pH values within acceptable limits.

Reliance on SC as an indicator of site conditions can also lead to erroneous conclusions. The SC value of a sample represents 55 to 75 percent of the total dissolved solids (TDS) depending on the concentration of sulfate. Without knowing the sulfate concentration, an estimate of TDS based on SC has a 25 percent error range. Further, without having a statistically significant amount of SC data for a study area, it is hard to define what constitutes a high or low SC value.

Thus, a water-sample with a near-neutral pH and a moderate SC could be interpreted to mean that no adverse impacts have occurred when, in fact, one or more dissolved-metal species may exceed standards. With this in mind, the evaluation of a mine site for adverse impacts on water and soil must include the collection of samples for analysis of metals, cations, and anions.

1.4 METHODOLOGY

1.4.1 Data Sources

The MBMG began this inventory effort by completing a literature search of all known mines in Montana. The MBMG plotted the published location(s) of the mines on US Forest Service maps. From the maps, the MBMG developed an inventory of all known mines which were located on or could affect National Forests System lands in Montana. The following data sources were used:

- 1) the MILS database (U.S. Bureau of Mines),
- 2) the MRDS database (U.S. Geological Survey),
- 3) published compilations of mines and prospects data,
- 4) state publications on mineral deposits,
- 5) U.S. Geological Survey publications on the general geology of some quads,
- 6) recent USGS/USBM mineral resource potential studies of proposed wilderness areas, and
- 7) MBMG mineral property files.

During subsequent field visits, the MBMG located numerous mines and prospects for which no previous information existed. Conversely, other mines for which data existed could not be found.

1.4.2 Pre-field Screening

Field crews visited only sites with the potential to release hazardous substances, and sites which did not have enough information to make that determination without a field visit. For problems to exist, a site must have both a source of hazardous substances and a method of transport from the site. Most metal mines contain a source for hazardous substances, but the common transport mechanism, water, is not always present. Consequently, sites on dry ridgetops were assumed to be lacking this transport mechanism, while mines described in the literature as small prospects were considered to have an inconsequential hazardous materials source; neither were visited.

In addition, the MBMG and the USFS developed screening criteria (Table 1) which they used to determine if a site had the potential to release hazardous substances or posed other environmental or safety hazards. The first page of the Field Form (Appendix I) contains the screening criteria. If any of the answers were "yes" or unknown, the site was visited. Personal knowledge of a site and published information were used to answer the questions. Forest Service mineral administrators used these criteria to "screen out" several sites using their knowledge of an area.

Table 1
Screening Criteria

Yes No

- | | | |
|---|---|--|
| <input type="checkbox"/> <input type="checkbox"/> | 1. Mill site or tailings present | |
| <input type="checkbox"/> <input type="checkbox"/> | 2. Adits with discharge or evidence of a discharge | |
| <input type="checkbox"/> <input type="checkbox"/> | 3. Evidence of or strong likelihood for metal leaching or AMD (water stains, stressed or lack of vegetation, waste below water table, etc.) | |
| <input type="checkbox"/> <input type="checkbox"/> | 4. Mine waste in floodplain or shows signs of water erosion | |
| <input type="checkbox"/> <input type="checkbox"/> | 5. Residences, high public use area, or environmentally sensitive area (as listed in HRS) within 200 feet of disturbance | |
| <input type="checkbox"/> <input type="checkbox"/> | 6. Hazardous wastes/materials (chemical containers, explosives, etc.) | |
| <input type="checkbox"/> <input type="checkbox"/> | 7. Open adits/shafts, highwalls, or hazardous structures/debris | |

If the answers to questions 1 through 6 were all "NO" (based on literature, personal knowledge, or site visit), then the site was not investigated any further.

Mine sites which were not visited were retained in the database along with the data source(s) that were consulted (See Appendix II). However, often these sites were viewed from a distance while visiting another site. In this way the accuracy of the consulted information was often checked.

Placer mines were not studied as part of this project. Although mercury was used in amalgamation, the complex nature of placer deposits makes detection of mercury difficult and is beyond the scope of this inventory. Due their oxidized nature, placer deposits are not likely to contain other anomalous concentrations of heavy metals. Limestone and building stone quarries, gravel pits, and phosphate mines were considered to be free of anomalous concentrations of hazardous substances, and were not examined.

1.4.3 Field Screening

All sites which could not be screened out, as described above, were visited. All visits were conducted in accordance with a Health and Safety Plan which was developed for each Forest. An MBMG geologist usually made the initial field visit. The geologist gathered information on environmental degradation, hazardous mine openings, presence of historic structures, and land ownership. All site locations were refined using conventional field methods or by USFS Geographic Position System (GPS) crews. Each site is located by latitude/longitude and by Township-Range-Section-Tract (see Appendix I for explanation).

At sites for which little geologic or mining data existed, geologists characterized the geology, collected samples for geochemical analysis, evaluated the deposit, and described workings and processing facilities present.

Sites with potential environmental problems were studied more extensively. The selection of these sites was made during the initial field visit using the previously developed screening criteria (Table 1). In other words, if at least one of the first six screening criteria was met, the site was studied further. Sites which were not studied further are included in Appendix III.

On public lands, sites with ground-water discharge, flowing surface water, or contaminated soils as indicated by impacts on vegetation, the geologist constructed a Brunton and tape map showing the workings, exposed geology, dumps, tailings, surface water, and geologic-sample locations.

1.4.3.1 Collection of Geologic Samples

The geologist took the following samples, as appropriate:

- 1) select samples - specimens representing a particular rock type taken for assay;
- 2) composite samples - rock and soil taken systematically from a dump or tailings pile for assay, representing the overall composition of material in the source;
- 3) leach samples - duplicates of selected composite samples for testing leachable metals (EPA Method 1312).

The three types of samples were used, respectively, to characterize the economic geology of the deposit, to examine the value and metal content of dumps and tailings, and to check the availability of metals for leaching when exposed to water. Assay samples (Appendix IV) were only taken to provide some information on the types of metals present and a rough indication of their concentrations. Outcrops and waste-materials were not sampled extensively enough to provide reliable estimates of tonnages, grades, or economic feasibility.

1.4.4 Field Methods

A hydrogeologist visited all of the sites that the geologist determined had the potential for environmental problems. A hydrogeologist also visited the sites that only had evidence of seasonal water discharges, possible sedimentation, airborne dust, mine hazards, or stability problems and determined if there was a potential for significant environmental problems. The hydrogeologist then determined whether sampling was warranted and, if so, selected locations for all soil and water sampling.

1.4.4.1 Selection of Sample Sites

This project focused on the impact of mining on surface water, ground water, and soils. The reasoning behind this approach was that a mine disturbance may have high total metal concentrations yet may be releasing few metals into the surface water, ground water, or soil. Conversely, another disturbance could have lower total metal content, but be releasing metals in concentrations that adversely impact the environment.

The hydrogeologist selected and marked water and soil sampling locations based on field parameters (SC, pH, Eh, etc.) and observations (e.g. erosion and staining of soils/streambeds). The hydrogeologist chose sample locations that would provide the best information on the relative impact of the site to surface water and soils. If possible, surface water sample locations were chosen that were upstream, downstream, and at any discharge points associated with the site. Soil sample locations were selected in areas where waste material was obviously impacting natural material. In most cases where applicable, a composite-sample location across a soil/waste mixing area was selected. In addition, all sample sites were located so as to assess conditions on National Forest System lands; therefore, sample sites were located on National Forest System lands to the extent ownership boundaries were known.

Since monitoring wells were not installed as part of this investigation, the evaluation of impacts to ground water was limited to strategic sampling of surface water and soils. Background water-quality data is restricted to upstream surface water samples; background soil samples were not collected. Laboratory tests were used to determine the propensity of waste material to release metals and may lend additional insight to possible ground-water contamination at a site.

1.4.4.2 Marking and Labeling Sample Sites

Sample location stakes were placed as close as possible to the actual sample location and labeled with a sample identification number. The visiting hydrogeologist wrote a site sampling and analysis plan (SAP) for each mine site or development area which was then approved by the USFS project manager. Each sample location was plotted on the site map or topographic map and described in the SAP; each sample site was given a unique identifier based on its location as follows:

D DA T L I C

D: Drainage area - determined from topographic map

DA: Development Area (dominant mine)

T: Sample type: T - Tailings, W - Waste Rock, D - Soil, A - Alluvium,
L - Slag S - Surface Water, G - Ground Water

L: Sample Location (1-9)

I: Sample Interval (default is 0)

C: Sample Concentration (High, Medium, Low) determined by the hydrogeologist based on field parameters.

1.4.4.3 Collection of Water and Soil Samples

Sampling crews collected solid and liquid samples, and took field measurements (e.g. stream flow) in accordance with the following:

Sampling and Analysis Plan (SAP) - These plans are site specific and they specify the type, location, and number of samples and field measurements to be taken at a site.

Quality Assurance Project Plan or QAPP (Metesh, 1992) - This plan guides the overall collection, transportation, storage, and analysis of samples, and the collection of field measurements.

MBMG Standard Field Operating Procedures (SOP) - The SOP specifies how field samples and measurements will be taken.

1.4.4.4 Existing Data

Data collected in previous investigations were not qualified nor validated under this project. The Quality Assurance Managers and Project Hydrogeologist determined the useability of such data.

1.4.5 Analytical Methods

The MBMG Analytical Division performed the laboratory analyses and conformed, as applicable, to the following:

Contract Laboratory Statement of Work, Inorganic Analyses, Multi-media, Multi-concentration. March 1990, SOW 3/90, Document Number ILM02.0, U.S. EPA, Environmental Monitoring and Support Laboratory, Las Vegas, NV.

Method 200.8 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

Method 200.7 Determination of Trace Metals in Water and Waste by Inductively Coupled Plasma and Mass Spectrometry - U.S. EPA

If a Contract Laboratory Procedure method did not exist for a given analysis, the following method was used:

Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C.

EPA Method 1312 Acid-rain Simulation Leach Test Procedure -Physical/Chemical Methods, SW-846, 3rd edition, U.S. EPA, Washington D.C., Appendix G.

All analyses performed in the laboratory conformed to the MBMG Laboratory Analytical Protocol (LAP).

1.4.6 Standards

EPA and various state agencies have developed human health and environmental standard for various metals. To try put the metal concentrations that were measured into some perspective, they were compared to these developed standards. However, it is understood that metal concentrations in mineralized areas may naturally exceed these standards.

1.4.6.1 Water-Quality Standards

The Safe Drinking Water Act (SDWA) directs EPA to develop standards for **potable** water. Some of these standards are mandatory (primary) and some are desired (secondary). The standards established under the SDWA are often referred to as primary and secondary maximum contaminant levels (MCLs). Similarly, the Clean Water Act (CWA) directs EPA to develop acute and chronic water quality standards that will protect **aquatic organisms**. These standards may vary with water hardness and are often referred to as the Aquatic Life Standards. The primary and secondary MCLs along with the acute and chronic Aquatic Life Standards for selected metals are listed in Table 2. In some state investigations, the standards are applied to samples collected as total-recoverable metals. Since total-recoverable-metals concentrations are difficult, if not impossible to reproduce, this investigation used dissolved metals concentrations.

1.4.6.2 Soil Standards

There are no federal standards for concentrations of metals and other constituents in soils; acceptable limits for such are often based on human and/or environmental risk assessments for an area. Since no assessments of this kind have been done, concentrations of metals in soils were compared to the limits postulated by the U.S. EPA and the Montana Department of Health and Environmental Sciences for sites within the Clark Fork River Basin in Montana. The proposed upper limit for lead in soils is 1000 mg/Kg to 2000 mg/Kg, and 80 to 100 mg/Kg for arsenic in **residential** areas. The Clark Fork Superfund Background Levels (Harrington-MDHES, 1993) are listed in Table 3.

Table 2
Water-quality Standards

	PRIMARY MCL ⁽¹⁾ (mg/l)	SECONDARY MCL ⁽²⁾ (mg/l)	AQUATIC LIFE ACUTE ^(3,4) (mg/l)	AQUATIC LIFE CHRONIC ^(3,5) (mg/l)
Aluminum		.05-.2	.05	.087
Arsenic	.05		.36	.19
Barium	2			
Cadmium	.005		.0039/.0086 ⁽⁶⁾	.0011/.0020 ⁽⁶⁾
Chromium	.1		1.7/3.1 ^(6,7)	.21/.37 ^(6,7)
Copper		1	.018/.034 ⁽⁶⁾	.012/.012 ⁽⁶⁾
Fluoride	4	2		
Iron		.3	1	
Lead	.05		.082/.2 ⁽⁶⁾	.0032/.0077 ⁽⁶⁾
Manganese		.05		
Mercury	.002		.0024	.000012
Nickel	.1		1.4/2.5 ⁽⁶⁾	.16/.28 ⁽⁶⁾
Silver		.1	.0041 ⁽⁸⁾	.000012 ⁽⁸⁾
Zinc		5	.12/.21 ⁽⁶⁾	.11/.19 ⁽⁶⁾
Chloride		250		
Silicon		250		
Nitrate	10 (as N)			
Sulfate	500 ⁽⁹⁾	250		
pH (Standard Units)		6.5 - 8.5		

(1) 40 CFR 141; revised through 8/3/93

(2) 40 CFR 143; revised through 7/1/91

(3) Priority Pollutants, EPA Region VIII, August 1990

(4) Maximum concentration not to be exceeded more than once every 3 years.

(5) 4-day average not to be exceeded more than once every 3 years.

(6) Hardness dependent. Values are calculated at 100 mg/L and 200 mg/L.

(7) Cr⁺³ species.

(8) Hardness dependent. Values are calculated at 100 mg/L.

(9) Proposed, secondary will be superseded.

Table 3
Clark Fork Superfund Background Levels (mg/Kg) for Soils

Reference	As	Cd	Cu	Pb	Zn
U.S. Mean soil	6.7	.73	24.0	20.0	58
Helena Valley Mean soil	16.5	.24	16.3	11.5	46.9
Missoula Lake Bed Sediments	-	.2	25.0	34.0	105
Blackfoot River	4.0	<.1	13.0	-	-
Phytotoxic Concentration	100	100	100	1,000	500

1.4.7 Analytical Results

The results of the sample analyses were used to estimate the nature and extent of potential impact to the environment and human health. Selected results for each site are presented in the discussion; a complete listing of water-quality, soil chemistry, and acid rain leach test results are presented in Appendix V.

All of the data for this project were collated with existing data and were incorporated into a new MBMG abandoned - inactive mines database. The database will eventually include mines and prospects throughout Montana. It is designed to be the most complete compilation available for information on the location, geology, hydrogeology, production history, mine workings, references, and environmental impact of each of Montana's mining properties. The data-fields in the current database are presented in Appendix VI and are compatible with the MBMG ARC/INFO Geographical Information System (GIS).

1.5 DEERLODGE NATIONAL FOREST

The 1.3 million-acre Deerlodge National Forest (DNF administered land) straddles the Continental Divide in southwestern Montana (Figure 1). Headquartered in Butte, it lies in the heart of historic mining country. The Forest's eight mountain ranges, with elevations ranging from 4,075 to 10,604 feet, create a diverse landscape graduating from semiarid grassland foothills near the valley bottoms, to coniferous forests, to alpine regions of steep rocky peaks.

1.5.1 History of Mining

Some knowledge of the local mining history is helpful in understanding the problems created by the abandoned and inactive mines in the area. Gold was first discovered in the Deerlodge National Forest area on Gold Creek in the southwest portion of Powell County in 1852. By 1860, some gold placer mines were operating on Gold Creek, but most gold placers were discovered about 1865. Associated lode deposits were located soon thereafter.

Placers reached their maximum production before 1872, when the richest ones began to play out. By 1870, production from gold and silver lode deposits had become important. Most lode mines had been discovered by the late 1880s, with the main period of production from 1880 to 1907. Mines with silver as the major commodity were most active from 1883 until 1893, when the silver panic forced the closure of many of these polymetallic mines. Many operations never resumed. Mines yielding gold ores, especially of the "free milling" variety, which contain free gold, enjoyed a greater longevity. Some of these gold producers were worked until 1942, when the federal government placed restrictions on gold mining as a result of World War II. During World War II, government price supports and essential industry rulings brought many small to medium copper, lead, and zinc properties into production. Following the war the increase in supply and labor costs coupled with the withdrawal of price supports prematurely closed most of these properties. The Korean conflict brought some of these back on line as once again the government influenced the economics of mining. Additional properties were brought on line as the Defense Logistics Agency went through a period of creating stockpiles of critical strategic minerals.

Towns such as Philipsburg were turned into industrial centers for production of manganese until the quotas were met and, once again, the buying programs and price supports were eliminated creating ghost towns, partially mined deposits, and environmental hazards. For most, it may be decades or centuries before economics will coax them into production.

These boom-to-bust cycles continued with government influence through the 1980's when new environmental standards closed the Anaconda smelter and left many of the mines with place to sell the ore. The resulting inactive-abandoned properties continue to impact the environment.

1.5.1.1 Production

The total value of minerals produced from lode mines within the Deerlodge National Forest boundaries was probably more than \$60 million at the time of production (USGS/USBM, 1978; O'Neill and others, 1983; Loen and Pearson, 1984; Elliott and others, 1992). This excludes the Butte and Philipsburg districts whose production totals are \$6 billion and \$91 million, respectively. These districts lie adjacent to, but outside of, the Deerlodge National Forest.

Vicinity Map Deerlodge National Forest

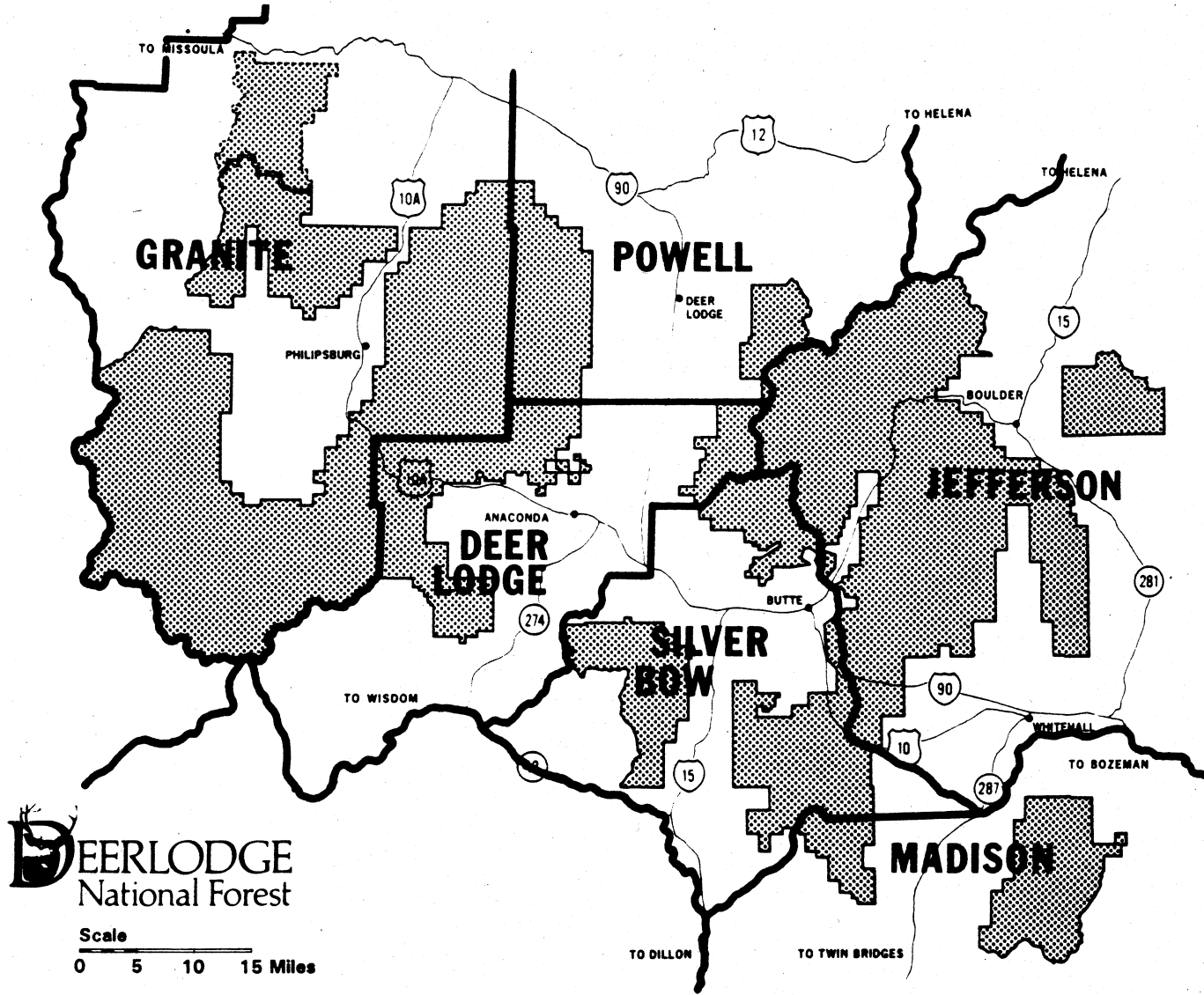


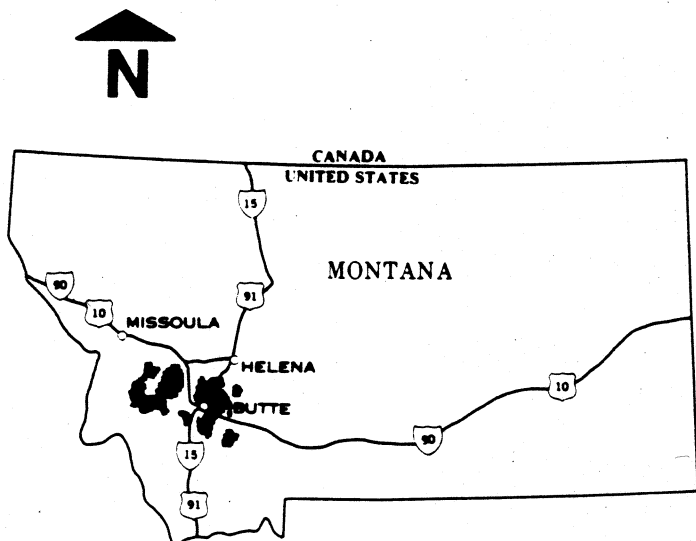


FIGURE 1

Legend

-  Deerlodge National Forest Lands
-  County Boundaries



1.5.1.2 Milling

An understanding of the history of milling developments is essential for interpreting mill sites, understanding tailings characteristics, and determining the potential for the presence of hazardous substances. Mills, usually adjacent to the mine, produce two materials: 1) a product which is either the commodity itself or a concentrate which is shipped offsite to other facilities for further refinement, and 2) waste, which is called tailings.

In the 1800s, almost all mills treated ore by crushing and/or grinding to a fairly coarse size followed by concentration using gravity methods. Polymetallic sulfide-ores were concentrated and shipped to be smelted (usually to sites off National Forest administered land). Gold was often removed from free-milling ores at the mill by mercury-amalgamation. Cyanidation arrived in the U.S. about 1891 and, because it resulted in greater recovery rates, it revolutionized gold extraction in many districts. Like amalgamation, cyanidation also worked only on free milling ores, but it required a finer particle size. About 1910 froth flotation became widely used to concentrate sulfide ores. This process required that the ore be ground and mixed with reagents to liberate the ore-bearing minerals from the barren rock.

Overall, then, there were two fundamental processes used for ore concentration: gravity and flotation, and three main processes used for commodity extraction: amalgamation, cyanidation, and smelting. Each combination of methods produced tailings of different size and composition, each used different chemicals in the process, and each was associated with a different geologic environment.

1.6 SUMMARY OF THE DEERLODGE NATIONAL FOREST INVESTIGATION

A literature search (Emmons and Calkin, 1913; Roby and others, 1960; Becraft and others, 1963; Ruppel, 1963; Earll, 1972; McClernan, 1976; Krohn and Weist, 1977; MILS database, U.S. Bureau of Mines; MRDS database, U.S. Geological Survey USGS/USBM, 1978; Erickson and others, 1981; O'Neill and others, 1983; Wallace and others, 1983; Loen and Pearson, 1984; Elliott and others, 1985; Elliot and others, 1988; Elliott and others, 1992) identified 1057 sites in the general area of the Deerlodge National Forest. The pre-field investigation that followed indicated that there are least 795 abandoned or inactive metal mines and mills that are located on or that affect the Deerlodge National Forest. Most became inoperative long before environmental regulations were put into effect, so tailings piles, waste-rock dumps, and mine discharges persist to potentially affect the environment today. Table 4 summarizes the results of the Deerlodge National Forest inventory.

Table 4
Summary of Deerlodge National Forest Investigation

Total Number of Abandoned/Inactive Mine Sites that were:

PART A - Field Form

Located in general area from Literature Search	1057
Not on or affecting Deerlodge NF	-262

PART B - Field Form (Screening Criteria)

Possibly affecting the Deerlodge NF	795
Screened out by DNF minerals administrator OR by description in literature	-275
Not found (location inaccurate)	- 86

Visited by geologist	432
Screened out by geologist	-327

Visited by hydrogeologist	105
Screened out by hydrogeologist	- 4

PART C - Field Form

Sampled (Water and Soil)	101
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A separate discussion of each of the 101 sites is included in the five volumes that comprise the DNF report. All 1057 sites which had the potential to affect DNF administered land are listed in Appendix II of each volume.

1.7 MINING DISTRICTS AND DRAINAGE BASINS

The Deerlodge National Forest includes all or part of 30 mining districts as defined by the USGS (Elliott and others, 1992; Loen and Pearson, 1984). Some mines are not located in traditional mining districts and, for the purposes of this study, have been organized into areas delineated by topography. In either case, boundaries have been determined in part by changes in geology and in part by drainage divides. This provides a convenient way to separate the Forest into manageable areas for discussion of both geology and hydrology; and perhaps more important it is an aid to the assessment of cumulative environmental impacts on each drainage.

BASIN MINING DISTRICT (CATARACT CREEK DRAINAGE)

The Basin Mining District located in the northeast part of the Deerlodge National Forest (Figure 2) contains two main watersheds, Basin Creek and Cataract Creek; both are tributaries of the Boulder River. A few mines within the District are in other small tributaries of the Boulder River. Figure 3 shows the location of the mines and major drainages within the Basin Mining District.

Land use in the District is restricted by the deeply incised streams and rough terrain. Elevations range from a high of 8,739 feet on Jack Mountain to 5,355 feet at the town of Basin. The town of Basin sits at the mouth of Basin Creek and has a population of less than 100 (1990 Montana Census). In addition, there are approximately 20 to 30 homes along Basin and Cataract Creeks; some are year-round residences and others seasonal.

2.1 GEOLOGY

The geologic setting of the Basin District has been well described by Ruppel (1963) and Becraft and others (1963). Throughout the district, quartz monzonite and granodiorite of the Cretaceous Boulder Batholith have intruded quartz latite and andesite of the comagmatic (Rutland, 1985; Watson, 1986) Elkhorn Mountain Volcanics. Tertiary Lowland Creek Volcanics and younger Tertiary rhyolite unconformably overlie portions of the batholith. Unconsolidated Quaternary sediments obscure much of the bedrock geology in the district.

2.2 ECONOMIC GEOLOGY

The economic geology was characterized by Roby and others (1960), Pinckney (1965), and Derkey and Matsueda (1987). The majority of mines and prospects explore veins of quartz, tourmaline, pyrite, galena, tetrahedrite, sphalerite, arsenopyrite, chalcopyrite, and siderite that occupy east-trending, late Cretaceous, extensional shear zones in the batholith and adjacent areas of the Elkhorn Volcanics (Woodward, 1986). The veins are concentrated in several elliptical centers of mineralization. In these mineralization centers, veins are closely spaced, wide (up to 40 feet), and have alteration haloes with concentric quartz-sericite-pyrite, kaolinite-siderite, and montmorillonite-chlorite alteration products (Pinckney, 1965).

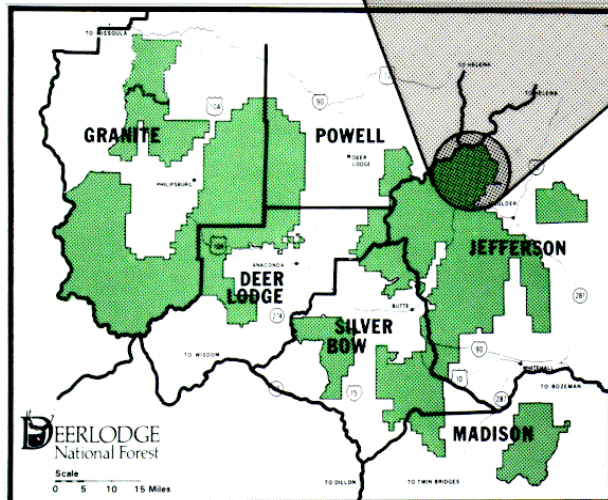
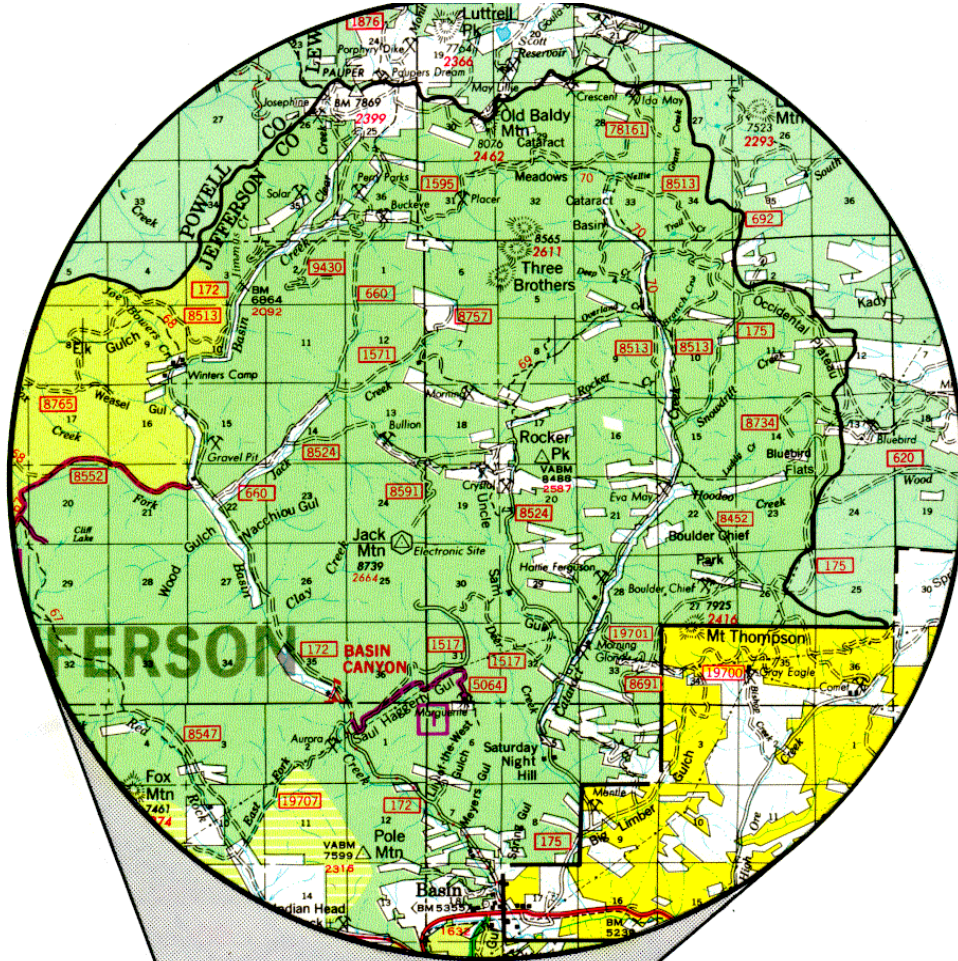


FIGURE 2
BASIN - CATARACT
CREEK DRAINAGE

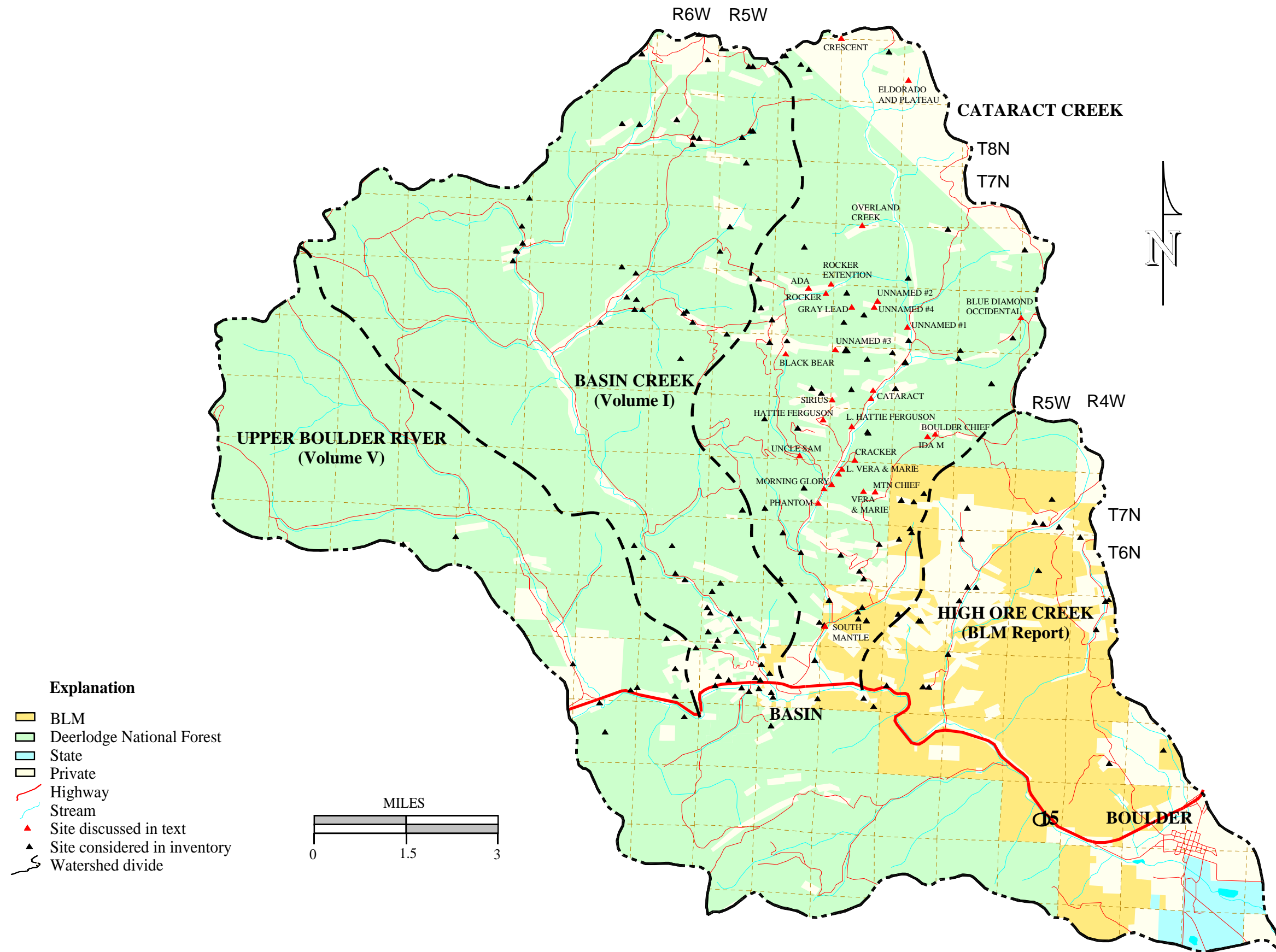


Figure 3. The Cataract Creek drainage is in the upper Boulder River drainage which includes Basin Creek (Volume I). The remaining sites on USFS administered lands in the upper Boulder River are discussed in the Jefferson River report (Volume V). Abandoned - inactive mines in High Ore Creek are on BLM administered lands and are discussed in MBMG Open-file report 348.

The veins themselves can be several miles in length, but on their distal ends they narrow, have less wallrock alteration, bear fewer sulfides, and contain more siderite, chalcedony, and calcite. The veins were mined mainly for their silver and base metal content, although some contained appreciable amounts of gold. Silver to gold ratios were very high. Samples collected in this investigation averaged 80:1.

Lode production in the district from 1902-1957 was 129,040 oz gold (Au), 5,603,300 oz silver (Ag), 4,237,522 lbs copper (Cu), 35,293,697 lbs lead (Pb), and 27,201,179 lbs zinc (Zn), worth \$15,609,000 at the time of production (Elliot and others, 1992).

A few mines and prospects are located in late Cretaceous to early Tertiary NW- to NE-striking veins and breccia zones that cross-cut and offset the east-west veins. This mineralization consists mostly of fine-grained to microcrystalline quartz, hematite, minor pyrite, and local barite. Metal values are usually low and little production has been recorded from this type of system. The breccia zones were often later intruded by Tertiary quartz latite clastic dikes with no associated alteration or mineralization (Ruppel, 1963).

2.2.1 Processing

The high-sulfide ores required concentration by gravity or flotation in mills scattered throughout the district. The concentrate was usually smelted to recover metals; probably neither mercury nor cyanide were used at most mills in the Basin District. Both mine dumps and mill tailings in the area usually have abundant pyrite and significant metal content, and can be sources of contamination.

2.2.2 Uranium

Uranium mineralization is associated with the late stages of hydrothermal activity in these veins (Becraft, 1956; Thurlow and Reyner, 1952). As a result, slightly elevated gamma radiation levels can be detected at many of the dumps and tailings piles. No uranium production from the district has been recorded.

2.2.3 Open Pit Mines

At the Basin Creek mine, an active mine on the boundary between Deerlodge National Forest and Helena National Forest, disseminated gold has been open pit mined from Tertiary rhyolite which covers the batholith. This particular mine is in the Basin Creek drainage near the drainage divide, but is not within the Cataract Creek drainage. All abandoned mines associated with this ore body are outside Deerlodge National Forest boundaries. In the Cataract Creek drainage, the Crystal mine has small open pits on private land.

2.2.4 Placer Mines

Gold placer workings are common in the district. The placers appear to be unrelated to the east-west veins. The distribution of placer gold was probably complicated by Pleistocene glaciation. A by-product of some placer operations was cassiterite in the form of wood tin. Its source may be the Tertiary rhyolite (Brinker, 1944).

2.3 MINERAL RESOURCE POTENTIAL

Although a detailed mineral resource potential study was not done, some inferences can be made from the literature, sample results, and geologic observations. Mineral potential is similar to that described for the Electric Peak Wilderness Area to the northwest (Federspiel and Mayerle, 1988). There is a high potential for the discovery of small high grade silver veins with base metal and some associated gold both adjacent to inactive mines and at depth on known deposits. In fact, Elliott and others (1992) assigned a very high rating for potential discovery of new deposits of this type to much of the Basin district. Similar veins may exist to the northwest, where batholithic host rocks are covered by Tertiary volcanic rocks and Quaternary sediments.

However, deposits are small, contain only unpredictable and sporadic gold, have high arsenic content, and must be mined by expensive underground methods. This deposit type is probably of interest only to small miners. A few larger exploration targets may exist. These are areas of closely spaced veins with high gold values and relatively extensive alteration haloes that have the potential to host disseminated gold. Examples are the Eldorado and Plateau area, the Uncle Sam area, and the Sirius area. Some of these have recently been tested by exploration programs, but results are not available.

Under Quaternary cover to the west and northwest of the area, there is some potential for Tertiary disseminated gold mineralization similar to that of the Basin Creek mine.

Dumps and tailings piles may also constitute a resource in the Basin District. Preliminary sampling suggests that the Cataract tailings (1000 tons at .053 oz/ton Au and 3.37 oz/ton Ag) contains fairly high grade ore. Placer tin deposits could become reserves under favorable economic conditions.

2.4 HYDROLOGY AND HYDROGEOLOGY

The average annual precipitation for the area ranges from 12 to 14 inches in valleys; most precipitation occurs in the spring months in the form of snow or rain. Temperatures in southwest Montana can be extreme and range from well below 0°F during the winter months to over 90°F during the summer; freezing temperatures can occur at any time during the year.

The District contains two main drainages which discharge to the Boulder River. Tributary drainages are numerous and largely controlled by the structure of the underlying plutonic rocks and glacial deposits. There are no stream gage stations in either drainage; both Basin Creek and Cataract Creek are perennial streams.

Ground water occurs in the fractured bedrock, alluvial valley fill and glacial moraines within valley bottoms. Ground-water flow in the bedrock is probably controlled by fracture aperture, density, and mineralization. Each of these characteristics can change dramatically in a short distance. Ground-water flow in the unconsolidated material is probably controlled more by local flow conditions than by the bedrock aquifer (Metesh and others, 1994). This fact becomes important on mine and mill sites where there is the potential for leaching metals from the waste material.

2.5 SUMMARY OF THE BASIN MINING DISTRICT - CATARACT CREEK

The Cataract Creek watershed contains the highest concentration of inactive mines in Deerlodge National Forest (DNF administered land). There are 58 mines and 5 mills within the drainage; 51 sites were visited in 1992 and 1993 (Table 5). Twenty-seven mine openings discharge water. Several sites had environmental problems associated with erosion of and runoff from waste materials. As in the rest of the Basin District, mines that explored high-sulfide, east-west veins associated with emplacement of the Boulder Batholith exhibited the most environmental problems. Some, such as the Cataract and Sirius, the Boulder Chief and Ida M., and the Rocker and Ada, explore different portions of the same shear zone.

Table 5
Summary of Basin Mining District (Cataract Creek Drainage)

MINE ¹	OWNER ²	VISIT	SAMPLE ³	REMARKS
Ada	M	Y	Y	Adit discharge
Apollo	P	Y	N	Streamside dump
BaKaMa	F	Y	N	Dry caved adit
Billie T.	P	Y	N	Minor soil contamination
Black Bear	M	Y	Y	2 discharges; soil contam.
BlueDiamond/Occidental	F	Y	Y	2 adit discharges
Boulder Chief	F	Y	Y	Discharge; soil contamination;
Cataract	P	Y	Y	2 short adit discharges
Cataract Tails⁴	M	Y	Y	In floodplain
Cracker	F	Y	Y	Adit discharge
Crescent	P	Y	Y	Adit discharge
Crystal	P	Y	N	Adit discharge; previous study
Custer	M	Y	N	Dry caved workings
Eldorado and Plateau	F	Y	Y	Caved workings; seeps
Elmer	P	Y	N	Dry caved adit
Eva May ⁴	P	Y	N	Tailings in floodplain
First Shot/Last	P	N	N	Ridgetop location
Gray Lead⁴	F	Y	Y	Tailings and adit discharge
Great Shield	F	N	N	Unable to locate
Hidden Treasure	U	N	N	Unable to locate
Hattie Ferguson	M	Y	Y	Adit discharges
Ida M.	F	Y	Y	Adit discharge
Ida May	P	Y	N	Flooded shaft, no discharge
John T.	F	Y	N	Dry caved adit
Jumbo	P	Y	N	Dry caved adit
Klondyke	M	Y	N	Numerous dry workings
Lizzie Osborne	F	Y	N	Dry caved adits
Louise	F	Y	N	Small dry prospect
Manhattan	P	Y	N	Dry caved workings
Mantle	p	Y	N	Streamside dumps
Mary Anne	P	Y	N	Dry workings

TABLE 5 Continued

Mike #14	F	Y	N	Dry caved adit
Minneapolis	P	Y	N	Dry caved workings
Morning Glory	F	Y	Y	Unmineralized dumps
Morning Glory Tailings⁴	F	Y	Y	Streamside tailings
Morning Marie	F	Y	Y	Adit discharge
Mountain Chief⁴	M	Y	Y	Adit discharge
Overland Creek	F	Y	Y	Streamside dumps; shaft
Phantom	M	Y	Y	Adit discharge
Piermont #1 East	F	Y	Y	Discharge; see Basin report
Quartz Creek	F	Y	N	Caved dry workings
Rocker	M	Y	Y	Adit discharge
Rocker Extension	F	Y	Y	Adit discharge
Saint Lawrence	P	Y	N	Flooded open cut
Saint Nick	P	Y	N	Dry caved workings
Saturday Night	F	Y	N	Dry caved adit; dump eroded
Seattle	M	Y	N	Dry caved workings
Sirius	F	Y	Y	Discharge; soil contamination
South Mantle	P	Y	Y	Streamside dump
Sparkling Water	P	Y	N	Dry
Sylvan	F	Y	N	Dry caved adit
Uncle Sam	F	Y	N	Dry workings
Unnamed #1	F	Y	Y	Adit discharge
Unnamed #2	F	Y	Y	Adit discharge
Unnamed #3	F	Y	Y	Discharge
Unnamed #4	F	Y	Y	Discharge
Vera and Marie	F	Y	Y	Dump discharge

1) Mines in **bold** may pose environmental problems to DNF administered land and are discussed in the text; others are included only in Appendix II (all mines) and Appendix III (sites visited).

2) Administration/Ownership Designation

F: USFS (DNF)

P: Private

M: Mixed (DNF and private)

U: Owner unknown

3) Solid and/or water samples (including leach samples)

4) Mill sites present

2.5.1 Summary of Environmental Observations

Based on down-stream samples, stressed vegetation, and iron precipitate in the stream bed and high water marks, the Crystal mine in Uncle Sam Gulch is a major contributor to the dissolved-metals loading in Cataract Creek. Few of the other mines in the drainage have discharges that reach the creek and fewer still have waste material in contact with surface water. On DNF administered land, the Boulder Chief is the major contributor of AMD and metals-rich waste material that impact this drainage.

Several mines on private ground, such as the Black Bear mine and the Eva May mine are impacting DNF administered land; at these sites, sample collection was restricted to areas below the mine on DNF administered land. However, at least some data were collected for all sites with a potential for off-site impacts to surface water, ground water or soils, on private as well as DNF administered land. The sites listed in **bold** in Table 5 are those that displayed at least some indication of adverse impact and were sampled; these sites are discussed in more detail in the following sections.

2.6 CRESCENT MINE

2.6.1 Site Location and Access

The Crescent mine is on private land near the head of Cataract Creek basin (T8N R5W Section 29AAAD) and, even though cat-work has been done recently, the site is accessible only by foot. The site is approximately 1.5 miles from the main road in Cataract Meadows and is uphilled of DNF administered land.

2.6.2 Site History - Geologic Features

A single portal is located on a N70W 71S shear zone containing discontinuous quartz-pyrite-galena-sphalerite veins. A select sample of vein material from the dump ran 0.344 oz/ton Au, 9.02 oz/ton Ag, 0.430% Cu, 4.55% Pb, and 0.600% Zn. Production figures show similar values; from 1935-1956, 399 tons of ore was produced with 190 oz Au, 3392 oz Ag, 5466 lbs Cu, 45,934 lbs Pb, and 15,138 lbs Zn recovered (Roby and others, 1960). It appears that the Crescent vein contained much higher gold values than most of the Boulder Batholith veins. According to Becraft and others (1963), there were actually three veins mined on about 800 feet of workings. They also report that a flotation mill was built in 1954, but there were no surface deposits of tailings at the time of this inventory.

2.6.3 Environmental Condition

The site consists of a single caved adit and associated dumps downhill from the adit. Since the site was on private land, a site map was not prepared, nor were detailed observations made of structures on the site.

2.6.3.1 Site Features - Sample Locations

The site was sampled on 7/14/94. The caved adit was discharging water at rate of about 5 gpm. Below the adit there were several acres of dumps and tailings that had recently been re-worked by bulldozer. Although the adit was on private land, the discharge reached DNF administered land downstream. A sample of the discharge (CSS10M) was collected as it flowed onto DNF administered land.

2.6.3.2 Soil

Soil on DNF administered land did not appear to have been affected by runoff or sedimentation from the disturbed area. No soil samples were collected.

2.6.3.3 Water

The adit discharge was the only surface water in the area and flowed into a wetlands area downhill. The quality of the adit discharge was poor and exceeded MCLs for several constituents (Table 6). Aluminum, cadmium, lead, and zinc concentrations exceeded both drinking water and aquatic life criteria. The low field pH (<4.0) and low sulfate concentration suggest that little buffering occurs along the stream before it discharges into the wetlands.

Table 6
Water Quality Exceedences
Crescent Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CSS10M)	S,A C			P,A C		SAC		P,A C	S				SAC						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.6.3.4 Vegetation

Vegetation on DNF administered land below the site indicated little, if any, stress except in the discharge stream. Despite the poor quality water, vegetation in the wetlands appeared unaffected. However, dead trees at the downstream end of the wetlands may indicate contaminated ground water discharging from the mine or, possibly, buried tailings.

2.6.3.5 Summary of Environmental Condition

The poor quality discharge is small and represents only a small amount of metals loading to the drainage. There is the possibility, however, of a plume of contaminated ground water from the mine workings or from buried tailings; the extent of this problem could not be determined within the scope of this inventory.

2.6.4 Structures

All of the structures, waste dumps, and debris were on private land. No building material associated with the mine was observed on DNF administered land.

2.6.5 Safety

Since all of the structures, dumps, and debris were on private land, no evaluation was made with regard to safety. Dead or dying trees in the wetlands area may pose a safety concern, especially during high wind or snowfall.

2.7 ELDORADO AND PLATEAU MINE

2.7.1 Site Location and Access

The Eldorado and Plateau mine is located near the headwaters of Nellie Grant Creek, a tributary of Cataract Creek. The site location (T8N R5W 27 CBCB) is shown on the Chessman Reservoir USGS 7.5 minute quadrangle. Access to the site is by Banner Creek Road, south of Rimini. The entire site is on DNF administered land.

2.7.2 Site History - Geologic Features

A shaft, an adit, and an open cut follow a N84E 70NW shear zone with veins of quartz, pyrite, galena, and sphalerite. The property is of note because a large area of altered, iron-stained quartz monzonite extends to the north and because there are some high metal values associated with the system. A select vein sample ran 0.332 oz/ton Au, 17.63 oz/ton Ag, 0.290 oz/ton Cu, 2.7% Pb, and 4.3% Zn. A vein sample described by the USGS (MRDS database) had 0.25 oz/ton Au and 6 oz/ton Ag.

2.7.3 Environmental Condition

An open cut and several waste-rock dumps were in the central portion of the site. To the west of the cut, there were four collapsed shafts and a mineralized waste-rock dump. Several hundred feet east of the cut, there was a collapsed adit and several cabins and mine buildings. The site covers approximately two acres.

2.7.3.1 Site Features - Sample Locations

The site was sampled on 9/28/93. A seep was flowing at about 0.05 gpm from the west end of the open cut into a standing pool of water (10 ft. x 100 ft.) that was held back by a waste-rock dam. A second seep, which was flowing about 0.5 gpm, drained into the pool from the north. Samples were collected from both these seeps (NEPS10H and NEPS20M) and from the pool (NEPS30H). On the day the hydrogeologist visited the site (9/22/93), no flow was observed across the top of the waste-rock dam, but washed sediments below the dam indicate that the dam is intermittently overtopped. A sample was also collected from a small flooded pit at the foot of the dam (NEPS40H). In addition to the water associated with the mine workings, there is a developed spring flowing at about 3 gpm on the hillside south of the cabins. This spring is probably used occasionally as a drinking-water supply by hunters and other recreational users who visit the site. A sample was collected from the spring (NEPS50M).

Nellie Grant Creek is several hundred yards east of the site. The only surface water that was flowing directly from the site into the creek originated from the developed spring. However, the extensive wetlands surrounding the creek suggest that there is a significant ground-water

contribution to stream flow. The seeps and ponded water associated with the open cut and pit may be impacting the ground water that is ultimately discharged in these wetlands. Samples NEPS60L and NEPS70L were collected from the creek to evaluate this potential impact. The creek was flowing at approximately 58 gpm upstream of the development area and at approximately 90 gpm downstream of the development area. Site features and sample locations are shown in Figure 4.

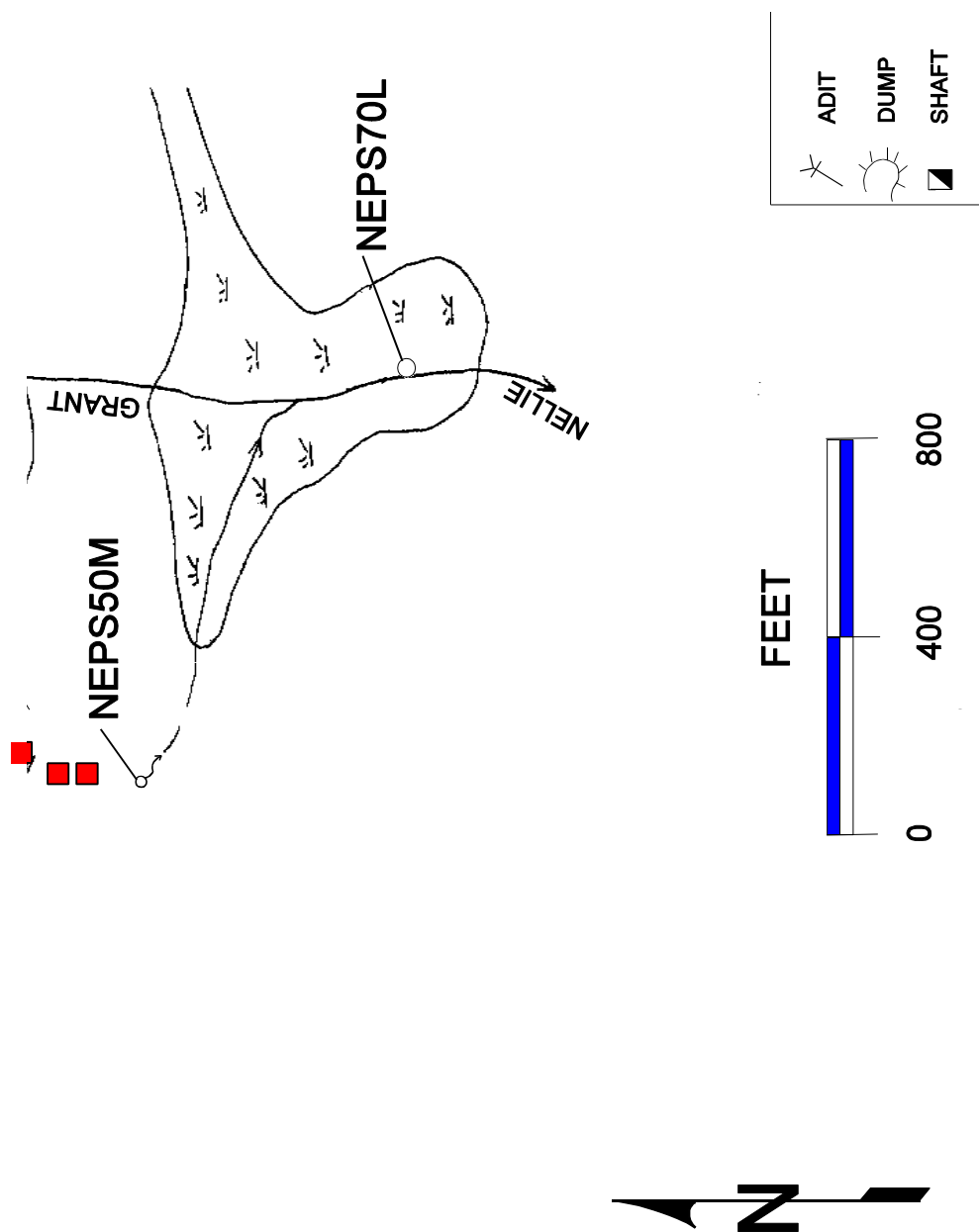


Figure 4 The Eldorado and Plateau mine is often dry. There is, however, standing water on the site and a wetlands below the site. Camera symbols show locations of photographs shown in Figures 4A and 4B.



Figure 4A. After spring runoff and precipitation events, water ponds in the lower end of the cat cut.



Figure 4B. The adit (right of the building) was dry, but a seep broke out just below the building and flowed toward the wetlands area.

2.7.3.2 Soil

Erosion of the mineralized waste-rock dumps appeared to be a minimal problem at the site; therefore, no soil samples were collected.

2.7.3.3 Water

The seep on the west end of the open cut, the pool of water in the cut, and the ponded water in the pit below the dam all exceeded MCLs for cadmium, copper, manganese, mercury, zinc, and pH. In addition, both the west seep and the pit water exceeded the MCL for lead. Also, the west seep exceeded MCLs aluminum. The seep on the north side of the pit only exceeded the MCL for mercury. The water from the developed spring exceeded MCLs for mercury and for pH.

Above the site, Nellie Grant Creek exceeded MCLs for aluminum. Downstream of the site, MCL for copper and pH were exceeded.

Table 7
Water-Quality Exceedences
Eldorado and Plateau Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Nellie Grant Cr - Upstream (NEPS60L)																			
Seep at west end of cut (NEPS10H)	S,A C			P,A C		A,C		P,C	S	A,C			S,A C						S
Seep at north side of cut (NEPS20M)										A,C									
Ponded water in cut (NEPS30H)				P,A C		A,C			S	A,C			A,C						S
Ponded water in pit (NEPS40H)				P,A C		A,C		C	S	A,C			A,C						S
Spring - south of cabins (NEPS50M)										A,C									S
Nellie Grant Cr. - Downstream of site (NEPS70L)																			S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.7.3.4 Vegetation

Local undisturbed vegetation at the site included grasses, brush, and conifers. In the wetlands adjacent to Nellie Grant Creek, marsh grasses predominated. In all of the areas disturbed by mining, the ground was barren to sparsely vegetated with weeds and grasses.

2.7.3.5 Summary of Environmental Condition

Water quality within the disturbed area was generally poor, especially in the open cut area. All water samples collected at the site exceeded one or more water-quality criteria. Water samples collected from Nellie Grant Creek above and below the site also exceeded several MCLs; however, these exceedences were probably related to background conditions rather than impact from the mine.

2.7.4 Structures

Two mine building and two cabins were south of the collapsed adit. All of the buildings were in fair condition. One of the mine building housed a large compressor on wheels that was probably used to operate drilling equipment when the mine was active.

2.7.5 Safety

The flooded pit and the depressions around the collapsed shafts pose some hazard. Also, water from the developed spring may not be safe to drink. The site is visited occasionally by hunters and other recreational users and is easily accessible by a 4-wheel drive road.

2.8 OVERLAND CREEK MINE

2.8.1 Site Location and Access

The Overland Creek mine (T7N R5W Section 9BBB) is adjacent to Overland Creek which flows into upper Cataract Creek. The site is approximately 3100 feet upstream from the main Cataract Creek road and is accessible only by foot. The site is entirely on DNF administered land

2.8.2 Site History - Geologic Features

The locations of the workings indicate a N79W vein trend over at least 300 feet of strike length. The eastern shaft has 500 tons of quartz monzonite with kaolinite and siderite alteration products in the dump. A select sample of quartz-tourmaline-pyrite-galena-sphalerite vein ran 0.488 oz/ton Au, 8.03 oz/ton Ag, 0.170% Cu, 6.50% Pb, and 3.3% Zn.

2.8.3 Environmental Condition

The site consists of two flooded shafts with associated waste-rock dumps. About three hundred feet of the stream have been extensively placer-mined, apparently after the underground mining ceased. The distinction between the two methods of mining is difficult in some areas.

2.8.3.1 Site Features - Sample Locations

One shaft was at the east end of the site on the north side of Overland Creek, and the other was on the west end of the site on the south side of Overland Creek. Waste-rock dumps containing appreciable amounts of sulfide minerals were next to each mine shaft. The water-level elevation in the shafts was higher than the water-level elevation of Overland Creek in the vicinity of the shafts. Major site features and sample locations are presented in Figure 5.

Samples were collected on 8/15/92. Surface water samples of Overland Creek were collected upstream (COCS20L) and downstream (COCS10L) of the disturbed area. Additional samples were collected from the north shaft (COCS30M) and the south shaft (COCS40M). Neither shaft was discharging water; the discharge of Overland Creek was about 18 gpm upstream and about 27 gpm downstream of the disturbed area.

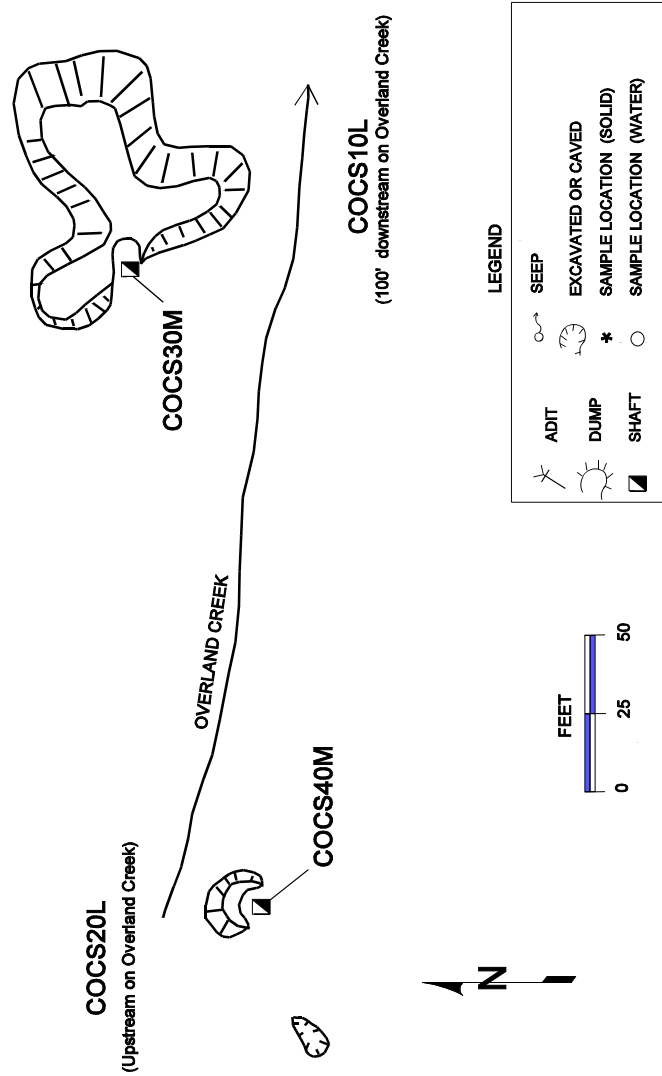


Figure 5 The Overland Creek mine is adjacent to Overland Creek and consists of two shafts and associated dumps. Overland Creek has been placer mined in this area.

2.8.3.2 Soil

There was no evidence of impact to soils at the base of the dumps. The areas below the base of the dumps had been disturbed more by placer activities than by sediments washed from the dumps. No soil samples were collected.

2.8.3.3 Water

Only the water samples collected from the shafts showed any exceedence of MCLs (Table 8). A comparison of the upstream and downstream samples shows at least a slight increase in the concentrations of several metals, arsenic, and sulfate in Overland Creek. These data and the fact that the water levels in the shafts were higher than the stream suggests that contaminated ground water from the mine workings may discharge to the creek.

One constituent, cadmium, decreased across the site. This may be explained by the fact that some buffering is occurring (pH increases from 7.31 to 7.51) and the solubility control on cadmium changes at a pH of 7.5.

Table 8
Water Quality Exceedences
Overland Creek Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Overland Creek - upstream of development area (COCS20L)																			
Shaft south of creek (COCS40M)	S																		
Shaft north of creek (COCS30M)	S			P,A C		C			S				A,C						S
Overland Creek - downstream of development area (COCS10L)																			

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.8.3.4 Vegetation

The disturbance caused by the placer operation had the greatest effect on vegetation. Outside the placer area and off the dumps there appeared to be little or no stress related to mining activities.

2.8.3.5 Summary of Environmental Condition

Although none of the dumps or workings discharge surface water to Overland Creek, there is most likely contaminated ground water discharging to the creek. The overall impact appears slight, however, since MCLs were not exceeded in samples collected downstream of the site. Increased sedimentation from the placer workings may be of some concern during high runoff periods.

2.8.4 Structures

No significant structures were observed on the site; neither shaft had a gallows frame nor associated buildings.

2.8.5 Safety

The prominent safety concern on this site is the condition of the two shafts; each was covered with a wood bulkhead.

2.9. ADA MINE

2.9.1 Site Location and Access

The Ada mine site (T7N R5W 17ADBA) is near the head of Rocker Creek, a tributary of Cataract Creek, approximately 1.5 miles west of the main road. The site is accessible only by trail. Most of the disturbed area is on DNF administered land with a lesser portion on private land.

2.9.2 Site History - Geologic Features

The Ada mine explores a N72E 70NW vein of quartz, pyrite, sphalerite, galena, tetrahedrite, and chalcopyrite (Ruppel, 1963). The mine was most active from 1900-1902, and was worked intermittently until 1907. Production was about 2000 tons of silver-lead ore mined from a single hanging wall shoot 20-30 feet thick and 80 feet long (Ruppel, 1963). This vein is presently exposed in the caved inclined shaft; a chip sample across the 5 foot width contained 0.024 oz/ton Au, 1.54 oz/ton Ag, 0.06% Cu, 0.19% Pb, and 0.11% Zn. Obviously this does not represent part of the high grade shoot. This vein is probably related to the same shear zone exposed at the Rocker and Rocker Extension mines to the east.

A discharge issues from the main adit, which appears to be a crosscut to the vein with about 1000 feet of underground workings. The dump is comprised of 1500 tons of altered quartz monzonite. A composite sample assayed 0.004 oz/ton Au, 3.75 oz/ton Ag, 0.057% Cu, 0.320% Pb, and 0.005% Zn.

2.9.3 Environmental Condition

The site consisted of eight caved adits, one trench, and one shaft with associated waste-rock dumps. The western part of the site, with two caved adits, was privately owned. Several of the adits and the trench were discharging water and soil contamination was evident in areas below several of the dumps.

2.9.3.1 Site Features - Sample Locations

Water from a caved adit on private land in the creek bottom was discharging into Rocker Creek. One of the adits and the trench on DNF administered land discharged water (<0.5 gpm); however, the water completely infiltrated the ground within tens of feet. Fined-grained waste material from the large, eastern adit on DNF administered land had been washed onto native soil. Evidently, in the past, seepage from the eastern adit was channeled to the west side of the waste-rock dump and infiltrated the soil. A crust of iron hydroxide extending several inches below land surface was still evident. Major features and sample locations are shown in Figure 6. The site was sampled on 8/4/92. Surface-water samples were collected upstream (CADS20L) and

downstream (CADS50L) of the development area, and downstream of the western adit that was on private ground (CADS30L). Samples were also collected of the water discharging from the adit on DNF administered land (CADS60L) and of the water discharging from the trench on DNF administered land (CADS40L). The discharge rate of Rocker Creek was approximately 18 gpm upstream and 18 gpm downstream of the mine area.

A composite soil sample (5-foot centers) was collected near the base of the eastern waste-rock dump (CADD10H) and a grab sample was collected on the west side of the same dump (CADD20H).

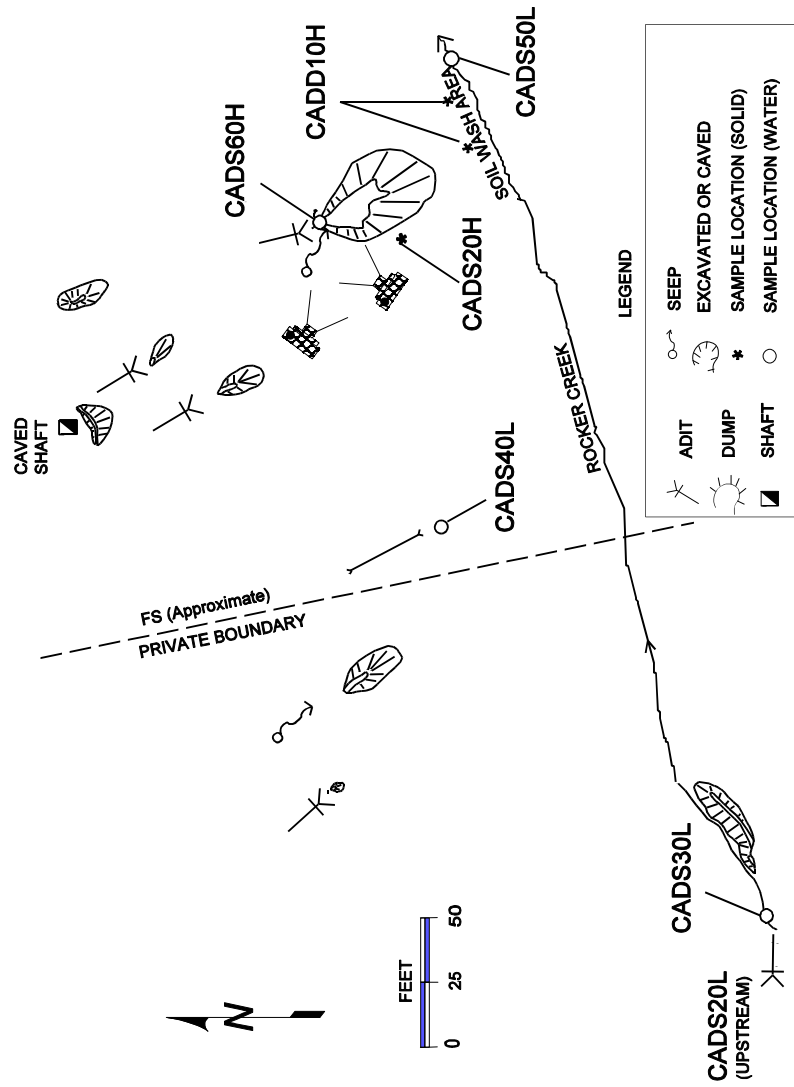


Figure 6 The Ada mine, with several adits and a caved shaft, is on private and DNF administered land. The largest dump, on DNF administered land, is contributing waste material to Rocker Creek.



Figure 6A. A spring emanated from the hillside next to the main adit. This spring infiltrated the ground below the dump.



Figure 6B. Material from the waste-rock dump has been eroded and deposited on native soils below the dump. Some of this material is probably washed into the creek during runoff or precipitation.

2.9.3.2 Soil

Soils have been strongly impacted by material washed from the waste-rock dump associated with the east adit. Phytotoxic limits have been exceeded for arsenic, copper, lead, and zinc in soils that have been actively eroded and washed into Rocker Creek (Table 9).

Table 9
Soil Sampling Results
Ada Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Soils wash area - eastern dump (CADD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}
Soil mix area -eastern dump (CADD20H)	794 ^{1,2}	1.3 ¹	49.2 ¹	504 ¹	86.6

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.9.3.3 Water

Both adit discharge streams were acidic (pH <3) and had metals-concentrations exceeding MCLs for drinking water and aquatic life criteria; this is especially true of the east adit (Table 10) Although the discharge rate of the adits was relatively small (<0.5 gpm each), the impact of the adit discharges is evident in the data for Rocker Creek downstream of the site. Cadmium, copper, and manganese each exceeded one or more MCLs on Rocker Creek downstream of the site and pH decreased from greater than 7 upstream to less than 6 downstream.

Table 10
Water Quality Exceedences
Ada Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Rocker Creek - upstream of site (CADS20L)	S																		
Rocker Creek - downstream of adit (CADS30L)									S										
Adit discharge (CADS40L)		P		A,C		A,C													
Adit discharge (CADS60L)	S,C	P,A C		P,A C		S,A C	S,A	P,A C	S			C	S,A C				S		S
Rocker Creek - downstream of site (CADS50L)	S,A C			C		A,C			S										S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.9.3.4 Vegetation

The waste-rock dumps and soil wash areas below the dumps were devoid of vegetation. The same is true for the area along the adit discharge streams. Vegetation adjacent to Rocker Creek showed some stress near the adit discharge stream; otherwise, there was little apparent stress.

2.9.3.5 Summary of Environmental Condition

The poor quality of the adit discharge streams has had an obvious impact on the quality of water in Rocker Creek and on the vegetation. Likewise, the erosion of waste material from the dumps has had a strong impact on soils.

2.9.4 Structures

Debris from various buildings and adit covers was scattered throughout the mine area. An ore bin on the largest dump is mostly intact.

2.9.5 Safety

The aforementioned ore bin appeared to be structurally sound, but still poses some concern. The waste-rock dumps were steep and footing was precarious in some areas.

2.10. ROCKER MINE

2.10.1 Site Location and Access

The Rocker mine (T7N R5W 17AAAD) is on DNF administered land near the head of Rocker Creek and is downstream of the Ada mine (Section 2.8 of this report). Rocker Creek flows into Cataract Creek about 1.25 miles below the development area. Access to the site is limited to a trail that leads from the Cataract Creek main road up Rocker Creek. This same trail eventually leads into the Basin Creek drainage.

2.10.2 Site History - Geologic Features

Two caved adits, one short caved shaft, and several trenches appear to explore a N65W trending vein in altered quartz monzonite. The Rocker is noteworthy for the presence of some beautiful specimens of Boulder Batholith vein containing quartz, tourmaline, pyrite, sphalerite, galena, tetrahedrite, chalcopyrite, and arsenopyrite. A select sample of this material ran 0.092 oz/ton Au, 6.67 oz/ton Ag, and a few percent Cu, Pb, and Zn.

The dump size indicates about 750 feet of workings present. The dump contains about 1500 tons of quartz monzonite with abundant pyrite. A composite sampled assayed 1.46 oz/ton Au.

2.10.3 Environmental Condition

The site had two caved adits and one caved shaft with associated dumps; the southeast adit was discharging water (<1 gpm) which flowed down an old road toward Rocker Creek, but infiltrated the ground before reaching the creek. During high-flow periods, however, the adit discharge probably reaches Rocker Creek. Fine-grained waste material has been eroded from the dump of the larger adit onto native soils.

2.10.3.1 Site Features - Sample Locations

The site was sampled on 8/4/92. A sample of the adit discharge (CROS10H) was collected at the adit. The discharge rate at the sample point was less than 1 gpm. Soil grab-samples were collected at the base of the largest dump (CROD10H) and from the discharge stream area (CROD20H) where soils have obviously been impacted by the discharge water. Site features and sample locations are shown in Figure 7.

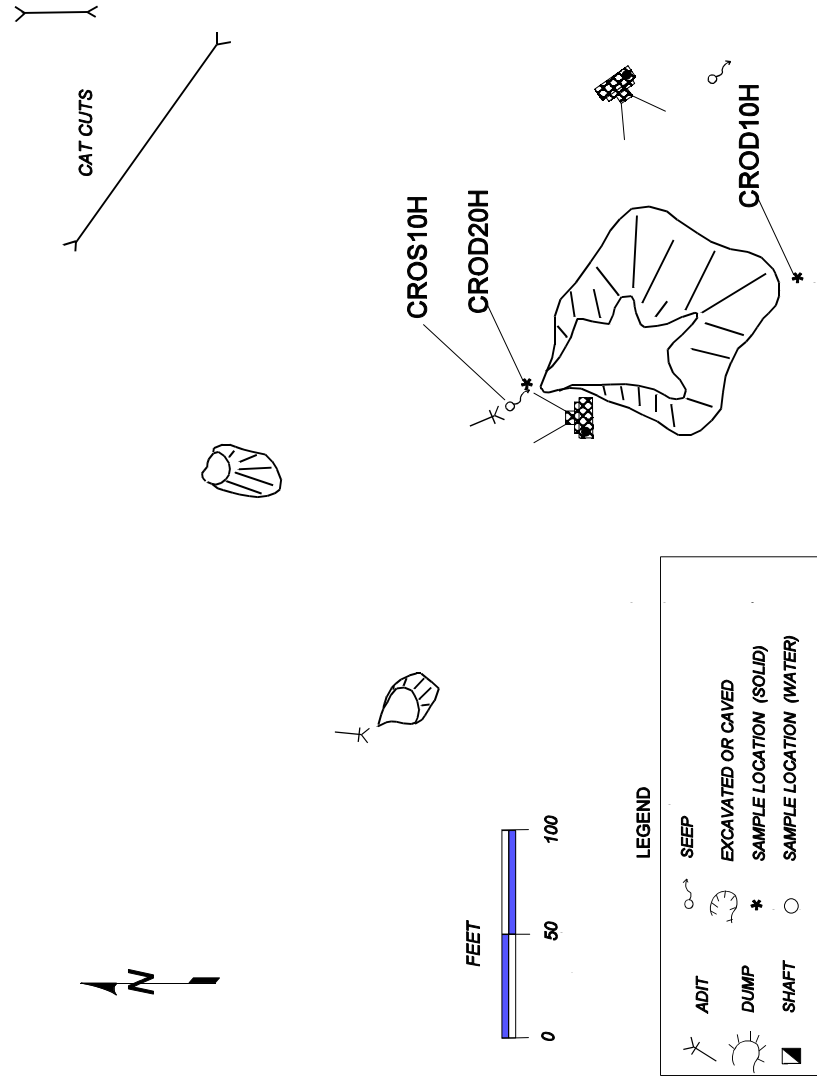


Figure 7 The Rocker mine is up slope from Rocker Creek. Although there were several small workings, only one adit discharged water. Soil down slope of the waste-rock dump appeared to have been impacted.



Figure 7A. The adit issued a small discharge that infiltrated the ground before reaching Rocker Creek. There were several structures in poor repair near the caved adit.



Figure 7B. Material from the waste-rock dump has been eroded and washed onto native soils below the dump.

2.10.3.2 Soil

Both the soils collected at the base of the waste-rock dump and near the adit discharge exceeded the phytotoxic limits for arsenic. The soil collected from the base of the waste-rock dump exceeded several other phytotoxic concentrations (Table 11). Lead and zinc concentrations were especially high at the base of the dump.

Table 11
Soil Sampling Results
Rocker Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Near base of waste-rock dump (CROD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}
Adit discharge stream area (CROD20H)	794 ^{1,2}	1.3 ¹	49.2 ¹	504 ¹	86.6

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.10.3.3 Water

The sample of the adit-discharge had concentrations that exceed several MCLs (Table 12). The concentrations of aluminum, copper, and zinc were especially high and the discharge was strongly acidic (pH 3.35).

Table 12
Water Quality Exceedences
Rocker Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CROS10H)	S,A C			P,A C		A,C	S,A	P,C	S				A,C						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.10.3.4 Vegetation

The disturbed area was devoid of vegetation. Outside the disturbed area, vegetation appeared to be stressed where waste material had been washed down from the dump at the Rocker mine. The same is true in the area near the adit discharge stream.

2.10.3.5 Summary of Environmental Condition

Much of the impact from the Rocker mine is restricted to the disturbed area; the adit discharge infiltrates the ground and waste material has been washed only a few tens of feet. During runoff events, however, the adit discharge probably reaches Rocker Creek, and fine-grained material from the waste-rock dump may also reach the creek.

2.10.4 Structures

There were several buildings and other structures on the Rocker mine site; all were in poor repair. The largest, intact structure is a small cabin near the entrance of the collapsed adit cover.

2.10.5 Safety

The structures near the collapsed adit were not secure from entry and, because of their poor condition, may pose a risk to safety.

2.11. ROCKER EXTENSION MINE

2.11.1 Site Location and Access

The Rocker Extension (T7N R5W 17ACDC) is on DNF administered land below the Rocker mine (Section 2.9 of this report) near the head of Rocker Creek and is downstream of the Ada mine (Section 2.8 of this report). The mine is immediately adjacent to the creek which flows into Cataract Creek about 1.25 miles below. Access to the site is limited to a trail that leads from the Cataract Creek main road up Rocker Creek and into the Basin Creek drainage to the west.

2.11.2 Site History - Geologic Features

The Rocker Extension has a caved adit with a couple hundred feet of workings. The dump contains 350 tons of altered quartz monzonite with very low metal values.

2.11.3 Environmental Condition

The Rocker Extension mine site is in the flood plain of Rocker Creek about 700 feet upstream from the Rocker mine. The site consists of a caved adit and a waste-rock dump, both of which were on the south bank of Rocker Creek. Both the adit and the dump were discharging water. The adit discharge channel contained deposits of ferric hydroxide.

2.11.3.1 Site Features - Sample Locations

Samples were collected on 8/31/93. Surface water samples were collected from Rocker Creek upstream (CRES10L) and downstream (CRES40L) of the site, from the adit seepage (CRES20L), and from the seep at the base of the waste-rock dump (CRES30L) (Figure 8). The adit discharged at a rate of about 2 gpm; the seeps at the base of the dump discharged at a combined rate of about 5 gpm. The discharge rate of Rocker Creek was approximately 560 gpm upstream and 580 gpm downstream of the disturbed area. Since past erosion of the waste-rock dump appeared minimal, no soil samples were collected.

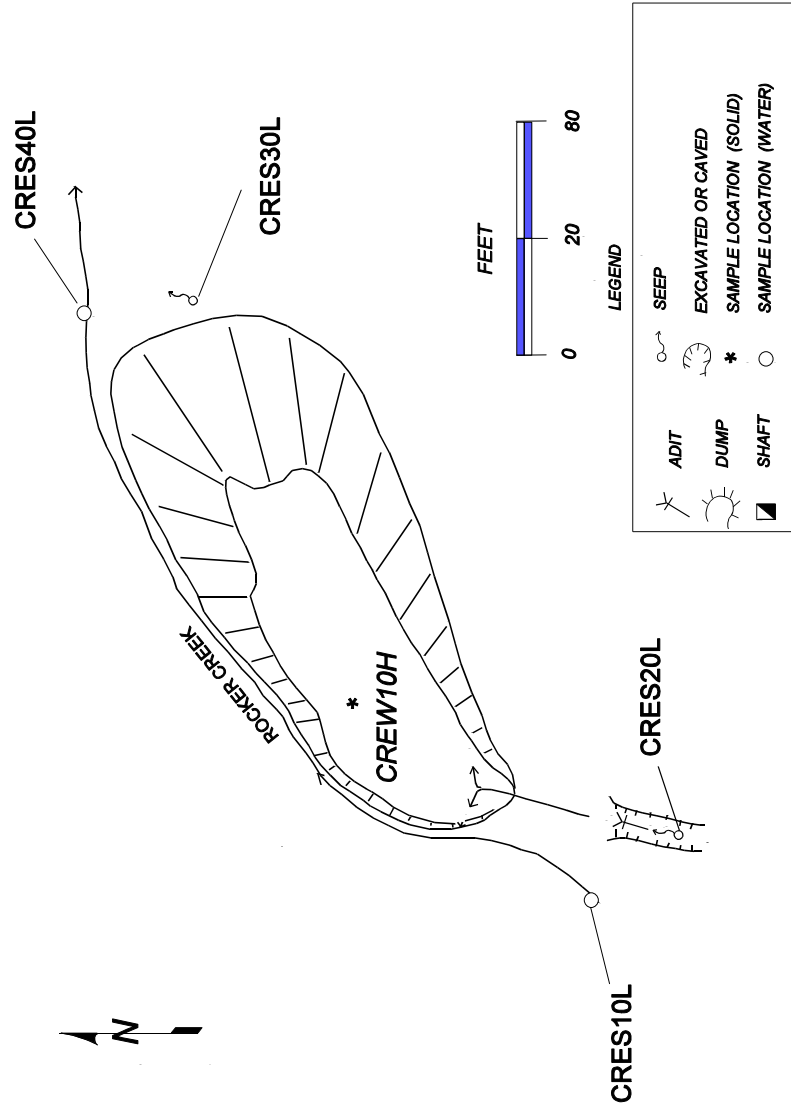


Figure 8 At the Rocker Extension mine, the adit discharge and the springs at the base of the waste-rock dump discharge directly to Rocker Creek.

2.11.3.2 Soil

No soil samples were collected at the Rocker Extension mine site.

2.11.3.3 Water

A comparison of water quality upstream and downstream of the disturbed area suggests little impact from the mine (Table 13). Although the concentrations of several metals exceeded MCLs, the concentrations changed very little from upstream to downstream. The adit discharge and the seep at the base of the waste-rock dump appeared to have little impact on Rocker Creek.

Table 13
Water Quality Exceedences
Rocker Extension Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Rocker Creek - upstream of site (CRES10L)	S,C					A,C	S	P,C	S										S
Adit discharge (CRES20L)							S		S				A,C						S
Seep at base of waste-rock dump (CRES30L)									S				A,C						S
Rocker Creek - downstream of site (CRES40L)	S,C					A,C	S		S				A,C						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.11.3.4 Vegetation

No obvious stress to vegetation was observed outside of the disturbed area at the Rocker Extension. The waste rock dumps were generally barren or only sparsely vegetated.

2.11.3.5 Summary of Environmental Condition

The relative impact of the Rocker Extension workings on Rocker Creek appeared to be limited to the disturbed area. The quality of Rocker Creek was somewhat poor and did not degrade appreciably as it flows past the site.

Soils showed minimal impact from erosion of waste material; vegetation outside the disturbed area showed little or no stress. Waste material in the floodplain appeared to be stable, but during a high-flow event, at least some material may be eroded by Rocker Creek.

2.11.4 Structures

An ore bin and elevated railway were the dominant structures on the Rocker Extension. Both structures were in poor condition.

2.11.5 Safety

The poor condition of the structures on the site may pose a safety concern. The dumps on this site were particularly steep and tall, and footing was poor.

2.12. GRAY LEAD MINE

2.12.1 Site Location and Access

The Gray Lead mine, on DNF administered land, is at the head of an unnamed drainage above Cataract Creek (T7N R5W 16BCAD). Access to the site is restricted to a little used jeep trail from the main Cataract Creek road approximately 1.5 miles below the site.

2.12.2 Site History - Geologic Features

The Gray Lead includes an open adit with a discharge and 800 feet of total workings that apparently cross cut to a low grade quartz-tourmaline-pyrite vein in quartz monzonite with quartz, sericite, and pyrite alteration products. Mining from 1928-1949 produced 2235 tons of ore which yielded only 135 oz Au, 775 oz Ag, 104 lbs Cu, 27,308 lbs Pb, and 31 lbs Zn (Roby and others, 1963). A gravity mill operated on the site and produced about 800 tons of tailings; a composite sampled assayed 0.022oz/ton Au, 0.97 oz/ton Ag, 0.035% Cu, 1.15% Pb, and 0.093% Zn. The dumps were mostly unaltered quartz monzonite, and even the altered monzonite that is present contains very low metal values.

2.12.3 Environmental Condition

The site consisted of a caved adit, with at least three associated waste-rock dumps, and a demolished mill with tailings. Seeps issued from the base of the lowest waste-rock dump that was cut by an old road. These seeps converged with a natural spring that originated on the site. More seeps originated at the downhill end of the tailings impoundment and flowed toward the natural spring.

2.12.3.1 Site Features - Sample Locations

Surface water and soil samples were collected on 7/30/92. Surface water samples were collected from the adit discharge (CGLS10L), the seeps at the base of the dump (CGLS20L) and from the spring downstream of the mine and mill (CGLS30L). The adit discharged water at about 3 gpm; the seeps at the base of the dump discharged less than 1 gpm; below the disturbed area, the natural spring discharged approximately 0.5 gpm.

A soil-composite sample (CGLD10H) of the area below the tailings was also collected. Site features and sample locations are presented in Figure 9.

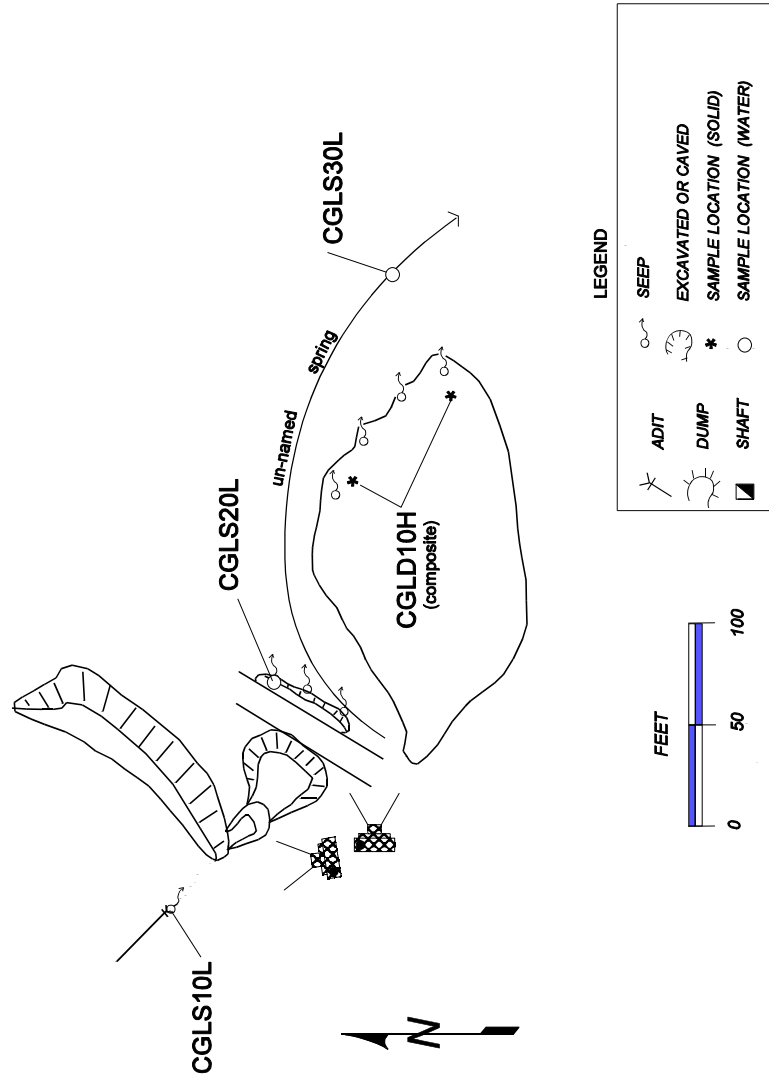


Figure 9 The Gray Lead mine adit discharges water. The greatest impact at this site, however, is the seeps and tailings wash down slope of the tailings impoundment.



Figure 9A. Tailings from the Gray Lead mill have been washed toward the small stream. Several seeps break at the lower end of the tailings.



Figure 9B. The mill has been partially dismantled or has collapsed (foreground). The waste-rock dumps and adit were near the cabin (background).

2.12.3.2 Soil

The analysis of the soil-composite sample collected near the base of the tailings indicates high concentrations of arsenic, lead, copper, and zinc (Table 14). Each of these constituents exceeded the phytotoxic limits.

Table 14
Soil Sampling Results
Gray Lead Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Wash area below tailings (CGLD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.12.3.3 Water

In many respects, the adit discharge was the least contaminated water on this site. Concentrations of arsenic, lead, and manganese were higher in the seeps than in the adit discharge and exceeded several MCLs (Table 15). Concentrations of arsenic, cadmium, and lead were especially high in the seeps. Arsenic exceeded the MCL in the sample collected downstream of the site. In general, water quality reflects the high concentration of metals in the waste material and contaminated soils on the site.

Table 15
Water Quality Exceedences
Gray Lead Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CGLS10L)				A,C				C					A,C						
Seep at base of dump(CGLS20L)				P,A C				P,C	S				A,C						
Unnamed stream downstream (CGLS30L)		P		C				P,C	S				A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.12.3.4 Vegetation

Vegetation was strongly impacted in the area below the tailings; several dead trees and barren soil were observed. The upper waste-rock dump was completely vegetated while the lower, smaller dump was barren of vegetation. The tailings pile was partially vegetated on its edges, but there was a large area in the center that was barren.

2.12.3.5 Summary of Environmental Condition

The adit discharge presents less of a problem on this site than the seeps originating in the waste material. The tailings probably contribute the greatest amount of metals to ground water and surface water. Soil samples and water samples both indicated high concentrations of metals.

2.12.4 Structures

A demolished mill with some equipment and a small cabin in good repair were observed on the site. The debris from the mill was observed to be scattered over a fairly large area.

2.12.5 Safety

The cabin was secured with locks to restrict entry. The unstable nature of the mill building and piled debris may pose a safety concern. Dead and dying trees near the tailings pile may also pose a concern during high wind or heavy snowfall.

2.13. UNNAMED #4 MINE

2.13.1 Site Location and Access

The Unnamed #4 mine (T7N R5W 16ACBD) was found during the investigation of the Gray Lead mine. The site is approximately 0.5 miles east of the Gray Lead mine and is accessible only by trail. The site is entirely on DNF administered land.

2.13.2 Site History - Geologic Features

No record of the site was found in existing database or literature. The site was not visited by the geologist and was not mapped.

2.13.3 Environmental Condition

The Unnamed #4 mine consisted of a single caved adit and a small dump. There were no other mine workings in the area, nor were there any active streams.

2.13.3.1 Site Features - Sample Locations

The site was sampled on 7/30/92. The single source of water at the site was a seep from the caved adit which was discharging at a rate of about 1 gpm. A surface water sample was collected at the adit (CUXS10L). The small dump appeared stable and no impact to soils was evident.

2.13.3.2 Soil

Since the dump was vegetated and no erosion was evident, no soil samples were collected.

2.13.3.3 Water

Although the adit discharge had a near-neutral pH, concentrations of cadmium and zinc exceeded MCLs for aquatic life criteria (Table 16). No drinking water MCLs were exceeded.

Table 16
Water Quality Exceedences
Unnamed #4 Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CUXS10L)				C									A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.13.3.4 Vegetation

The vegetation on the site showed little stress from either the discharge stream or material from the waste-rock dump. A portion of the dump and surrounding area appeared to be well vegetated.

2.13.3.5 Summary of Environmental Condition

The adit discharge exceeded only a few standards (aquatic life, only) and the site appeared to have little impact on the immediate area or the drainage in general. Waste material appeared to be stable and did not appear to have impacted the native soils.

2.13.4 Structures

No structures were observed on or near the site.

2.13.5 Safety

No safety concerns were identified for this site.

2.14. UNNAMED #2 MINE

2.14.1 Site Location and Access

The Unnamed #2 mine is about 500 feet north of the Unnamed #4 mine (T7N R5W 16ACBD) and is accessible only by trail. The site is approximately 0.5 miles from the upper Cataract Creek road on DNF administered land.

2.14.2 Site History - Geologic Features

There is a small caved adit which is probably less than 150 feet long on this site. The approximately 250 tons of dump material were composed of altered quartz monzonite with low metal values.

2.14.3 Environmental Condition

There was seepage from the small caved adit and from the base of the rock dump. An old road cut across the site between the adit and the dump. There was no other surface water in the area.

2.14.3.1 Site Features - Sample Locations

Surface water samples were collected on 7/30/92 from the adit seep (CUKS10L) which flows over the dump and infiltrates the ground, and from the seeps at the base of the dump (CUKS20L). The seep from the caved adit discharged about 1 gpm and the seep at the base of the dump discharged less than 0.5 gpm. Although ferric-hydroxide evident in both the adit and the dump seep, no soil contamination was evident below the dump. Site features and sample locations are shown in Figure 10.

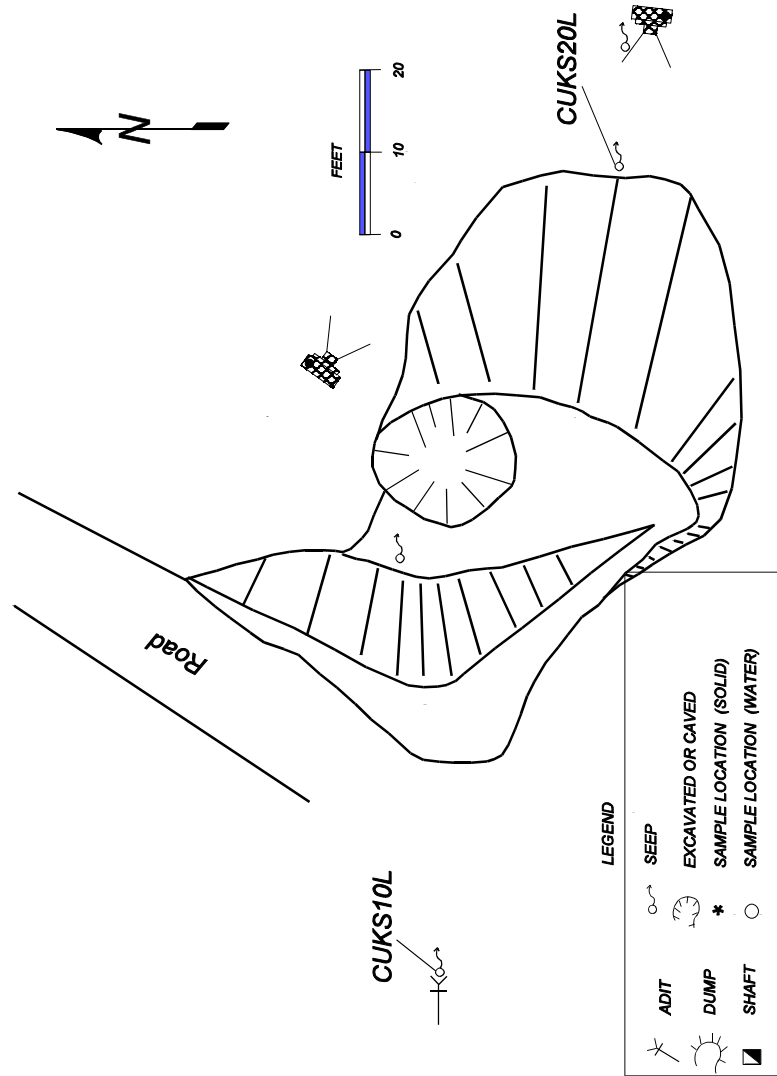


Figure 10 The Unnamed #2 mine discharges water from the caved adit and from the base of the waste-rock dump. Closed depressions in the dump may act as local recharge areas for the seeps.



Figure 10A. There were at least two seeps at the base of the waste-rock dump. Ferric-hydroxide staining was evident in the seep closest to the dump.



Figure 10B. The base of the waste-rock dump was generally well vegetated. Vegetation on the dump was sparse.

2.14.3.2 Soil

Since there was no evidence of soil contamination near the base of the dump or in the vicinity of the seeps, no samples were collected.

2.14.3.3 Water

Both water samples had manganese concentrations that exceeded the secondary drinking water criteria (Table 17), but the concentration of metals and arsenic in the water seeping from the waste-rock dump were generally higher. The near neutral pH of the waste rock seep, the ferric hydroxide, and the relatively high concentration of arsenic suggests that acidic water in the dump had been buffered.

Table 17
Water Quality Exceedences
Unnamed #2 Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CUKS10L)									S										
Seep at base of dump (CUKS20L)		P					S,A		S										

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.14.3.4 Vegetation

The base of the dump and the adit area were moderately vegetated. Numerous small deciduous trees were growing at the base and sides of the waste-rock dump. No stressed vegetation was observed outside of the disturbed area.

2.14.3.5 Summary of Environmental Condition

The waste-rock dump is evidently the source for several dissolved metals and arsenic in surface water and probably, ground water. The water within the dump is likely to be acidic and is

then buffered as it seeps from the base. The volume of acidic water was probably small, however there were numerous young trees growing next to the dump and the vegetation in the area appeared to be unaffected.

2.14.4 Structures

An elevated tramway extended from the collapsed adit to the waste-rock dump. Portions of the railway support had collapsed.

2.14.5 Safety

The elevated tramway may pose a threat to safety. No openings or buildings were observed on the site.

2.15. UNNAMED #1 MINE

2.15.1 Site Location and Access

The Unnamed #1 mine is on DNF administered land adjacent to the upper Cataract Creek (T7N R5W 15CBDB). The site is accessible by off-road vehicles from the main Cataract Creek road by crossing the creek.

2.15.2 Site History - Geologic Features

A short (less than 500 feet) caved adit trends N85W in unaltered and altered quartz monzonite. The dump contained about 500 tons of host rock with quartz, sericite, and pyrite alteration products. The pyrite was abundant (> 10%) but coarse grained. A composite sample of the mineralized dump material assayed 0.03 oz/ton Au, 1.25 oz/ton Ag, and only a fraction of a percent of base metals.

2.15.3 Environmental Condition

The site consisted of a caved adit and an associated waste-rock dump. A small seep emanated from the base of the dump and ferric-hydroxide precipitate was evident. A second, small stream ran along the south side of the disturbed area and flowed into Cataract Creek.

2.15.3.1 Site Features - Sample Locations

Surface water samples were collected on 7/27/92 from the seep at the base of the dump (CU1S10H) and upstream of the site on the unnamed stream (CU1S20L). Samples were collected on Cataract Creek, upstream (CU1S40L) and downstream (CU1S30L) of the disturbed area. The dump was partially vegetated; several small trees were growing on the crown of the dump. There was no evidence of soil contamination downhill of the dump or near the stream. The remarkable feature on this site is the abundance of coarse-grained pyrite on the dump. Site features and sample locations are shown in Figure 11.

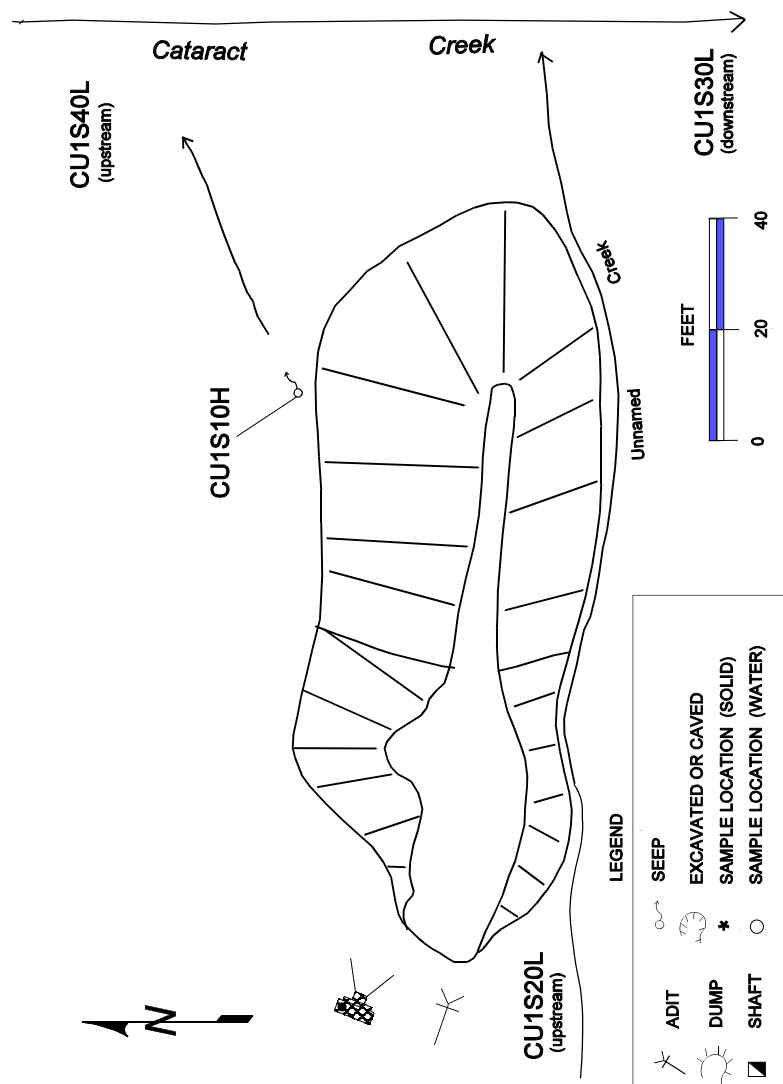


Figure 11 The waste-rock dump of the Unnamed #1 mine contained large amounts of pyrite. Despite this, there was little evidence of acid mine drainage or impact to soils.



Figure 11A. Despite the large percentage of pyrite, the waste-rock dump of the Unnamed #1 mine was well vegetated. Several small trees were growing on the crown of the dump.

2.15.3.2 Soil

The disturbed area and the area below were stable and showed no indication of soil contamination. No soil samples were collected.

2.15.3.3 Water

Only the seep at the base of the waste-rock dump exceeded the MCL for aluminum (Table 18), and only by a small amount. In fact, the concentration of aluminum in this sample was just above the detection limit. The pH of all the waters was above neutral and the sulfate concentration was very low; there was no evidence of acid being generated and buffered.

Table 18
Water Quality Exceedences
Unnamed #1 Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Unnamed stream - upstream of development area (CU1S10H)																			
Seep at base of dump (CU1S20L)	A																		
Cataract Creek - upstream (CU1S40L)																			
Cataract Creek - downstream of site (CU1S30L)																			

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.15.3.4 Vegetation

The vegetation outside of the disturbed area showed no stress due to the waste material or seep. The dump was partially vegetated with grasses and small trees; the adit was almost overgrown.

2.15.3.5 Summary of Environmental Condition

Despite the abundance of pyrite on the waste-rock dump, the water on and near this site was of very good quality. The site was generally well vegetated and there was no evidence of impact to the surrounding area.

2.15.4 Structures

No structures or remnants of structures were observed on the site.

2.15.5 Safety

The slope of the waste-rock dump was steep and footing was poor in some areas. No other features presented safety concerns on this site.

2.16. BLUE DIAMOND - OCCIDENTAL MINES

2.16.1 Site Location and Access

The Blue Diamond and Occidental mines (T7N R5W 14ADDD), on Hoodoo Creek, are at the south end of the Occidental Plateau near the Cataract Creek - Boulder River drainage divide. Access to the site can be gained by the road that follows the nearby power line. The entire area is on DNF administered land.

2.16.2 Site History - Geologic Features

No information existed in the literature for this area. The site is on the western extension of the Bluebird-Pen Yan vein system and consisted of two caved adits on Hoodoo Creek, each about 500 feet long, and numerous short adits and prospect pits. The workings explored two parallel west-trending veins 1000 feet apart. The host rock is Elkhorn Mountain tuff which locally contains quartz, sericite, and pyrite alteration products. A chip sample across 3 feet of brecciated quartz and gossan on the west end of the north vein ran only 0.014 oz/ton Au and 0.83 oz/ton Ag.

The dump associated with the Occidental adit contained 600 tons of altered tuffs with very low metal values, and 300 tons of unaltered volcanic rock. The Blue Diamond dump contained 1000 tons of altered tuff; a composite sample assayed 0.042 oz/ton Au, 1.14 oz/ton Ag, 0.119% Cu, 0.760% Pb, and 0.056% Zn.

2.16.3 Environmental Condition

There were three caved adits on the site; two were discharging water to Hoodoo Creek. A small seep emanated from the bottom of the waste-rock dump associated with the Blue Diamond adit.

2.16.3.1 Site Features - Sample Locations

Samples were collected on 7/29/92. Surface-water samples were collected from the Blue Diamond adit (CBDS20L) (Figure 12), from the Occidental adit (CBDS10L) (Figure 13), and from Hoodoo Creek downstream of the disturbed area (CBDS30L) (Figure 12). The dumps appeared stable and there was no evidence of erosion. The Blue Diamond adit was discharging at a rate of about 2 gpm, the Occidental adit was discharging at a rate of about 7 gpm, and Hoodoo Creek downstream of the site was discharging at a rate of about 9 gpm.

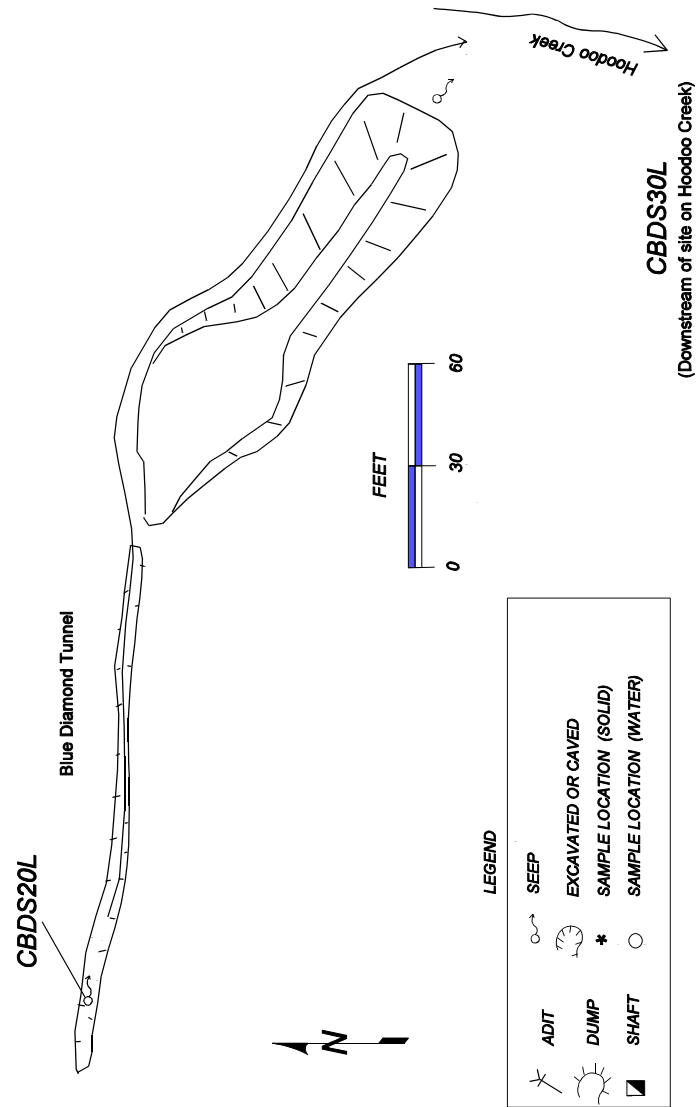


Figure 12 Discharge from the Blue Diamond tunnel reaches Hoodoo Creek, a tributary of Cataract Creek. The Occidental workings are up slope.

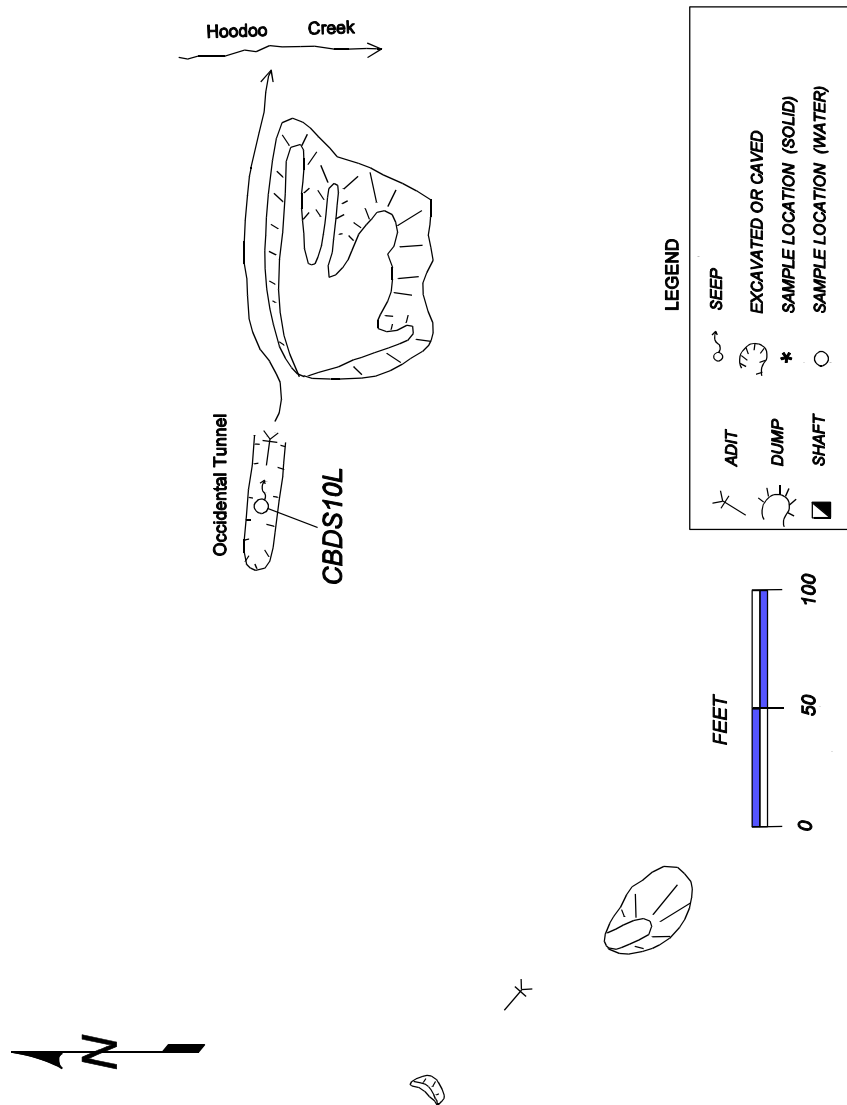


Figure 13 The Occidental tunnel discharges to Hoodoo Creek. The Blue Diamond tunnel (Figure 12) is downstream.

2.16.3.2 Soil

No material had been eroded from the dumps and there was no evidence of impact to soils below the dumps. No soil samples were collected.

2.16.3.3 Water

The concentration of aluminum exceeded the secondary drinking water standard in the sample collected from Hoodoo Creek below the disturbed area (Table 19). The pH of the Blue Diamond adit discharge was slightly acidic (6.55), but sulfate and iron concentrations were very low which suggest that there is little or no acid generation/buffering at this site.

Table 19
Water Quality Exceedences
Blue Diamond - Occidental Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Occidental adit discharge (CBDS10L)																			
Blue Diamond adit discharge (CBDS20L)																			
Hoodoo Creek - downstream of site (CBDS30L)	S																		

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.16.3.4 Vegetation

There was no obvious impact to vegetation from mining related activities. The vegetation at the base of the dumps appeared healthy and was similar to surrounding areas. Vegetation on the dumps was generally sparse or barren.

2.16.3.5 Summary of Environmental Condition

The quality of water in the adit discharges and in Hoodoo Creek was very good. The concentration of aluminum in the Blue Diamond adit discharge exceeded the secondary drinking water standard, but only by a small amount. The waste-rock dumps appeared to be stable and there was no evidence of impact to native soils outside the disturbed areas.

2.16.4 Structures

No structures or remnants of structures were present on the site.

2.16.5 Safety

The waste-rock dumps were steep in some areas and footing was loose in most areas on the side of dumps.

2.17. BLACK BEAR MINE

2.17.1 Site Location and Access

The Black Bear mine (T7N R5W 21BBBC) is near the head of an unnamed tributary of Cataract Creek approximately 1.25 miles from the main Cataract Creek road. Access to the site is restricted to a jeep trail from the main road. The main workings of the mine are on private land; part of the waste-rock dump and the area downhill is on DNF administered land.

2.17.2 Site History - Geologic Features

The main dump is composed of 3000 tons of quartz monzonite with abundant pyrite from alteration. A composite sample of the dump assayed 0.050 oz/ton Au, 2.07 oz ton Ag, 0.032% Cu, 0.175% Pb, and 0.176% Zn. The sample results indicate a higher grade than what was actually produced.

The mine is located on the Crystal shear zone between the Crystal mine and the Eva May mine. It was worked in 1902, 1911, and 1917 with 504 tons of production yielding 64 oz Au, 557 oz Ag, 6720 lbs Cu, 97 lbs Pb, and no Zn (Roby and others, 1960), so it was not a particularly rich mine. Vein minerals were quartz, pyrite, chalcopyrite, galena, and sphalerite.

2.17.3 Environmental Condition

There was a shaft and two caved adits on the site. There was discharge from both adits, but they infiltrated the ground on private land several hundred feet above the stream. Erosion of waste material from the main dump associated with the shaft, had impacted vegetation and soils for several hundred feet downhill.

2.17.3.1 Site Features - Sample Locations

Sampling at this site, which was conducted on 7/30/92, focused on the impacts to DNF administered land; no samples were collected on private land. A surface-water sample was collected upstream of the disturbed area (CBBS10L) and downstream of the disturbed area below the area where waste material has been washed into the stream (CBBS20M). A composite sample of soil (10-foot centers) was collected across the area where waste material has been washed down from the main dump associated with the shaft (CBBD10H). The main workings (shaft) and sample locations are shown in Figure 14. The stream discharge was about 17 gpm above the site and about 19 gpm below the site.

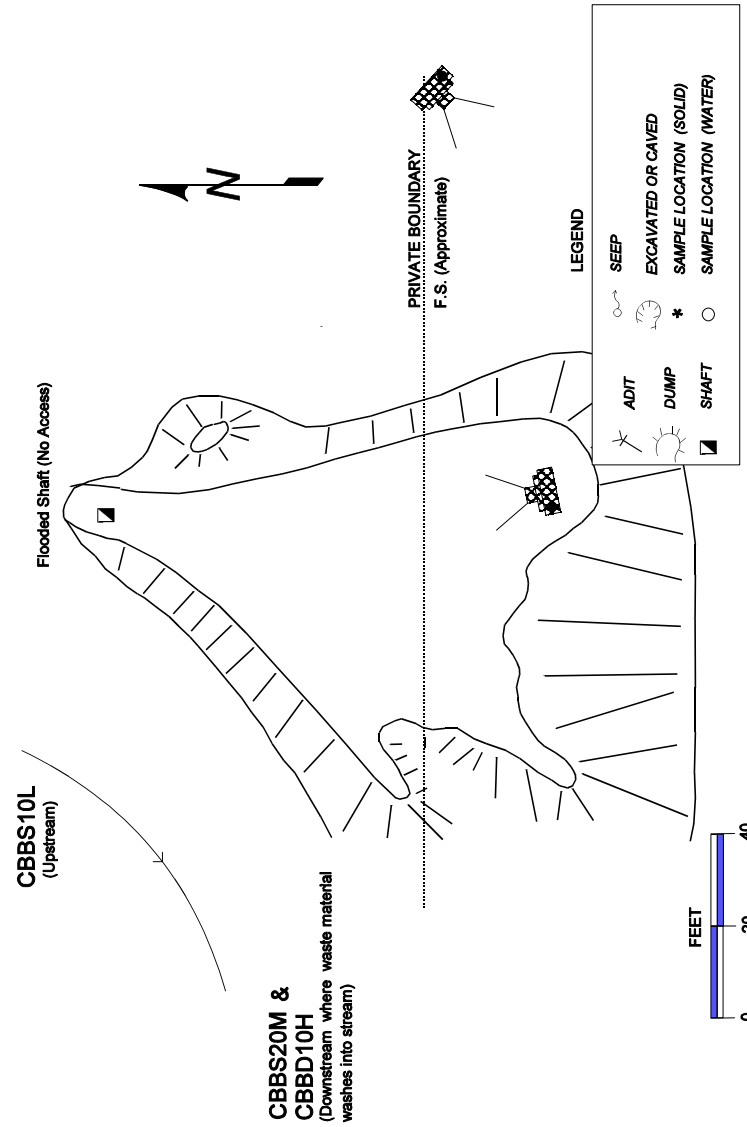


Figure 14 Waste material from the dump of the Black Bear shaft has contaminated soils down slope to the unnamed stream. The shaft and most of the waste-rock dump is on private land while part of the dump and the soil wash area are on DNF administered land.



Figure 14A. The main development area of the Black Bear mine consisted of a shaft on private land and a large waste-rock dump on private and DNF land.



Figure 14B. Fined-grained material from the waste-rock dump has been washed several hundred feet downhill toward a small stream. The area was generally devoid of vegetation.

2.17.3.2 Soil

The concentrations of metals and arsenic in the soil near the stream were quite high (Table 20). Arsenic, lead, and zinc exceeded phytotoxic limits. The area from which the sample was collected was only a few feet from the stream. In fact, sediments from this area were observed in the stream bed.

Table 20
Soil Sampling Results
Black Bear Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Soil wash area below shaft dump (CBBD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.17.3.3 Water

The impact of soils being washed into the stream is reflected in the concentrations of metals in the sample collected downstream of the disturbed area (Table 21). Although the concentration of arsenic did not quite exceed MCLs, it probably does exceed the MCL during low-flow conditions or, possibly during runoff events when sediment is moved. Cadmium, copper, and zinc exceeded the MCLs for several criteria. Iron and manganese concentrations were higher in the downstream sample.

Table 21
Water Quality Exceedences
Black Bear Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Unnamed stream above site (CBBS10L)																			
Unnamed stream below site (CBBS20M)				P,A C		A,C							A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.17.3.4 Vegetation

The main dump and the area below the main dump was barren of vegetation from its base to the stream. Vegetation near the stream appeared stressed where waste material had been washed down.

2.17.3.5 Summary of Environmental Condition

There was no direct evidence of ground-water contamination at this site. The waste material that had been washed down from the dump has had a strong impact on soils and vegetation as well as the quality of water in the nearby stream. Metals loading in the stream is probably quite high during storm events or run-off events.

2.17.4 Structures

No structures were observed on DNF administered land. A gallows frame over the shaft and a small dilapidated cabin nearby were observed on private land.

2.17.5 Safety

Since all of the structures were on private land, no direct observations were made regarding safety. However, the shaft did not appear to be adequately covered nor was access restricted.

2.18. UNNAMED #3 MINE

2.18.1 Site Location and Access

The Unnamed #3 mine was found during the investigation of the Black Bear mine. The mine is approximately 0.25 miles east and downhill of the Black Bear near the head of a separate drainage (T7N R5W 21BBDC). Access to the site is the same jeep trail from the main Cataract Creek road that leads to the Black Bear mine. The site is entirely on DNF administered land.

2.18.2 Site History - Geologic Features

This site was not visited by the geologist; no record of the site was found in existing databases or the literature.

2.18.3 Environmental Condition

Three flooded shafts, two caved adits, and numerous cat-cuts were found in an area of about 0.25 square miles. Several of the cat-cuts indicated that water had flowed in the past; several had deposits of ferric-hydroxide in the dry discharge channel.

2.18.3.1 Site Features - Sample Locations

Surface water samples were collected on 7/30/92 at the two points where flowing water was encountered. These included the seep below a flooded shaft in the main disturbed area (CU3S20M) and a seep emanating from a cat-cut or caved adit several hundred feet above the main disturbed area (CU3S10M). Both seeps discharged less than 1 gpm. There were no active streams in the area.

Waste-rock dumps showed little mineralization; pyrite represented only a small fraction. There appeared to be no impact to soils outside of disturbed areas.

2.18.3.2 Soil

The waste-rock dumps appeared stable and no soil-wash areas were found. No soil samples were collected.

2.18.3.3 Water

Water collected from the cat-cut exceeded several MCLs as did water from the shaft seepage (Table 22). The water from the two sample sites does not appear to be the same type, owing to the diverse mineralogy in the area.

Table 22
Water Quality Exceedences
Unnamed #3 Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Seeps from cat-cut (CU3S10M)		P											A,C						S
Seep from shaft (CU3S20M)	S,C								S										S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.18.3.4 Vegetation

Many of the features in the area were all but obscured by vegetation. Many of the dumps were well vegetated and no stressed vegetation was observed in or near the seeps.

2.18.3.5 Summary of Environmental Condition

Although several MCLs were exceeded in both water samples, there were no active streams in the area. If ground water is contaminated, there appears to be no immediate discharge point. The potential impact to soils is minimal.

2.18.4 Structures

A small cabin with a boiler was observed next to the flooded shaft in the main disturbed area. No other structures were seen in the area.

2.18.5 Safety

The primary concern for safety in this area is the flooded shafts which were open. Vegetation was so thick in the area that the shafts were obscured and posed a serious threat to safety.

2.19. CATARACT MINE AND TAILINGS

2.19.1 Site Location and Access

The Cataract mine is a large mine on private land for which there is no information in the existing literature. The tailing impoundment is in a small area between the main road and Cataract Creek and is easily accessible. A gravity mill apparently operated on the site as there were about 1000 tons of tailings in the Cataract Creek floodplain (T7N R5W 21DCCA) on private land and DNF administered land.

2.19.2 Site History - Geologic Features

At the mine, two caved shafts and three caved adits explored at least three due west trending veins that apparently lie in the eastern continuation of the Sirius shear zone. The veins contain the typical Boulder batholith assemblage of quartz, siderite, pyrite, and chalcopyrite, and the quartz monzonite wallrock is altered to quartz, sericite, and pyrite. A select sample of the vein ran 0.035 oz/ton Au, 8.86 oz/ton Ag, 0.150% Cu, 0.039% Pb, and 0.070% Zn, so unlike the Sirius on the same vein system, the Cataract was probably operated for its silver value.

A composite sample of the tailings assayed 0.053 oz/ton Au, 2.37 oz/ton Ag, 0.084% Cu, 0.51% Pb, and 0.150% Zn.

2.19.3 Environmental Condition

Since the mine and part of the tailings were on private land, sampling focused on the impact of the tailings on Cataract Creek and DNF administered land. The tailings covered a large area in the floodplain immediately adjacent to Cataract Creek. A portion of the stream bank was comprised of tailings and soil; tailings were also observed in the stream bottom downstream of the area.

2.19.3.1 Site Features - Sample Locations

The site was sampled on 7/22/92. Surface water samples were collected from Cataract Creek upstream (CCAS10L) and downstream (CCAS20L) below the tailings/soil wash area on DNF administered land. Cataract Creek was discharging 5140 gpm upstream and 4800 gpm downstream of the tailings site.

A composite soil sample (10-foot centers) was collected in the area where tailings and soils had mixed and had been washed into Cataract Creek (CCAD10H). Sample locations and site features are presented in Figure 15.

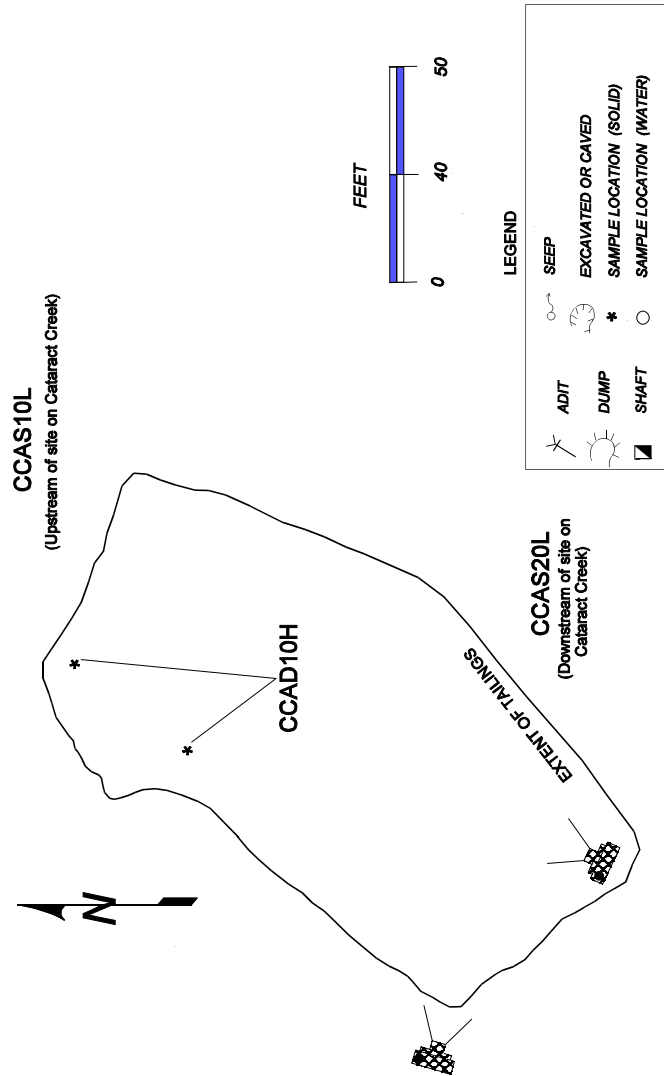


Figure 15 The Cataract mill produced approximately 1000 tons of tailings that are now adjacent to Cataract Creek. Erosion and animal traffic enhance the movement of the material into the creek.



Figure 15A. The vegetation cover on the Cataract Creek tailings ranges from sparse to none. Cataract Creek is to the left of the photograph.



Figure 15B. Tailings and soil have been washed into Cataract Creek. Cattle are common in the area and have trampled the stream banks.

2.19.3.2 Soil

Concentrations of arsenic, copper, lead, and zinc exceeded phytotoxic limits (Table 23). The soil samples were composited in an area where tailings and native soils had been mixed. The area where soil and tailings have been washed into Cataract Creek appeared to have a much higher fraction of tailings. The area had also been frequented by cattle that water at the stream.

Table 23
Soil Sampling Results
Cataract Tailings
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Tailings-soils wash area (CCAD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.19.3.3 Water

The upstream sample only exceeded MCLs for cadmium (Table 24); cadmium was not detected in the downstream sample, nor did any constituent exceed MCLs. Both upstream and downstream samples had similar concentrations of cations and anions.

Table 24
Water Quality Exceedences
Cataract Tailings

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cataract Creek - upstream of site (CCAS10L)				P,A C															
Cataract Creek - downstream of site (CCAS20L)																			

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.19.3.4 Vegetation

The area of tailings and soil/tailings mix was almost devoid of vegetation; areas of “clean” tailings was barren. This was especially evident in a small area where tailings and soil had been washed into Cataract Creek.

2.19.3.5 Summary of Environmental Condition

The relative amount of contaminated soil and tailings compared to the volume of water flowing in Cataract Creek must have been small enough to negate the metals-loading. Under other conditions such as during snow melt and storm events, the impact to Cataract Creek from the tailings is likely to be much higher. Under extreme conditions when flooding might occur, large amounts of tailings could be washed into the stream.

2.19.4 Structures

No structures were observed on DNF administered land or in the general area of the tailings.

2.19.5 Safety

No safety concerns were identified in the tailings area on DNF administered land.

2.20. BOULDER CHIEF MINE

2.20.1 Site Location and Access

The Boulder Chief mine is easily accessible by a road that follows the nearby power line. The site is approximately 1 mile east of Cataract Creek near the head of an unnamed tributary. The entire site was on DNF administered land.

2.20.2 Site History - Geologic Features

The Boulder Chief mine and the Ida M mine (next section) are within 1000 feet of each other on the same shear zone. This shear zone trends N82W 79NE and appears to be continuous for at least 1500 feet. Workings consist of the main adit with one locked adit and one caved 350 foot shaft with four levels (unpublished information, MBMG files) and approximately 4000 feet of workings, and a large surface cut along the shear zone. The property is located at the contact between Elkhorn Mountain andesite and Boulder Batholith quartz monzonite. Most of the material on the dumps is quartz monzonite with quartz, sericite, and pyrite alteration products. Becraft and others (1963) and Roby and others (1960) provide some background information. Apparently lead, silver, and copper were the main commodities, with most production from 1913-1917. The remaining badly eroded gravity tailings from the Boulder Chief mill suggest one to two thousand tons of ore was mined. The vein contained the typical Boulder Batholith assemblage of quartz, pyrite, galena, sphalerite, and arsenopyrite. Weak radioactivity was measured on the east end of the vein by Becraft and others (1963), who estimated that it contained .01% uranium. Our own scintillometer measurements showed that the dump material was only slightly anomalous.

A composite sample of the estimated 7000 tons of dump material assayed 0.042 oz/ton Au, 1.52 oz/ton Ag, 0.025% Cu, 0.97% Pb, and 0.22% Zn. A composite sample of the 1000-2000 tons of tailings assayed 0.018 oz/ton Au, 4.34 oz/ton Ag, 0.055% Cu, 2.32% Pb, and 3.87% Zn.

2.20.3 Environmental Condition

The site consisted of large, open cuts and trenches, a caved adit, a waste-rock dump, and a dismantled mill. Tailings and dump material have been carried more than 700 feet down slope by gravity and runoff. Several springs were breaking out at the downhill end of the waste material wash area.

2.20.3.1 Site Features - Sample Locations

The open pits and cuts at the top of the hill were generally dry, although there was evidence of ponding in several low areas. The impact to soil and vegetation appeared minimal outside the disturbed area. The main development area and mill area was dry except for the adit which was discharging about 0.1 gpm and infiltrating the waste-rock dump below. The site was sampled on 7/29/92. Surface water samples were collected from the adit discharge (CBCS10H) and from the confluence of several springs at the bottom of the tailings/waste rock wash area (CBCS20H).

A composite soil sample (CBCD10H) was collected in the seep area as well. This sample was collected at an interval of 1 to 1.5 feet below the surface in native soil. Site features and sample locations are shown in Figure 16.

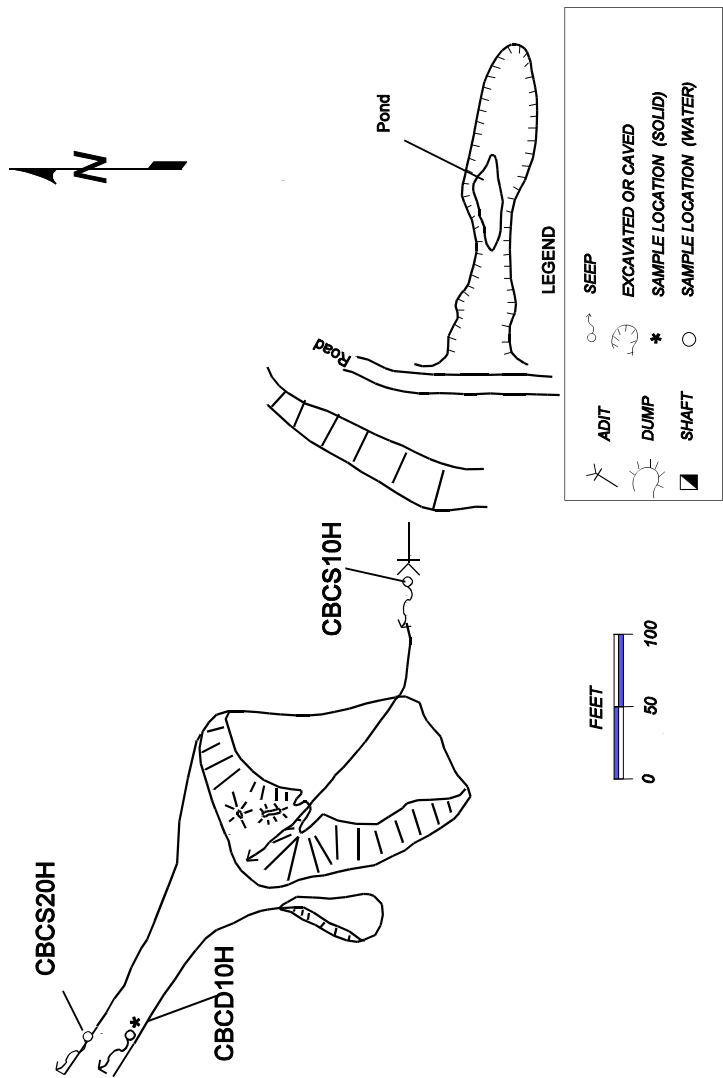


Figure 16 The adit discharge and the large tailings pile have significantly impacted vegetation down slope of the development area. In some areas, mass wasting may be possible as the hillside is quite steep.

2.20.3.2 Soil

Considering the lack of vegetation, the concentrations of metals in the soil samples was surprisingly low. Only arsenic exceeded the phytotoxic limits (Table 25). The slope of the hill was steep and recent, small-scale, movement of material down the hill was evident in several areas.

Table 25
Soil Sampling Results
Boulder Chief Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Tailings wash area (CBCD10H)	794 ^{1,2}	1.3 ¹	49.2 ¹	504 ¹	86.6

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.20.3.3 Water

The concentrations of dissolved metals in the spring samples were quite different than what might be expected given the soil analysis. Several criteria were exceeded for several constituents (Table 26). It is apparent from the adit discharge sample that acid is being produced in the underground workings. Moreover, since the springs probably represent the ground water discharging from the site, the contamination plume could be quite extensive. There was no other surface water for at least 1000 feet downhill from the site.

Table 26
Water Quality Exceedences
Boulder Chief Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CBCS10H)	S,A C			P,A C		S,A C	S,A	P,C	S			C	S,A C						S
Seeps at base of tailings wash area (CBCS20H)				P		A,C		P,C					A,C						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.20.3.4 Vegetation

The entire disturbed area was almost devoid of vegetation. The area below the adit and mill was particularly stressed; it was apparent from the condition of the trees that the impact of the tailings and waste material had progressed down the hill.

2.20.3.5 Summary of Environmental Condition

The disturbed area, the adit discharge stream, and the springs were well above any active streams. While there was strong evidence of a contaminated ground-water plume, its extent could not be determined.

The soils and tailings had migrated several hundred feet down slope and will likely continue to move.

2.20.4 Structures

There was a large ore bin and a dilapidated mill near the adit. No other structures were observed on the site.

2.20.5 Safety

The ore bin and dilapidated mill may pose a safety risk for visitors on the site. Unstable slopes in the uphill pit area and dead trees in the downhill area may also be a concern.

2.21 IDA M MINE

2.21.1 Site Location and Access

The Ida M mine (T7N R5W 27ACCC) is approximately 1000 feet downhill of the Boulder Chief mine a short distance from the power line road. The area between the adit and the waste-rock dump is easily accessible by vehicle. The entire site is on DNF administered land.

2.21.2 Site History - Geologic Features

The Ida M mine is on the same shear zone as the Boulder Chief mine. The mine consists of a single adit with about 800 feet of workings. A more complete description of the geologic features is given in the previous section.

2.21.3 Environmental Condition

The site consisted of a single, blocked adit that was discharging water. The adit discharge infiltrated the nearby waste-rock dump; there were indications that the adit-flow extended well below the dump during wetter conditions. There were several small seeps emanating from the base of the dump to form a small wetlands area downhill. There were no obvious impacts to soil or vegetation outside the disturbed area or below the dump.

2.21.3.1 Site Features - Sample Locations

Surface water samples were collected on 7/29/92 from the adit discharge (CIMS20H) and from the seeps at the base of the waste-rock dump (CIMS10H) (Figure 17). The adit was discharging approximately 2 gpm and the seeps were discharging less than 0.1 gpm. The waste-rock dump had been re-worked, but was stable with coarse material (cobbles) at the base.

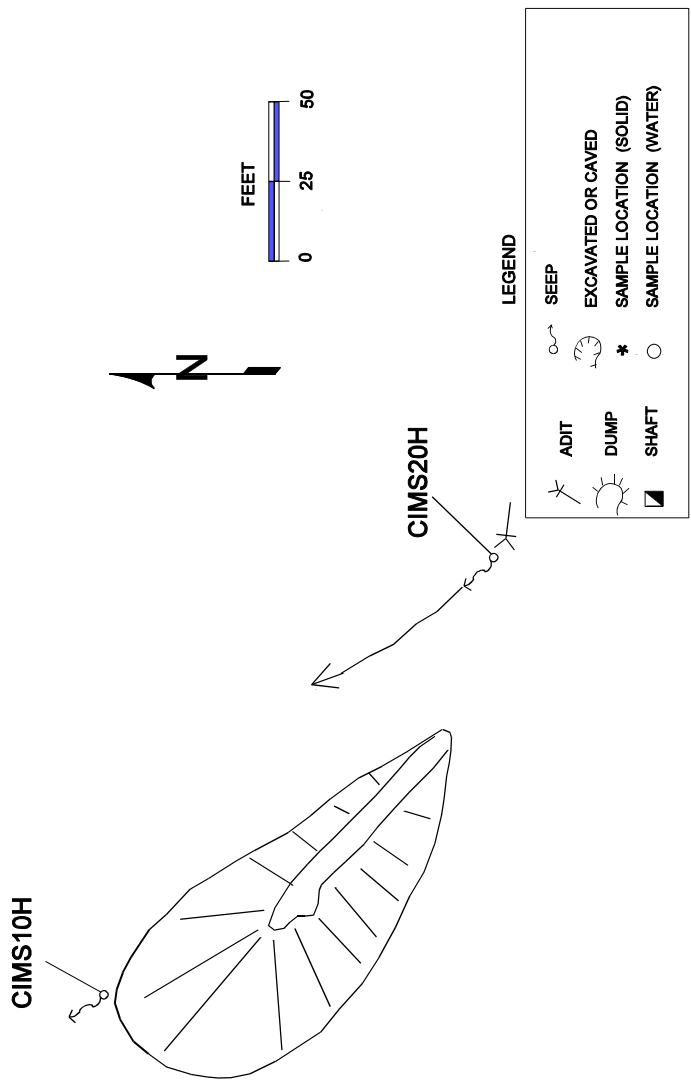


Figure 17 The discharge stream from the adit and the seeps at the base of the waste-rock dump merge in a wetlands area down slope of the development area. Impacts to soils are restricted to the disturbed areas.

2.21.3.2 Soil

The base of the dumps were mainly cobbles and boulders; no erosion or movement of waste material was evident. No soil samples were collected.

2.21.3.3 Water

The adit discharge was only slightly acidic (pH = 5.43), but the seeps at the base of the dumps were very acidic (pH = 2.98). Both waters contained high concentrations of sulfate, aluminum, cadmium, lead, and zinc. These metals and several others exceeded drinking water and aquatic life MCLs (Table 27).

Table 27
Water Quality Exceedences
Ida M Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Seeps at base of dump (CIMS10H)	S,A C			P,A C		A,C	S,A	P,A C	S				S,A C						S
Adit discharge (CIMS20H)	S,A C			P,A C		A,C	S	P	S				S,A C						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.21.3.4 Vegetation

Despite the low pH and the high concentrations of metals in the springs, the base of the dump and the wetlands area below the dump appeared to be well vegetated. On the dump however, vegetation was sparse to barren.

2.21.3.5 Summary of Environmental Condition

The Ida M mine is in a setting similar to the nearby Boulder Chief. The wetlands area below the Ida M was not extensive and the nearest active stream was about 1000 feet or more downhill. Despite the poor quality of the adit discharge and the springs at the base of the dump, the areas outside the development area show little impact.

2.21.4 Structures

No structures were observed on the site.

2.21.5 Safety

The caved adit had been blocked by waste material. Although there was no evidence to confirm it, there is a possibility of at least some hydraulic head behind the blockage and may pose a concern given the likelihood of failure. The waste-rock dump was steep and footing was poor in some areas; no other safety concerns were apparent on the site.

2.22 HATTIE FERGUSON MINE

2.22.1 Site Location and Access

There are two areas of past activity at the Hattie Ferguson mine: the lower Hattie Ferguson (T7N R5W 28BCDB) which is adjacent to the main Cataract Creek road and the upper Hattie Ferguson (T7N R5W 29ADAC) which is easily accessible by road up an unnamed tributary to Cataract Creek approximately 0.5 miles west and uphill. The lower Hattie Ferguson is on DNF administered land and the upper Hattie Ferguson is on both private and DNF administered land.

2.22.2 Site History - Geologic Features

Two areas of workings comprise the Hattie Ferguson, which is on the south end of the mineralized area centered at the Sirius. The mine was originally worked through a 140 foot shaft (Pardee and Schrader, 1933), an inclined shaft, and several short adits on the Upper Hattie Ferguson property. The workings explored a N75W steeply dipping vein of quartz, pyrite, galena, sphalerite, chalcopryite, and abundant carbonate minerals (Becraft and others, 1963). A select vein sample from the upper Hattie Ferguson area was quite rich, assaying 0.392 oz/ton Au, 15.32 oz/ton Ag, 0.20% Cu, 7.15% Pb, 1.60% Zn.

An 1800 foot crosscut (unpublished maps, MBMG files; Becraft and others, 1963) was later driven to the vein from Cataract Creek (the lower Hattie Ferguson). Vein material on the dump indicates that the crosscut reached the vein and drifted along it. Roby and others (1960) credited the Hattie Ferguson with producing 1516 ton of ore from which 313 oz Au, 27,982 oz Ag, 38,333 lbs Cu, 311,717 lbs Pb, and 33,802 lbs zinc were recovered. About half of the lower Hattie Ferguson dump material has been removed possibly for road construction; 2000 tons composed mainly of unaltered quartz monzonite remain. A composite sample of a few hundred tons of wallrock with quartz, pyrite, and sericite alteration products assayed 0.042 oz/ton Au, 1.52 oz/ton Ag, and less than 1% base metals. Radiation on the dump is 2 to 3 times background.

2.22.3 Environmental Condition

The lower Hattie Ferguson consisted of a caved adit from which a small discharge emanated and an associated waste-rock dump. Field parameters indicated a near-neutral pH and a high SC, but ferric-hydroxide was abundant. The discharge did not reach Cataract Creek and no evidence was found to indicate any ground-water discharge areas. The main waste-rock dump was on and below the main Cataract Creek road. Impact to soil was not evident; the base of the dump had been covered by 6 to 18-inches of soil and plant material.

The main development area of the upper Hattie Ferguson was caved and on private land (not mapped). East of the main development area there were four caved adits and a caved shaft; two of the four caved adits were discharging water to a small stream running through the site. Small seeps were emanating from the base of a waste-rock dump and also discharging into the stream.

2.22.3.1 Site Features - Sample Locations

At the lower Hattie Ferguson mine (Figure 18), a surface water sample was collected of the adit discharge (CHFS10H) which was flowing at less than 1 gpm. A sample was also collected from Cataract Creek below the adit (CHFS20L-A). No soil samples were warranted. The samples were collected on 7/23/92.

At the upper Hattie Ferguson mine (Figure 19), samples were collected from each of the two adit discharges (CHFS20M and CHFS40M) which flowed at about 0.5 gpm and 3 gpm, respectively. Additional samples were collected from a point upstream of the disturbed area (CHFS30L), from a point downstream of the upper discharging adit (CHFS60M), from a point just upstream of the DNF administered /private land boundary (CHFS50M), and downstream of the entire disturbed area on DNF administered land (CHFS70L). From upstream to downstream, the stream discharge at the sample points was 8 gpm, 8 gpm, 12 gpm, and 50 gpm.

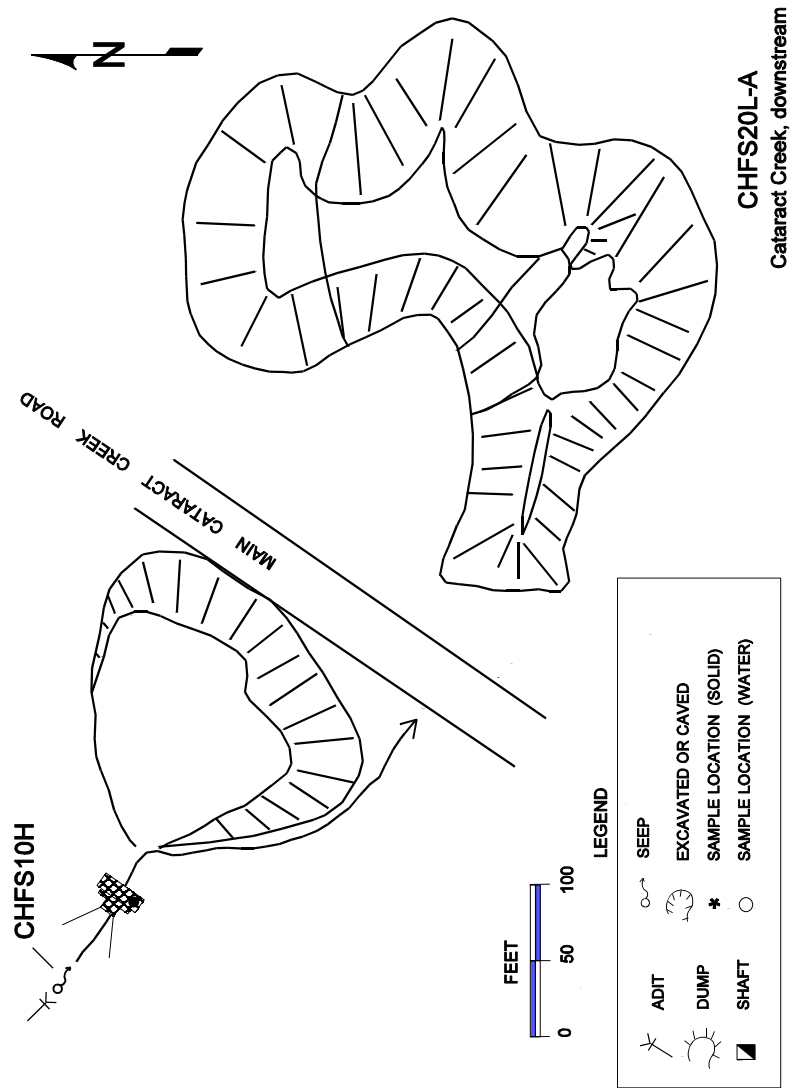


Figure 18 The caved adit of the lower Hattie Ferguson mine discharges a small amount of water. The discharge stream exhibited typical buffered-AMD characteristics: ferric-hydroxide flocculate, high specific conductivity, and filamentous algae.



Figure 18A. The collapsed adit of the lower Hattie Ferguson mine was discharging a small amount of water. The discharge did not extend across the road.

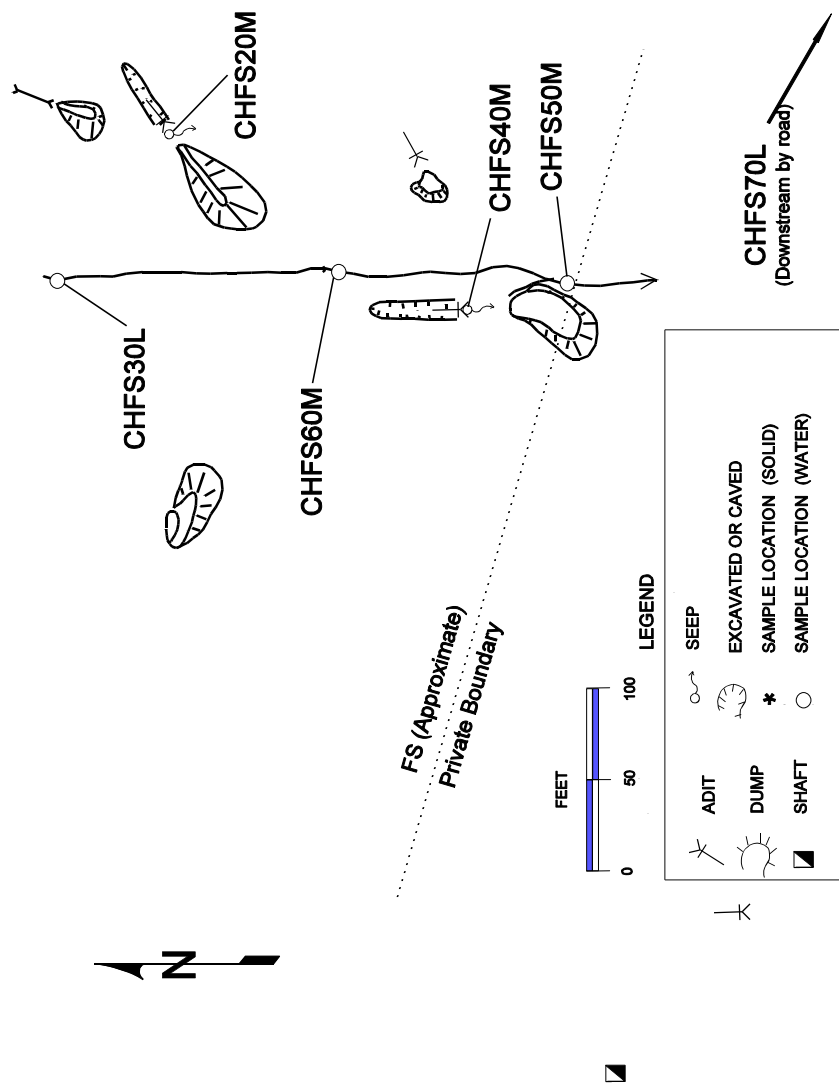


Figure 19 The largest workings of the upper Hattie Ferguson mine are on private land (not shown). The portion of the mine that was discharging water, however, is on DNF administered land.

2.22.3.2 Soil

There was no indication of impact to soils or vegetation outside the disturbed areas at either site; no soil samples were collected.

2.22.3.3 Water

The elevated concentrations of iron and manganese in the adit discharge of the lower Hattie Ferguson, which exceeded secondary drinking water standards (Table 28), are what might be expected for an acidic discharge that has been buffered. The concentration of arsenic, although present, was quite low and may have co-precipitated with the ferric-hydroxide. The sample collected on Cataract Creek below the adit exceeded aquatic life (chronic) criteria with respect to copper (Table 28). Without more detailed sampling, it is not certain whether the presence of copper can be related to the lower Hattie Ferguson or some other mine upstream.

There appeared to be little water-quality degradation of the stream flowing through the upper Hattie Ferguson (Table 28). Although the adit discharges generally contained slightly higher concentrations of dissolved metals, the overall impact was relatively small.

Table 28
Water Quality Exceedences
Lower Hattie Ferguson Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge - Lower Hattie F. (CHFS10H)							S		S										
CHFS20L-A - Cataract Creek below adit						C													
Unnamed stream above site- Upper Hattie F. (CHFS30L)				C					S				A,C						
Upper adit discharge - Upper Hattie F. (CHFS20M)				C									A,C						
Unnamed stream - below upper adit (CHFS60M)				C									A,C						
Lower adit discharge - Upper Hattie F. (CHFS40M)													A,C						
Unnamed stream - below lower adit (CHFS50M)				C									A,C						
Unnamed stream - below Upper Hattie F. site (CHFS70L)				C					S				A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.22.3.4 Vegetation

Most of the waste-rock dumps on DNF administered land were well vegetated. There was no indication of stressed vegetation near the dumps, the adit discharges, or the stream.

2.22.3.5 Summary of Environmental Condition

The impact of the adit and waste-rock dump of the lower Hattie Ferguson mine was local and small-scale. However, the site is on the main Cataract Creek road and is easily accessible.

The upper Hattie Ferguson mine is farther off the main road, but is still easily accessible. The adit discharges appeared to have little impact on the quality of the stream that flowed through the area. Dumps were generally stable and well vegetated; very little sedimentation from the dumps was evident in the stream.

2.22.4 Structures

There were no structures on the lower Hattie Ferguson mine site. There were no significant structures on DNF administered land at the upper Hattie Ferguson mine site; however, there were what appeared to be parts of building foundations above the uppermost adit.

2.22.5 Safety

There were no apparent safety concerns on DNF administered land at the upper or lower Hattie Ferguson mine sites.

2.23. SIRIUS MINE

2.23.1 Site Location and Access

The Sirius mine (T7N R5W 29AAAA) is accessed by road from the main Cataract Creek road. It is approximately 2000 feet north of the upper Hattie Ferguson (Section 2.22 of this report) in the same tributary drainage to Cataract Creek. The entire site is on DNF administered land.

2.23.2 Site History - Geologic Features

The Sirius lies near the center of an area of closely spaced veins and relatively pervasive wallrock alteration on a fraction of DNF administered land almost surrounded by patented claims. The Sirius itself drifts along a NE-trending, steeply NW dipping quartz-pyrite-galena-chalcopyrite vein with an ore shoot 175 feet long and 6 inches to 3 feet wide (Roby and others, 1960). Total production since the mine began working in 1906 has been 446 tons from which 287 oz Au, 5197 oz Ag, 1561 lbs Cu, 73017 lbs Pb, and 2667 lbs Zn were recovered. Gold values were quite high for a Boulder Batholith vein.

The dump is composed of 5000 tons of altered quartz monzonite. A composite sample assayed 0.040 oz/ton Au, 0.98 oz/ton Ag, 0.029% Cu, 0.91% Pb, and 0.57% Zn.

2.23.3 Environmental Condition

A caved adit discharged a small amount of water; field parameters indicated that the discharge was acidic and contained a relatively high amount of dissolved solids. Although the discharge stream infiltrated the ground in a short distance (<10 feet), ferric-hydroxide stains were evident several hundred feet farther down the drainage. The main waste-rock dump contained a significant amount of sulfides and damage to soils is evident in a large area down slope. Several areas below the dump as well as the dump itself were devoid of vegetation.

2.23.3.1 Site Features - Sample Locations

A sample was collected of the adit discharge (CSIS10H) which was flowing at a rate of about 1.5 gpm. No other surface water was found on or near the site. A composite (10-foot centers) soil sample (CSID10H) was collected near the base of the waste-rock dump. Site features and sample locations are shown in Figure 20. Samples were collected on 7/23/92.

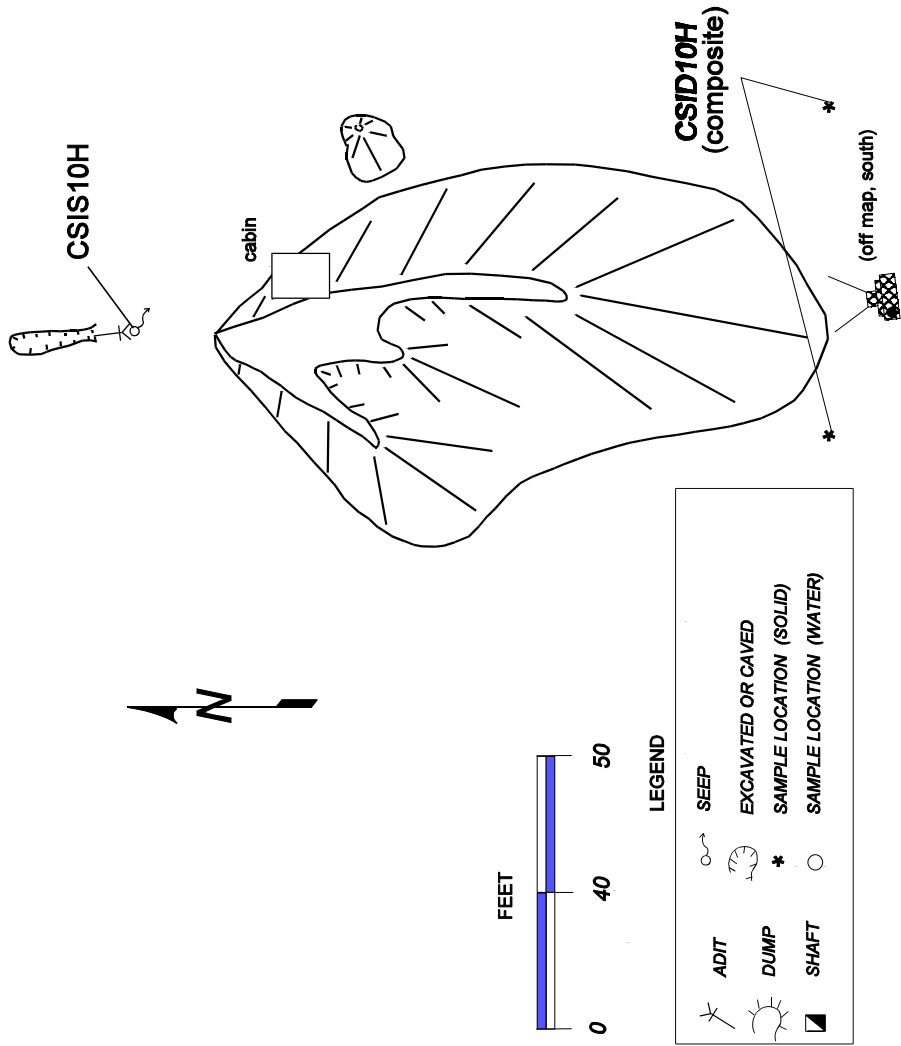


Figure 20 The adit discharge stream from the Sirius mine infiltrated the ground before reaching the edge of the waste-rock dump. Ferric hydroxide stains indicated a much longer discharge stream under wetter conditions. Soils down slope of the waste-rock dump have been significantly impacted for several hundred feet.



Figure 20A. Material from the waste rock of the Sirius mine has been eroded and mixed with native material for several hundred feet down slope. Some areas were devoid of vegetation.

2.23.3.2 Soil

The soil at the base of the waste-rock dump contained high levels of arsenic, copper, lead and zinc (Table 29). The concentrations of all four of these constituents exceeded phytotoxic limits. The area of soil affected by erosion of the dump was several hundred square feet and extended several hundred feet from the disturbed area.

Table 29
Soil Sampling Results
Sirius Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Soils at base of waste dump(CSID10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.23.3.3 Water

The adit discharge was acidic (pH=4.44) and had high concentrations of several dissolved metals. Primary and secondary drinking water criteria were exceeded for aluminum, cadmium, and manganese (Table 30).

Table 30
Water Quality Exceedences
Sirius Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CSIS10H)	S,C			P,A C		A,C		C	S				A,C						S

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.23.3.4 Vegetation

The waste-rock dump and the area immediately down-slope of the waste-rock dump were devoid of vegetation. Vegetation was still stressed for several hundred feet farther down the slope.

2.23.3.5 Summary of Environmental Condition

The waste material from the site has had a strong impact on soils and vegetation for several hundred feet below the disturbed area. The adit discharge contained high concentrations of several dissolved metals. Although the discharge was small at the time of sampling, it was evident that it can be much greater during wetter periods.

2.23.4 Structures

There was a small dilapidated cabin on top of the waste-rock dump near the caved adit. No other structures were observed on this site.

2.23.5 Safety

The poor condition of the cabin along with the good access may prove to be a safety concern. The high metals content of the soil below the workings may also be of concern. Since the area is large and vegetation sparse, there is a good potential for airborne transport of contaminated material.

2.24. CRACKER MINE

2.24.1 Site Location and Access

The Cracker mine (T7N R5W 28CDDC) is about 2000 feet off the main Cataract Creek road and about 600 feet east of Cataract Creek. Access to the site is easily gained by a road that follows a nearby power line. The entire site is on DNF administered land.

2.24.2 Site History - Geologic Features

Shears above the single portal of the Cracker mine have a N84E 70SE attitude and probably parallel the vein. Roby and others (1960) described the vein as containing quartz, galena, pyrite, chalcopyrite, and manganese oxides, with 1600 feet of total workings present. The dump consisted of 4000 tons of quartz monzonite with quartz, sericite, and pyrite alteration products, and has fairly high metal values. A composite sample assayed 0.014 oz/ton Au, 1.72 oz/ton Ag, 0.85% Pb, and only a small amount of Cu and Zn.

2.24.3 Environmental Condition

A locked adit discharging water on DNF administered land was the main feature of the Cracker. Material from the waste-rock dump below the adit had washed onto the soil down slope and appeared to have impacted the vegetation.

2.24.3.1 Site Features - Sample Locations

The site was sampled on 7/16/92. A surface-water sample was collected from the adit (CCRS10H) which was discharging about 12 gpm (Figure 21). The nearest active stream is Cataract Creek which is about 800 feet downhill.

A composite sample (5-foot centers) was collected of the soil near the base of the waste-rock dump (CCRD10H). This is an area where waste material had been washed down from the dump (Figure 21).

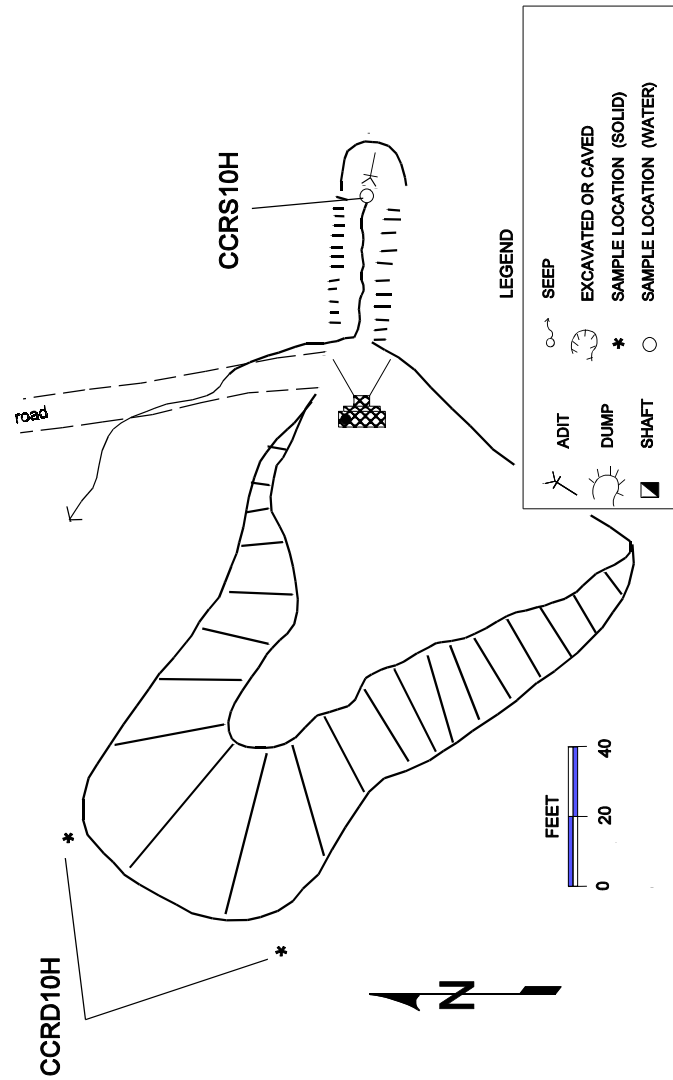


Figure 21 The adit of the Cracker mine discharged water toward Cataract Creek. Waste material has been washed onto and has mixed with soils down slope of the waste-rock dump.



Figure 21A. The adit of the Cracker mine was open, but secure. A small discharge issued from the adit and flowed toward Cataract Creek. Ferric-hydroxide precipitate was evident along its entire length.

2.24.3.2 Soil

The concentrations of arsenic and lead were very high in the soils below the waste-rock dump (Table 31). With the exception of cadmium, all of the metals for which analysis was performed exceeded the phytotoxic limit. The phytotoxicity was apparent in the lack of vegetation near the dump and stressed vegetation for several hundred feet down slope.

Table 31
Soil Sampling Results
Cracker Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Base of waste dump (CCRD10H)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.24.3.3 Water

The adit discharge exceeded MCLs for manganese and zinc (Table 32); many of the constituents for which analyses were performed were at or below the detection limit. The pH was near neutral (7.39) and the sulfate concentration was low (74.8 mg/L).

Table 32
Water Quality Exceedences
Cracker Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge (CCRS10H)									S				A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.24.3.4 Vegetation

The Cracker mine is in an area that is sparsely vegetated; however, the vegetation near the base of the waste-rock dump was markedly reduced. Farther down the hill, vegetation was more abundant but still showed signs of stress.

2.24.3.5 Summary of Environmental Condition

The waste material from the dump has been responsible for most of the impact at this site. The dump material has been eroded and has mixed with soil over an area of a few hundred square feet.

The adit discharge, although containing relatively low concentrations of dissolved metals, was large (about 12 gpm) compared to other sites in the Cataract Creek drainage. This "large" discharge translates to a significant metals-loading on Cataract Creek.

2.24.4 Structures

No structures were found on the Cracker mine site.

2.24.5 Safety

No safety concerns were identified for this site; the waste-rock dump was small and slopes appeared stable. The adit was open but secure from entry.

2.25. MOUNTAIN CHIEF MINE

2.25.1 Site Location and Access

The Mountain Chief mine (T7N R5W 33DAAB) is about one mile east of the main Cataract Creek road, adjacent to the east-west section of the power line. The road following the power line actually cuts across a portion of the adit. The adit and most of the waste-rock dump down-slope of the adit are on private land; the base of the dump and the area below are on DNF administered land.

2.25.2 Site History - Geologic Features

The single adit on the Mountain Chief has a southeasterly orientation and is probably only a few hundred feet in length. There is an associated 500 ton dump of quartz monzonite with quartz, sericite, and pyrite alteration products on DNF administered land. Metal values in the dump were very low.

2.25.3 Environmental Condition

The adit and shaft on private land were both caved. The adit discharged water across the dump; the discharge stream infiltrated the ground within 20 feet. Several seeps were breaking at the base of the waste-rock dump on DNF administered land and formed a small wetlands area. There was no indication of soil contamination below the dump.

2.25.3.1 Site Features - Sample Locations

The adit discharge was precipitating ferric-hydroxide near the mouth and along its path. The dump material appeared stable and contained only small amounts of sulfides. Two water-samples were collected on 7/22/92 from the seeps at the base of the dump: one was collected below the area where the adit discharge infiltrated the ground (CMCS10L) and the second was collected on the other side of the dump (CMCS20L) (Figure 22). Both seeps were discharging less than 0.5 gpm. No soil samples were warranted.

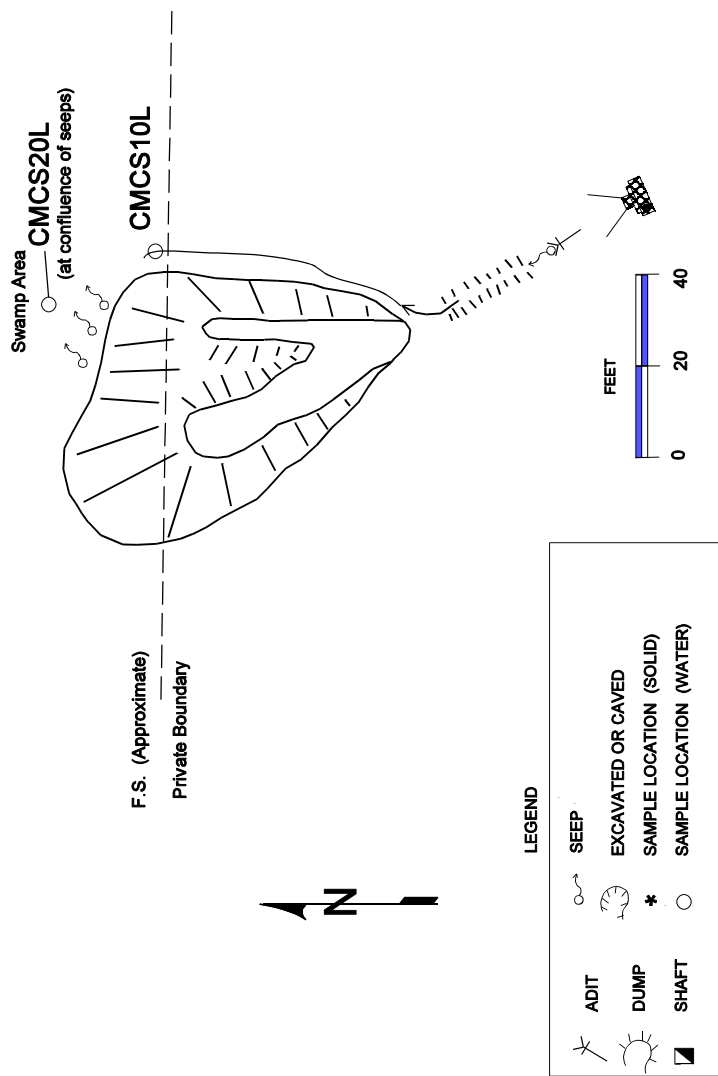


Figure 22 The adit and part of the waste-rock dump of the Mountain Chief mine are on private land; the lower portion of the dump and the seeps are on DNF administered land.



Figure 22A. The collapsed adit and part of the waste-rock dump of the Mountain Chief mine are on private ground. The lower part of the dump and the area downhill are on DNF administered land.

2.25.3.2 Soil

The dump material was generally coarse-grained and stable. There was little evidence of erosion or movement of the material. No waste material was observed in the area below the dump.

2.25.3.3 Water

With the exception of manganese and zinc, the water at the base of the dump had higher concentrations of dissolved metals than the water below the adit. Both waters exceeded MCLs for cadmium (aquatic life - chronic) and for manganese (drinking water - secondary) (Table 33).

Table 33
Water Quality Exceedences
Mountain Chief Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Seep at base of dump (CMCS10L)				C					S				A,C						
Second seep at base of dump (CMCS20L)	S,C			C					S										

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.25.3.4 Vegetation

Vegetation on the waste-rock dump was sparse, but the area near the caved adit was well vegetated. On DNF administered land below the dump, there was no indication of stressed vegetation.

2.25.3.5 Summary of Environmental Condition

The waste-rock dump appeared to be stable and there was no indication of erosion or other movement of material onto native soils. The discharge of water from the disturbed area to

DNF administered land was restricted to small seeps. The quality of this water was somewhat poor, but the the apparent impact was small.

2.25.4 Structures

No structures were observed on DNF administered land.

2.25.5 Safety

The only safety concern on DNF administered land may be the loose footing on the steep waste-rock dump.

2.26. VERA & MARIE MINE

2.26.1 Site Location and Access

The Vera and Marie mine (T7N R5W 33BBDB) is adjacent to Cataract Creek. Preliminary indications were that the site was on DNF administered land; however, markers at the site indicated that at least the main disturbed area of the mine was patented property. Thus, the field evaluation was restricted to the lowest areas, away from the main workings.

2.26.2 Site History - Geologic Features

Two open shafts, two caved adits, and several trenches mark the Vera and Marie, which explores an east-west quartz-sphalerite-pyrite vein for 350 feet along strike. The main adit dump contains about 1500 tons of altered, pyrite-bearing quartz monzonite with low metal values (see map). A select sample of vein from the ore bin had assayed 0.040 oz/ton Au and 12.90 oz/ton Ag. Total length of all workings is probably less than 1000 feet.

2.26.3 Environmental Condition

Several small springs were found near the boundary of the main development area and up the drainage from the main development area. Several small waste-rock dumps associated with the shafts and adit were found above the main portion of the site but all were dry. Soils did not appear to be impacted by any of the waste-rock dumps.

An upstream sample location was difficult to establish. The main spring flowing past the site came from 4 to 5 small springs that were breaking at various points along the hillside above the mine site. At least one of the streams had been diverted but the discharge of the trench was still within the same drainage. Field parameters were used to establish the upstream sample site.

2.26.3.1 Site Features - Sample Locations

The site was sampled on 7/20/92. Surface water samples were collected well above the site (CVMS20L), upstream of the main development area near the site (CVMS10L), at the seeps that were at the base of the waste-rock dump of the lower adit (CVMS40M), and from the stream below the site above its confluence with Cataract Creek (CVMS30L). At the time of the visit, the stream well above the site was discharging about 36 gpm, the stream near the site was discharging about 1gpm, and the seeps at the base of the dump were discharging about 1.5 gpm. All of these waters combined to form a stream that flowed into Cataract Creek; the discharge of the stream at that point was approximately 38 gpm. Since the investigation did not include the disturbed area, no soil samples were collected. Sample locations and site features are presented in Figure 23.

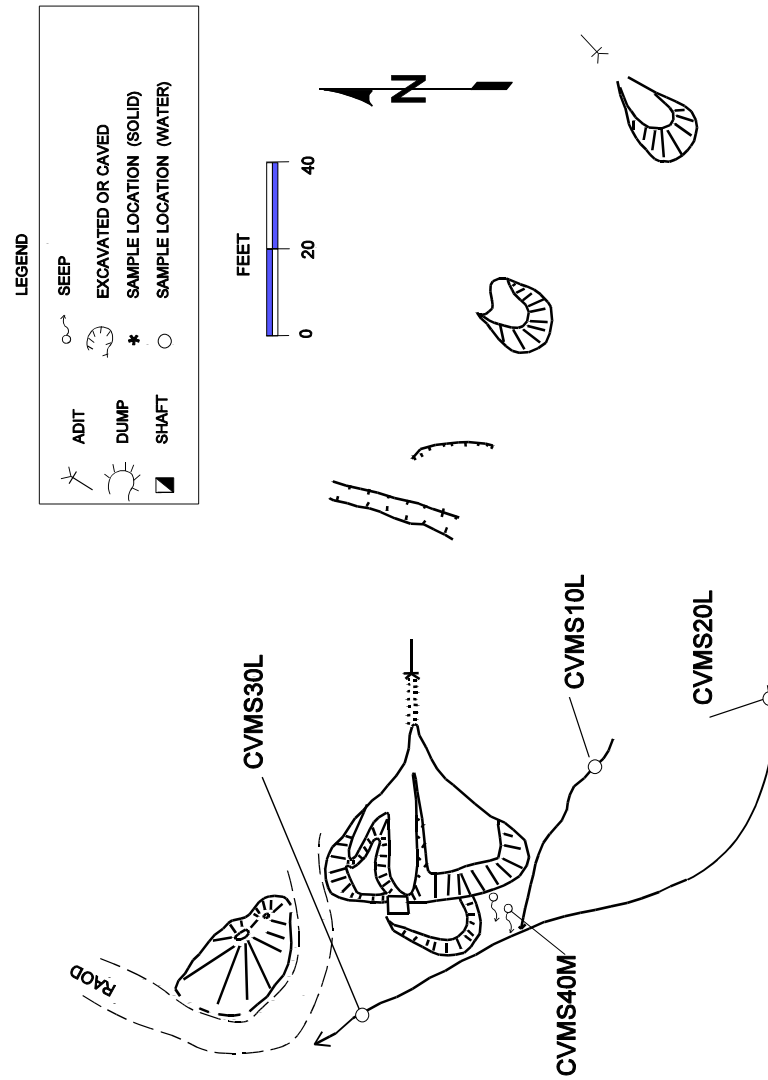


Figure 23 The ownership of the Vera and Marie development area is uncertain. Sampling focused on areas outside of the disturbed area and potential impacts to Cataract Creek.

2.26.3.2 Soil

The waste-rock dumps on the south end of the development area near the streams were comprised mainly of coarse-grained material. No erosion or other movement of material was evident. The small road on the northwest corner of the development area actually cut the base of the dump, but the dump still appeared to be stable.

2.26.3.3 Water

The only water sampled that exceeded any MCLs was that collected at the base of the waste-rock dump (Table 34). This water was slightly acidic (pH = 6.51) compared to waters elsewhere on the site. The concentrations of dissolved constituents in the downstream sample were very similar to those of the upstream samples.

Table 34
Water Quality Exceedences
Vera & Marie Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Unnamed stream - upstream of site (CVMS20L)																			
Unnamed stream - above main development area (CVMS10L)																			
Seeps at base of dump below main adit (CVMS40M)	S						S,A		S										
Unnamed stream - above confluence with Cataract Creek (CVMS30L)																			

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.26.3.4 Vegetation

The vegetation at the base of the waste-rock dumps was well established and showed no signs of stress. All of the streams and springs throughout the area were well vegetated. The vegetation on the dumps, most of which are on private land, ranged from sparse to well vegetated. A few small areas (<10 ft²) were barren.

2.26.3.5 Summary of Environmental Condition

The waste-rock dumps appeared stable and did not appear to have any impact on soils in the surrounding areas. The seeps at the base of the southern dump was contributing dissolved metals to the streams, but their effect was nil by the time the stream reached Cataract Creek. This contribution may increase during wetter periods; however, the overall impact would probably be small.

2.26.4 Structures

There were several small buildings and ore bins throughout the area. All were in poor repair. Since it was assumed that the site was on private ground, a detailed assessment was not made.

2.26.5 Safety

Several of the structures appeared to be in danger of collapse; the waste-rock dumps associated with the main development area were steep and footing was poor.

2.27. MORNING MARIE MINE

2.27.1 Site Location and Access

The Morning Marie mine is approximately 600 feet downstream from the Vera and Marie mine, on Cataract Creek. The site is easily accessible from the main Cataract Creek road. The mine is entirely on DNF administered land.

2.27.2 Site History - Geologic Features

A short adit and shaft apparently mined a new vein. The dump is composed almost entirely of unaltered quartz monzonite with very low metal values.

2.27.3 Environmental Condition

The Morning Marie mine site consisted of a caved adit that discharged water and a caved shaft with no discharge. There were two waste-rock dumps associated with the adit and shaft.

2.27.3.1 Site Features - Sample Locations

The adit was discharging a small amount of water (less than 0.5 gpm) toward Cataract Creek at the time of the geologist's visit (Figure 24). A few days later, when the hydrogeologist visited the site, there was no discharge. The site was checked periodically over the following weeks, but no discharge was ever found.

There was no indication of soil contamination from either waste-rock dump or the adit discharge; no soil samples were collected.

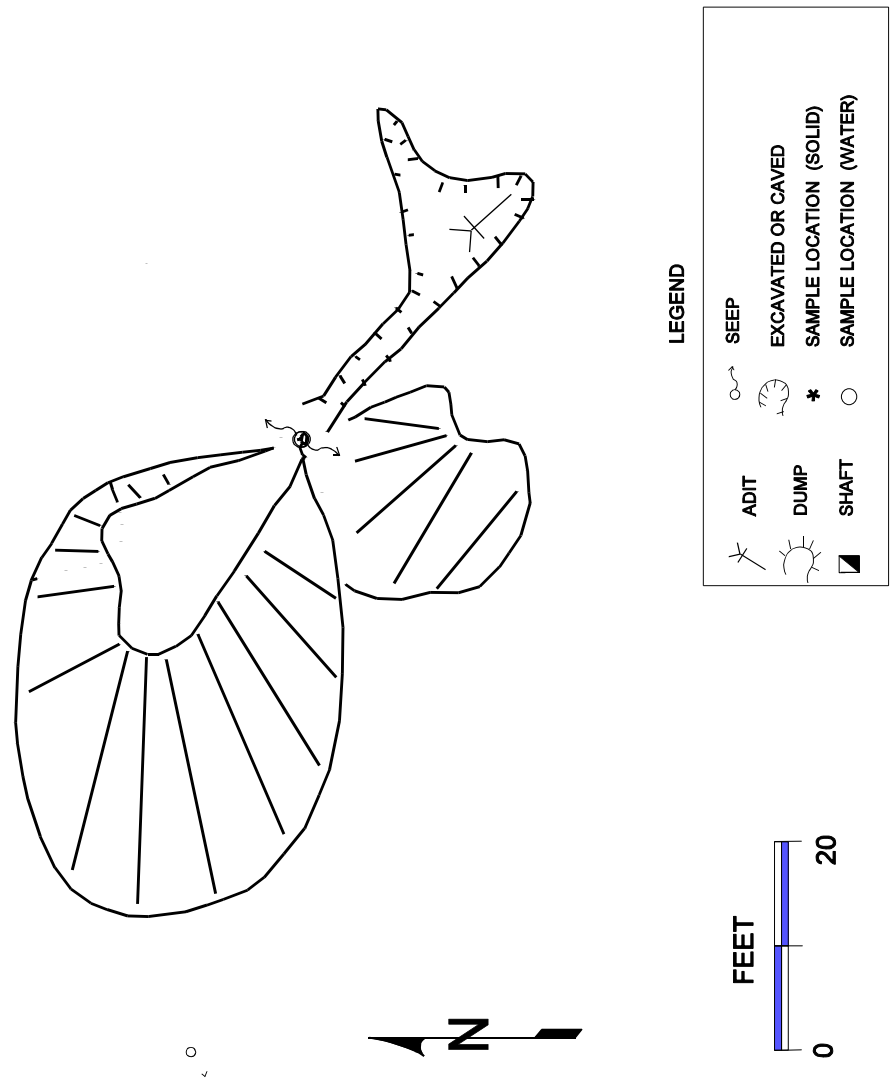


Figure 24 The discharge from the Morning Marie adit is small and only flows intermittently. The waste-rock dump appears stable and does not appear to impact soils down slope.

2.27.3.2 Soil

The waste-rock dump, comprised mainly of coarse-grained, unmineralized wall-rock, showed little weathering and no erosion. The soils at the base of the dump showed no indication of sedimentation or other impacts.

2.27.3.3 Water

As noted, the adit evidently discharges only during spring runoff or extended wet periods. There was no ferric-hydroxide or other visual evidence of poor quality water in the area of the discharge.

2.27.3.4 Vegetation

Vegetation appeared healthy throughout the development area; some vegetation was established on the crown of the dumps.

2.27.3.5 Summary of Environmental Condition

The waste material on the site is composed mainly of unaltered, unmineralized wall-rock. Although there was an adit discharge, it is evidently sporadic and small.

2.27.4 Structures

There were several cabins in generally poor repair on the Morning Marie mine site.

2.27.5 Safety

The poor condition of the cabins and the easy access to the site may pose a safety concern. The depression caused by the caved shaft was shallow and the waste-rock dumps were generally stable.

2.28. CRYSTAL MINE AND UNCLE SAM MINE - UNCLE SAM GULCH

2.28.1 Site Location and Access

The Crystal mine is a large, complex mine on private land. Its environmental effects have been the subject of several studies. Therefore it was not studied as a part of this project, but a summary of the property is provided because it is one of the major contributors to degradation of the Cataract Creek watershed. The Uncle Sam mine (T7N R5W 29DCDB) is on DNF administered land in Uncle Sam Gulch about 1.75 miles downstream of the Crystal mine. The Uncle Sam mine is about 0.75 miles from the main road in Cataract Creek and is easily accessible by road.

2.28.2 Site History - Geologic Features

The geology of the Crystal mine is well described in other references (Roby and others, 1960; Ruppel, 1963; unpublished information, MBMG files). The mine produced from underground workings and open pits from 1908 until at least the 1960s. Total production has been 22,586 tons with 3579 oz Au, 343,591 oz Ag, 536,915 lbs Cu, 2,060,623 lbs Pb, and 939,190 lbs Zn recovered (Roby and others, 1960). Two adits with 6000 feet of workings over a vertical range of 200-300 feet mined a N70-80W 70NE vein in sericitized aplite. The ore shoots were discontinuous lenses 2-30 feet wide of quartz, pyrite, arsenopyrite, galena, chalcopyrite, tetrahedrite, covellite, and chalcocite. Though no vertical zoning is evident, some zoning across the width of the shear zone was noted (Ruppel, 1963). Ore in the footwall shoots contained over 1 oz/ton Au, while in the central and hanging wall shoots gold content was negligible and silver values were higher.

The Uncle Sam mine occupies an area of several closely spaced N78-80W north dipping (Ruppel, 1963) shear zones hosting veins with fairly pervasive wallrock alteration characterized mainly by kaolinite and siderite alteration products. Similar mineralogy suggests that this may be the western extension of the Morning Glory zone. Host rock is aplite at the contact between the quartz monzonite and Elkhorn Mountains andesite (Knopf, 1913). Production has been more than 12,000 tons from 2000-3000 feet of workings (Roby and others, 1960). Production of 259 tons on the property yielding 5 oz Au, 4764 oz Ag, 76 lbs Cu, 26,869 lbs Pb, and 35,854 lbs zinc (Knopf, 1913) indicates the mine was valued principally for its silver, but our own select vein sample had considerable gold. Values from this quartz-pyrite-galena-sphalerite vein were .456 oz/ton Au, 15.82 oz/ton Ag, 0.144% Cu, 3.10% Pb, and 1.60% Zn. Anomalous radioactivity, two to four times background, is also present on the dumps, especially in the vein material and wall rock with quartz, pyrite, and sericite alteration products. There has been some recent exploration activity at this site, but results have not been released.

2.28.3 Environmental Condition

There is at least one adit discharge from the Crystal mine. The quality of the water in Uncle Sam Gulch was strongly degraded its entire length below the mine. Ferric hydroxide staining of boulders and sediments was visible in the gulch and in Cataract Creek.

No surface water was found associated with any of the workings or dumps of the Uncle Sam mine. Most of the disturbed area was covered by vegetation. Water that appeared to issue from the lower adit actually originated in a natural spring above the adit.

2.28.3.1 Site Features - Sample Locations

In addition to an investigation of the impact to Uncle Sam Gulch by the Uncle Sam mine, the site investigation also focused on impact to the drainage from the Crystal mine. Surface water samples were collected from the spring above the Uncle Sam mine (CUSS10L), on Uncle Sam Gulch downstream of its confluence with the Crystal mine adit discharge (CUSS20L), on Uncle Sam Gulch above its confluence with Cataract Creek (CUSS30L), and on Cataract Creek above (CUSS40L) and below (CUSS50L) its confluence with Uncle Sam Gulch. All samples were collected on 7/28/92. The spring above the disturbed area discharged approximately 2 gpm. Uncle Sam Gulch discharged about 112 gpm just below the Crystal mine and about 476 gpm just above its confluence with Cataract Creek. Cataract Creek was discharging approximately 2690 gpm above its confluence with Uncle Sam Gulch and approximately 3200 gpm just below its confluence with Uncle Sam Gulch.

There was no evidence of soil contamination near the waste material on the Uncle Sam mine site; no soil samples were collected.

2.28.3.2 Soil

The impact to soils was restricted to the disturbed area. Although the dump contained fine-grained material, erosion was minimal.

2.28.3.3 Water

The spring above the Uncle Sam mine was of good quality; no MCLs were exceeded for any of the dissolved constituents for which analyses were conducted.

The impact of the Crystal mine discharge was quite evident along the entire length of Uncle Sam Gulch. Although water quality improved somewhat downstream of the mine, the MCLs for several constituents were exceeded (Table 35). Likewise, a comparison of the water quality of Cataract Creek upstream of its confluence with Uncle Sam Gulch to downstream of the confluence indicates a large amount of metals-loading.

Table 35
Water Quality Exceedences
Crystal Mine and Uncle Sam Mine - Uncle Sam Gulch

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Spring above Uncle Sam mine (CUSS10L)																			
Uncle Sam Gulch below the Crystal mine (CUSS20L)	S,A C			P,A C		S,A C	S,A	P,A C	S				S,A C						S
Uncle Sam Gulch above confluence with Cataract Creek (CUSS30L)				P,A C		A,C			S				A,C						
Cataract Creek above confluence with Uncle Sam Gulch (CUSS40L)													A,C						
Cataract Creek below confluence with Uncle Sam Gulch (CUSS50L)	S,C			P,A C		A,C			S				A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.28.3.4 Vegetation

Vegetation at the Uncle Sam mine has been impacted by the Crystal mine discharge far more than from the Uncle Sam mine. The vegetation adjacent to Uncle Sam Gulch was obviously stressed as far downstream as its confluence with Cataract Creek.

2.28.3.5 Summary of Environmental Condition

The Uncle Sam mine contributes little, if any, of the metals loading to Uncle Sam Gulch or Cataract Creek. It was strongly apparent that the Crystal mine discharge dominates the metals-loading in this drainage.

2.28.4 Structures

Only remnants of structures were visible on the Uncle Sam mine site. No structures were easily identifiable. Some general debris, mainly building material, was observed.

2.28.5 Safety

The piles of old building material may pose some hazard on this site.

2.29. MORNING GLORY TAILINGS

2.29.1 Site Location and Access

The Morning Glory tailings (T7N R5W 32ADDC), on DNF administered land, were produced by a mill at the Morning Glory mine (T7N R5W 33BCCB) which is on private land approximately 200 feet upstream on Cataract Creek. The tailings pile is accessible by crossing Cataract Creek from the main road.

2.29.2 Site History - Geologic Features

The Morning Glory mine is near the western end of the highly productive Comet-Gray Eagle shear zone. Although alteration products are primary kaolinite and siderite rather than quartz, sericite, and pyrite, suggesting a low grade vein (Pinckney, 1965), the Morning Glory was quite productive. From 1920-1957 the mine produced 19,231 tons of ore yielding 2484 oz Au, 268,054 oz Ag, 4138 lbs Cu, 83,140 lbs Pb, and 7793 lbs Zn. Four parallel N62W 80-84NE veins with ore shoots up to 100 feet long and 5 feet wide occupy an east-west shear zone (Roby and others, 1960; Becraft and others, 1963). The veins contain quartz, chalcedony, galena, sphalerite, siderite, and calcite. The abundant carbonates were associated with low metal values, while the ore was composed of plentiful galena and sphalerite (Becraft and others, 1963). The large mine-dumps representing thousands of feet of workings were outwardly composed of unaltered quartz monzonite and quartz monzonite with kaolinite and siderite alteration products.

During the 1930's (Roby and others, 1960), a flotation mill operated at the site. Today there are approximately 6000 tons of tailings on the banks of Cataract Creek. A composite sample assayed 1.64 oz/ton Ag and low base metal values. Radiation was also slightly anomalous.

Since the mine site is private land, no map was constructed. The limit of the tailings pile was too indistinct to map.

2.29.3 Environmental Condition

Although they impinged on Cataract Creek the dumps did not appear to contribute to the degradation of the creek; the mineralogy of the waste material suggests little potential for metals to be leached. The mill tailings were completely overgrown by vegetation and there was little evidence of erosion.

2.29.3.1 Site Features - Sample Locations

Surface-water samples were collected upstream on Cataract Creek for the Uncle Sam - Crystal mine investigation (see previous section for results). Additional samples were collected downstream, below the Phantom mine (see next section for results).

2.29.3.2 Vegetation

There was no apparent stress to the vegetation in the mill tailings nor along Cataract Creek that may have been related to the tailings.

2.29.3.3 Summary of Environmental Condition

Erosion and deposition of tailings and waste-rock material present the greatest potential for impact to Cataract Creek; both have been eroded to a least some degree by the stream. The rate of erosion is small, however; no significant sediment was observed in the stream bottom.

2.29.4 Structures

Remnants of tailings dams and sluice boxes were found, but no other structures were observed in this area.

2.29.5 Safety

No safety concerns were identified for this site.

2.30. PHANTOM MINE

2.30.1 Site Location and Access

The Phantom mine (T7N R5W 32DACC) is on Cataract Creek about 1500 feet downstream of the Morning Glory tailings. The site is accessible from the main road by crossing Cataract Creek. The entire site is on DNF administered land.

2.30.2 Site History - Geologic Features

The Phantom is a short caved adit collared in unaltered quartz monzonite and has mostly unaltered rock on a dump that has been eroded by Cataract Creek. Only about 200 tons of dump material remain. There is some quartz-calcite-siderite-pyrite vein on the dump with very low metal values (<0.006 oz/ton Au and 0.30 oz/ton Ag). The vein probably parallels N75W 82NE shear zones at the portal.

2.30.3 Environmental Condition

The site consisted of a small caved adit and a small waste-rock dump adjacent to the creek. The adit discharged a small volume of water out of a pipe into Cataract Creek. Waste rock had been washed down-slope into Cataract Creek.

2.30.3.1 Site Features - Sample Locations

A surface water sample was collected from the adit discharge pipe (CPHS10L); the discharge was approximately 0.5 gpm. A soil composite sample (5-foot centers) was collected near the base of the dump where material has been washed toward the creek (CPHW10H). A surface water sample was also collected from Cataract Creek downstream of the Phantom mine to assess cumulative impacts to the stream (CUSS60L). The samples were collected on 7/16/92.

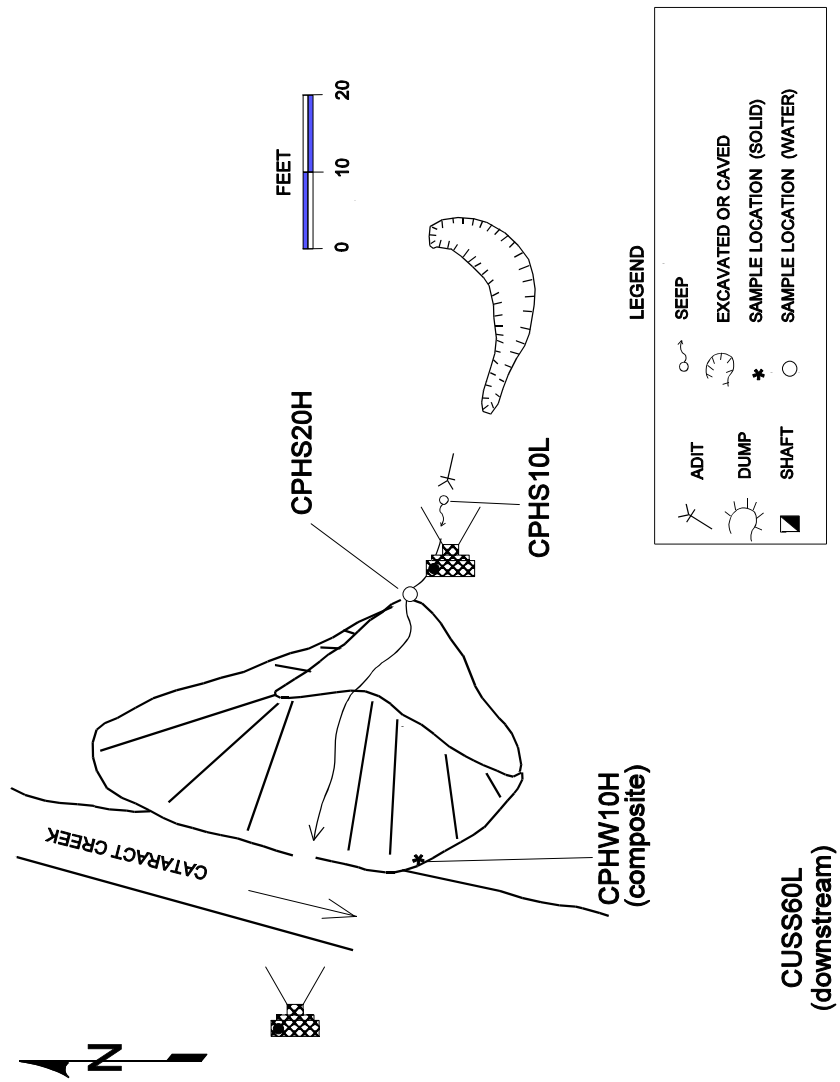


Figure 25 The adit of the Phantom mine was discharging water directly into Cataract Creek. The base of the waste-rock dump has been eroded by the creek.



Figure 25A. The collapsed adit of the Phantom mine discharged water to Cataract Creek. Ferric hydroxide precipitate was evident for most of its length.



Figure 25B. The discharge from the adit was flowing into Cataract Creek. Material from the waste-rock dump had been washed into the creek as well.

2.30.3.2 Soil

Arsenic, copper, lead, and zinc concentrations in the soils below the waste-rock dump exceeded the phytotoxic limits (Table 36). This material has been eroded and almost certainly has been deposited into Cataract Creek either by gravity or during runoff events.

Table 36
Soil Sampling Results
Phantom Mine
(mg/kg)

Sample Location	As	Cd	Cu	Pb	Zn
Soils below waste-rock dump (CPHW10L)	7835 ^{1,2}	8.9 ¹	309 ^{1,2}	5356 ^{1,2}	1937 ^{1,2}

(1) Exceeds one or more Clark Fork Superfund Background Levels (Table 3)

(2) Exceeds Phytotoxic levels (Table 3)

2.30.3.3 Water

Even though the discharge stream exhibited a large amount of ferric-hydroxide precipitate manganese was the only constituent whose concentration exceeded an MCL (Table 37). Many of the metals concentrations were at or below the detection limit.

It is difficult to attribute the poor quality of water in Cataract Creek to a specific mine. As discussed in previous sections, the Crystal mine appeared to have the greatest impact on Cataract Creek downstream of Uncle Sam Gulch.

Table 37
Water Quality Exceedences
Phantom Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Adit discharge - from pipe (CPHS10L)									S										
Cataract Creek - below site (CUSS60L)				P,A C					S				A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.30.3.4 Vegetation

Vegetation had not been established on the waste-rock dumps and appeared stressed in the area downslope of the dump. Vegetation around the adit and on the sides of the dump was abundant and appeared healthy.

2.30.3.5 Summary of Environmental Condition

Only the impact of the metals-laden waste-material can be attributed to the Phantom mine with any certainty. The material that has been eroded from the dump onto native soils and, eventually, into Cataract Creek contained high concentrations of metals and arsenic. There is a potential of a massive release of waste material into stream during a large storm event or flood.

The impact of water leaving the Phantom was masked by the impact of the Crystal mine on Uncle Sam Gulch. The adit discharge, however, showed little evidence of impact, both in terms of volume and dissolved constituents.

2.30.4 Structures

No structures other than the adit cover were observed on the site.

2.30.5 Safety

Erosion of the waste-rock dump area by Cataract Creek has caused some undercutting of the bank. This may pose a safety problem if it progresses.

2.31 SOUTH MANTLE MINE

2.31.1 Site Location and Access

The South Mantle mine (T6N R5W 8 DADA) is on Cataract Creek, approximately one mile northeast of the town of Basin. The site can be accessed by the main Cataract Creek road. The mine site is on private land, but a small portion of DNF administered land crosses Cataract Creek downstream of the site.

2.31.2 Site History - Geologic Features

No site history was available for the South Mantle mine. Since the entire site is on private land, no geologic features were mapped and no assay samples were collected.

2.31.3 Environmental Condition

The site consisted of three caved adits with mineralized waste-rock dumps. The aerial extent of the site was approximately half an acre. Because all of the features are on private property, no site map was constructed. The main Cataract Creek road cuts between one of the caved adits and its associated waste-rock dump. This dump was on the west side of the Cataract Creek floodplain and has been periodically eroded during flooding events. A ferric-hydroxide stained seep emerged near this dump, but the water is probably associated with the caved adit on the opposite side of the road. The water from the seep crossed the floodplain and eventually flowed into the creek. A second waste-rock dump was on the east bank of Cataract Creek. Its toe extended into the creek and is subject to constant erosion.

2.31.3.1 Site Features - Sample Locations

To evaluate the impact of the seep and waste-rock dumps, surface-water samples were collected from Cataract Creek upstream of the site (CMAS10M), from Big Limber Gulch upstream of the site (CSMS20H), and from Cataract Creek downstream of the site (CSMS10M). The site was sampled on 10/13/93. Cataract Creek was flowing approximately 6460 gpm upstream of the development area and approximately 5200 gpm downstream of the development area. Big Limber Gulch was flowing at about 58 gpm at the sample location above the site. Sample locations and approximate property boundaries are shown in Figure 26.

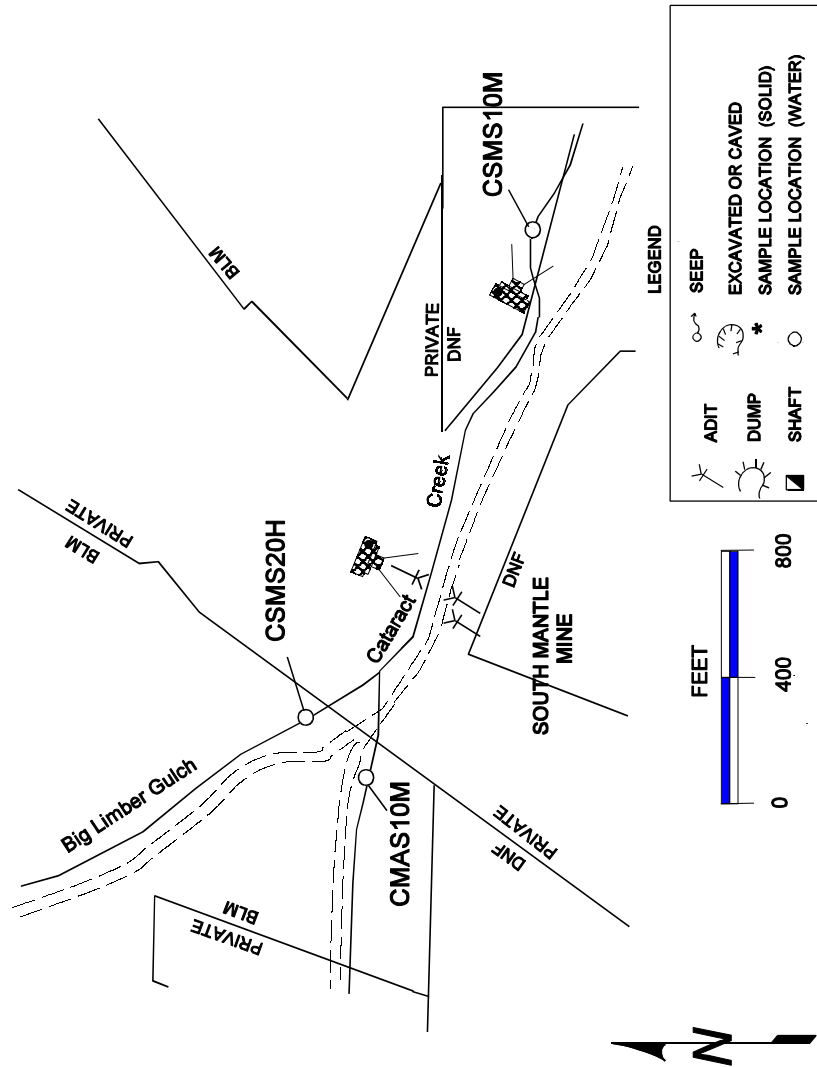


Figure 26 The South Mantle mine is on private ground, but Cataract Creek downstream of the site flows across DNF administered land. Samples were collected upstream on BLM administered land and downstream on DNF administered land.



Figure 26A. The development area of the South Mantle mine is on private land; although a detailed assessment was not conducted, waste material has probably made its way into Cataract Creek.



Figure 26B. Cataract Creek was sampled at a small section of DNF administered land downstream of the South Mantle mine.

2.31.3.2 Soil

No impacts to soil were evident on the piece of DNF administered land downstream of the site. Therefore, no soil samples were collected.

2.31.3.3 Water

Concentrations of copper, mercury, zinc, and chloride exceeded MCLs in Cataract Creek both upstream and downstream of the site. The secondary MCL for manganese was exceeded in Cataract Creek upstream of the site but was not exceeded below the site. Big Limber Gulch, which joins Cataract Creek upstream of the site, did not exceed any MCLs. Water-quality exceedences are summarized in Table 38.

Table 38
Water Quality Exceedences
South Mantle Mine

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO ₃	SO ₄	Si	pH
Cataract Creek - Upstream (CMAS10M)						A,C			S	C			A,C						
Big Limber Gulch - Upstream (CSMS20H)																			
Cataract Creek - Downstream (CSMS10M)						A,C				C			A,C						

Exceedence codes:

P - Primary MCL

S - Secondary MCL

A - Aquatic Life Acute

C - Aquatic Life Chronic

Note: The analytical results are listed in Appendix V

2.31.3.4 Vegetation

The three waste-rock dumps were barren to sparsely vegetated. Outside the disturbed area, the mine appeared to have had no impact on vegetation.

2.31.3.5 Summary of Environmental Condition

Because water quality downstream did not differ significantly from water quality upstream of the site, the mine appears to have little or no impact on Cataract Creek. However, the proximity of the waste-rock dumps to the creek suggests that storm events or heavy runoff may cause erosion of waste materials that could contribute to the suspended and dissolved load in the creek.

2.31.4 Structures

No structures were observed on the mine site or DNF administered land the site.

2.31.5 Safety

Erosion of the base of the dump on the east bank of Cataract Creek could cause instability and subsequent mass failure in the future. No other significant safety concerns were observed at the site.

2.32 SUMMARY OF BASIN MINING DISTRICT - CATARACT CREEK

The Cataract Creek drainage has one of the highest concentrations of mines in southwest Montana. The geologic and mineralogic framework of the Basin Mining District is one that favors the formation of acid mine drainage, but does not favor buffering. Since buffers such as carbonate rocks are found only in small veins in the area, most of the buffering that occurs is driven by aluminosilicates found in alteration zones or by atmospheric- CO_2 .

Seven of the mine and mill sites sample in the Cataract Creek drainage had at least one discharge whose pH was less than 6:

Crescent mine adit	pH=3.15
Ada mine adit	pH=2.57
Rocker mine adit	pH=3.35
Rocker Creek	pH=5.82
Boulder Chief mine adit	pH=2.63
Ida M mine adit	pH=2.98
waste rock seep	pH=5.40
Sirius mine adit	pH=4.44
Crystal mine adit(?)	pH=3.52

Other sites had waste material that was capable of producing acid, but water was not present. Some sites, such as the Hattie Ferguson mine, had an adit discharge that had evidently been buffered.

Based on the quantity of contaminated water and soil and the severity of the contamination, the Crystal mine and the Boulder Chief mine have the greatest environmental impact of the sites investigated in the Cataract Creek drainage. If other factors such as susceptibility to erosion or ease of access are considered, other sites become more of a concern. The Cataract Creek tailings, for example, had no site discharges, but could easily be eroded and transported during a flood and are adjacent to the main road.

Nearly all of the waste dumps in the area could fail and move during a catastrophic event, but the Boulder Chief mine is particularly susceptible. The tailings and waste rock material were on a steep, wet slope and small-scale slope failures have already occurred.

Erosion by wind and water are also a concern on several sites. Large areas devoid of vegetation and comprised of fine-grained material were found at the Sirius mine, the Black Bear mine, and the Cataract Creek tailings. At each of these sites, the material contained high concentrations of metals and arsenic. The Cataract tailings, the Morning Glory tailings, and the Phantom waste-rock dump have all been undercut by Cataract Creek.

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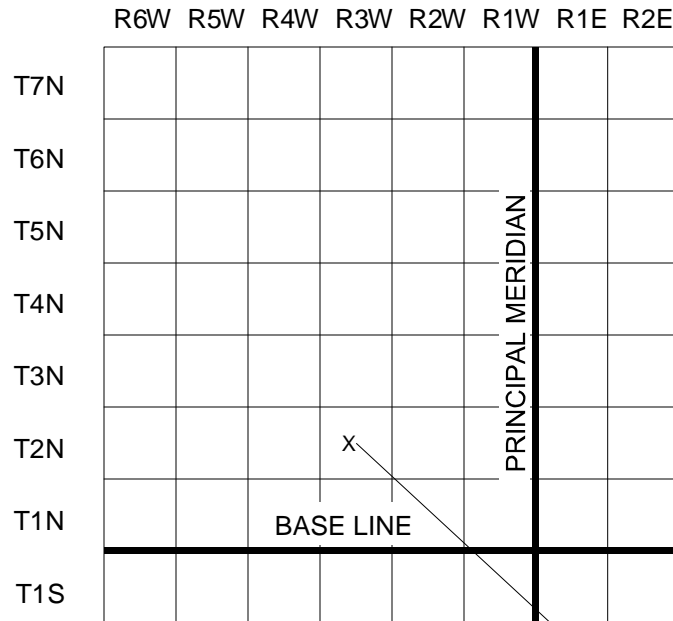
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APPENDIX I

ABANDONED - INACTIVE MINES PROGRAM
FIELD FORM

AND

EXPLANATION OF
TOWNSHIP-RANGE-SECTION-TRACT

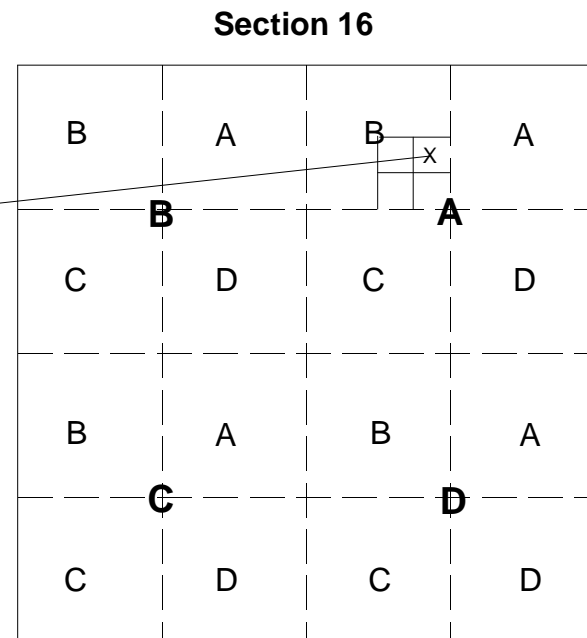
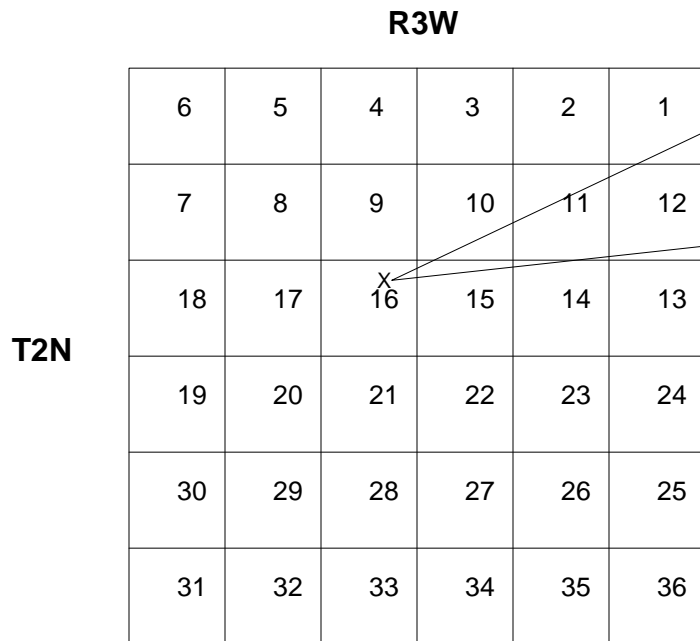


APPENDIX I

Explnation of

Township - Range - Section -Tract

T2N R3W Section 16ABDA



PART A

(To be completed for all identified sites)

LOCATION AND IDENTIFICATION

ID# _____ Site Name(s) _____
FS Tract # _____ FS Watershed Code _____
Forest _____ District _____
Location based on: GPS _____ Field Map _____ Existing Info _____ Other _____
Lat _____ Long _____ xutm _____ yutm _____ zutm _____
Quad Name _____ Principal Meridian _____
Township _____ Range _____ Section _____ 1/4 _____ 1/4 _____ 1/4 _____
State _____ County _____ Mining District _____

Ownership of *all* disturbances:

- _____ National Forest (NF)
_____ Mixed private and National Forest (or unknown)
_____ Private.

If private only, impacts from the site on National Forest Resources are
_____ Visually apparent _____ Likely to be significant _____ Unlikely or minimal

If all disturbances are private and impacts to National Forest Resources are unlikely or minimal - STOP

PART B

(To be completed for all sites on or likely effecting National Forest lands)

SCREENING CRITERIA

Yes	No	
_____	_____	1. Mill site or Tailings present
_____	_____	2. Adits with discharge or evidence of a discharge
_____	_____	3. Evidence of or strong likelihood for metal leaching, or AMD (water stains, stressed or lack of vegetation, waste below water table, etc.)
_____	_____	4. Mine waste in floodplain or shows signs of water erosion
_____	_____	5. Residences, high public use area, or environmentally sensitive area (as listed in HRS) within 200 feet of disturbance
_____	_____	6. Hazardous wastes/materials (chemical containers, explosives, etc)
_____	_____	7. Open adits/shafts, highwalls, or hazardous structures/debris
_____	_____	8. Site visit (<i>If yes, take picture of site</i>), Film number(s) _____ <i>If yes</i> , provide name of person who visited site and date of visit Name: _____ Date: _____ <i>If no</i> , list source(s) of information (If based on personal knowledge, provide name of person interviewed and date): _____

If the answers to questions 1 through 6 are all No - STOP

PART C

(To be completed for all sites not screened out in Parts A or B)

Investigator _____ Date _____
Weather _____

1. GENERAL SITE INFORMATION

Take panoramic picture(s) of site, Film Number(s) _____
Size of disturbed area(s) _____ acres Average Elevation _____ feet
Access: _____ No trail _____ Trail _____ 4wd only _____ Improved road
_____ Paved road
Name of nearest town (by road): _____
Site/Local Terrain: _____ Rolling or flat _____ Foothills _____ Mesa _____ Mountains
_____ Steep/narrow canyon
Local undisturbed vegetation (Check all that apply): _____ Barren or sparsely vegetated
_____ weeds/grasses _____ Brush _____ Riparian/marsh _____ Deciduous trees
_____ Pine/spruce/fir
Nearest wetland/bog: _____ On site, _____ 0-200 feet, _____ 200 feet - 2 miles, _____ > 2 miles
Acid Producers or Indicator Minerals: _____ Arsenopyrite, _____ Chalcopyrite, _____ Galena,
_____ Iron Oxide, _____ Limonite, _____ Marcasite, _____ Pyrite, _____ Pyrrhotite,
_____ Sphalerite, _____ Other Sulfide
Neutralizing Host Rock: _____ Dolomite, _____ Limestone, _____ Marble, _____ Other Carbonate

2. OPERATIONAL HISTORY

Dates of significant mining activity _____

MINE PRODUCTION

Commodity(s)							
Production (ounces)							

Years that Mill Operated _____
Mill Process: _____ Amalgamation, _____ Arrastre, _____ CIP (Carbon-in-Pulp), _____ Crusher only,
_____ Cyanidation, _____ Flotation, _____ Gravity, _____ Heap Leach, _____ Jig Plant,
_____ Leach, _____ Retort, _____ Stamp, _____ No Mill, _____ Unknown

MILL PRODUCTION

Commodity(s)							
Production (ounces)							

3. HYDROLOGY

Name of nearest Stream _____ which flows into _____
Springs (*in and around mine site*): _____ Numerous _____ Several _____ None _____
Depth to Groundwater _____ ft, Measured at: _____ shaft/pit/hole _____ well _____ wetland
Any waste(s) in contact with active stream _____ Yes _____ No

4. TARGETS (*Answer the following based on general observations only*)

Surface Water

Nearest surface water intake _____ miles, Probable use _____
Describe number and uses of surface water intakes observed for 15 miles downstream of site: _____

Wells

Nearest well _____ miles, Probable use _____
Describe number and use of wells observed within 4 miles of site: _____

Population

Nearest dwelling _____ miles, Number of months/year occupied _____ months
Estimate number of houses within 2 miles of the site (*Provide estimates for 0-200ft, 200ft-1mile, 1-2miles, if possible*)

Recreational Usage

Recreational use on site: _____ High (*Visitors observed or evidence such as tire tracks, trash, graffiti, fire rings, etc.; and good access to site*), _____ Moderate (*Some evidence of visitors and site is accessible from a poor road or trail*), _____ Low (*Little, if any, evidence of visitors and site is not easily accessible*)
Nearest recreational area _____ miles, Name or type of area: _____

5. SAFETY RISKS

_____ Open adit/shaft, _____ Highwall or unstable slopes, _____ Unstable structures,
_____ Chemicals, _____ Solid waste including sharp rusted items, _____ Explosives

6. MINE OPENINGS

Include in the following chart all mine openings located on or partially on National Forest lands. Also, include mine openings located entirely on private land if a point discharge from the opening crosses onto National Forest land. In this case, enter data for the point at which the discharge flows onto National Forest land; you do not need to enter information about the opening itself.

TABLE 1 - ADITS, SHAFTS, PITS, AND OTHER OPENINGS

Opening Number						
Type of Opening						
Ownership						
Opening Length (ft)						
Opening Width (ft)						
Latitude (GPS)						
Longitude (GPS)						
Condition						
Ground water						
Water Sample #						
Photo Number						

Comments (When commenting on a specific mine opening, reference opening number used in Table 1):

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Type of opening: ADIT=Adit, SHAFT=Shaft, PIT=Open Pit/Trench, HOLE=Prospect Hole, WELL=Well

Ownership: NF=National Forest, MIX=National Forest and Private (Also, for unknown), PRV=Private

Condition (Enter all that apply): INTACT=Intact, PART=Partially collapsed or filled, COLP=Filled or collapsed, SEAL=Adit plug, GATE=Gated barrier,

Ground water (Water or evidence of water discharging from opening): NO=No water or indicators of water, FLOW=Water flowing, INTER=Indicators of intermittent flow, STAND= Standing water only (In this case, enter an estimate of depth below grade)

7. MINE/MILL WASTE

Include in the following chart all mine/mill wastes located on or partially on National Forest lands. Also, include mine/mill wastes located entirely on private land if it is visually effecting or is very likely to be effecting National Forest resources. In this case enter data for the point at which a discharge from the waste flows onto National Forest land, or where wastes has migrated onto National Forest land; only enter as much information about the waste as relevant and practicable.

TABLE 2 - DUMPS, TAILINGS, AND SPOIL PILES

Waste Number						
Waste Type						
Ownership						
Area (acres)						
Volume (cu yds)						
Size of Material						
Wind Erosion						
Vegetation						
Surface Drainage						
Indicators of Metals						
Stability						
Location with respect to Floodplain						
Distance to Stream						
Water Sample #						
Waste Sample #						
Soil Sample #						
Photo Number						

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Waste Type: WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon, ORE=Ore Stockpile, HEAP=Heap Leach

Ownership: NF=National Forest, MIX=National Forest and Private (Also, for unknown), PRV=Private

Size of material (If composed of different size fractions, enter the sizes that are present in significant amounts): FINE=Finer than sand, SAND=sand, GRAVEL=>sand and <2", COBBLE=2"-6", BOULD=>6"

Wind Erosion, Potential for: HIGH=Fine, dry material that could easily become airborne, airborne dust, or windblown deposits, MOD=Moderate, Some fine material, or fine material that is usually wet or partially cemented; LOW=Little if any fines, or fines that are wet year-round or well cemented.

Vegetation (density on waste): DENSE=Ground cover > 75%, MOD=Ground cover 25% - 75%, SPARSE=Ground cover < 25%, BARREN=Barren

Surface Drainage (Include all that apply): RILL=Surface flow channels mostly < 1' deep, GULLY=Flow channels >1' deep, SEEP=Intermittant or continuous discharge from waste deposit, POND=Seasonal or permanent ponds on feature, BREACH=Breached, NO=No indicators of surface flow observe

Indicators of Metals (Enter as many as exist): NO=None, VEG=Absence of or stressed vegetation, STAIN=yellow, orange, or red precipitate, SALT=Salt deposits, SULF=Sulfides present

Stability: EMER=Imminent mass failure, LIKE=Potential for mass failure, LOW=mass failure unlikely

Location w/respect to Stream: IN=In contact with normal stream, NEAR=In riparian zone or floodplain, OUT=Out of floodplain

8. SAMPLES

Take samples only on National Forest lands.

TABLE 3 - WATER SAMPLES FROM MINE SITE DISCHARGES

Sample Number						
Date sample taken						
Sampler (Initials)						
Discharging From						
Feature Number						
Indicators of Metal Release						
Indicators of Sedimentation						
Distance to stream (ft)						
Sample Latitude						
Sample Longitude						
Field pH						
Field SC						
Flow (gpm)						
Method of measurement						
Photo Number						

Comments: (When commenting on a specific water sample, reference sample number used in Table 3):

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Discharging From: ADIT=Adit, SHAFT=Shaft, PIT=Pit/Trench, HOLE=Prospect Hole, WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon, WELL=Well

Feature Number: Corresponding number from Table 1 or Table 2 (Opening Number or Waste Number)

Indicators of Metal Release (Enter as many as exist): NO=None, VEG=Absence of, or stressed vegetation/organisms in and along drainage path, STAIN=yellow, orange, or red precipitate, SALT=Salt deposits, SULF=Sulfides present, TURB=Discolored or turbid discharge

Indicators of Sedimentation (Enter as many as exist): NO=None, SLIGHT=Some sedimentation in channel, banks and channel largely intact, MOD=Sediment deposits in channel, affecting flow patterns, banks largely intact, SIGN=Sediment deposits in channel and/or along stream banks extending to nearest stream

Method of Measurement: EST=Estimate, BUCK=Bucket and time, METER=Flow meter

TABLE 4 - WATER SAMPLES FROM STREAM(S)

Location relative to mine site/features	Upstream (Background)	Downstream		
Sample Number				
Date sample taken				
Sampler (Initials)				
Stream Name				
Indicators of Metal Release				
Indicators of Sedimentation				
Sample Latitude				
Sample Longitude				
Field pH				
Field SC				
Flow (gpm)				
Method of measurement				
Photo Number				

Comments: (When commenting on a specific water sample, reference sample number used in Table 4):

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Indicators of Metal Release (Enter as many as exist): NO=None, VEG=Absence of, or stressed streamside vegetation/organisms in and along drainage path, STAIN=yellow, orange, or red precipitate, SALT=Salt deposits, SULF=Sulfides present, TURB=Discolored or turbid discharge

Indicators of Sedimentation (Enter as many as exist): NO=None, SLIGHT=Some sedimentation in channel, natural banks and channel largely intact, MOD=Sediment deposits in channel, affecting stream flow patterns, natural banks largely intact, SIGN=Sediment deposits in channel and/or along stream banks extending ½ a mile or more downstream

Method of Measurement: EST=Estimate, BUCK=Bucket and time, METER=Flow meter

TABLE 5 - WASTE SAMPLES

Sample Number				
Date of sample				
Sampler (<i>Initials</i>)				
Sample Type				
Waste Type				
Feature Number				
Sample Latitude				
Sample Longitude				
Photo Number				

Comments: *(When commenting on a specific waste or soil sample, reference sample number used in Table 5):*

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Sample Type: SING=Single sample, COMP=composite sample (enter length)

Waste Type: WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, HIGH=Highwall, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon sludge, ORE=Ore Stockpile, HEAP=Heap Leach

Feature Number: Corresponding number from Table 2 (*Waste Number*)

TABLE 6 - SOIL SAMPLES

Sample Number				
Date of sample				
Sampler (<i>Initials</i>)				
Sample Type				
Sample Latitude				
Sample Longitude				
Likely Source of Contamination				
Feature Number				
Indicators of Contamination				
Photo Number				

Comments: (When commenting on a specific waste or soil sample, reference sample number used in Table 6):

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Sample Type: SING=Single sample, COMP=composite sample (enter length)

Likely Source of Contamination: ADIT=Adit, SHAFT=Shaft, PIT=Open Pit, HOLE=Prospect Hole, WASTE=Waste rock dump, MILL=Mill tailings, SPOIL=Overburden or spoil pile, PLACER=Placer or hydraulic deposit, POND=Settling pond or lagoon, ORE=Ore Stockpile, HEAP=Heap Leach

Feature Number: Corresponding number from Table 1 or 2 (*Opening or Waste Number*)

Indicators of Contamination (*Enter as many as exist*): NO=None, VEG=Absence of vegetation, PATH=Visible sediment path, COLOR=Different color of soil than surrounding soil, SALT=Salt crystals

9. HAZARDOUS WASTES/MATERIALS

TABLE 7 - HAZARDOUS WASTES/MATERIALS

Waste Number				
Type of Containment				
Condition of Containment				
Contents				
Estimated Quantity of Waste				

Comments: *(When commenting on a specific hazardous waste or site condition, reference waste number used in Table 7):*

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments,
NO=NO or none

Type of Containment: NO=None, LID=drum/barrel/vat with lid, AIR=drum/barrel/vat without lid,
CAN=cans/jars, LINE=lined impoundment, EARTH=unlined impoundment

Condition of Containment: GOOD=Container in good condition, leaks unlikely, FAIR=Container has some
signs of rust, cracks, damage but looks sound, leaks possible, POOR=Container has visible holes,
cracks or damage, leaks likely, BAD=Pieces of containers on site, could not contain waste

Contents: from label if available, or guess the type of waste, e.g., petroleum product, solvent, processing
chemical.

Estimated Quantity of Waste: Quantity still contained and quantity released

10. STRUCTURES

For structures on or partially on National Forest lands.

TABLE 8 - STRUCTURES

Type						
Number						
Condition						
Photo Number						

Comments:

Codes Applicable for all entries: NA= Not applicable, UNK=Unknown, OTHER=Explain in comments, NO=NO or none

Type: CABIN=Cabin or community service (*store, church, etc.*), MILL=mill building, MINE=building related to mine operation, STOR=storage shed, FLUME=Ore Chute/flume or tracks for ore transport

Number: Number of particular type of structure all in similar condition or length in feet

Condition: GOOD=all components of structure intact and appears stable, FAIR=most components present but signs of deterioration, POOR=major component (*roof, wall, etc*) of structure has collapsed or is on the verge of collapsing, BAD=more than half of the structure has collapsed

11. MISCELLANEOUS

Are any of the following present? (Check all that apply): ☐ Acrid Odor, ☐ Drums,
☐ Pipe, ☐ Poles, ☐ Scrap Metal, ☐ Overhead wires,
☐ Overhead cables, ☐ Headframes, ☐ Wooden Structures,
☐ Towers, ☐ Power Substations, ☐ Antennae, ☐ Trestles,
☐ Powerlines, ☐ Transformers, ☐ Tramways, ☐ Flumes,
☐ Tram Buckets, ☐ Fences, ☐ Machinery, ☐ Garbage

Describe any obvious removal actions that are needed at this site:

General Comments/Observations (not otherwise covered)

12. SITE MAP

Prepare a sketch of the site. Indicate all pertinent features of the site and nearby environment. Include all significant mine and surface water features, access roads, structures, etc. Number each important feature at the mine site and use these number throughout this form when referring to a particular feature (Tables 1 and 2). Sketch the drainage routes off the site into the nearest stream.

13. RECORDED INFORMATION

Owner(s) of patented land

Name: _____

Address: _____

Telephone Number: _____

Claimant(s)

Name: _____

Address: _____

Telephone Number: _____

Surface Water (*From water rights*)

Number of Surface Water Intakes within 15 miles downstream of site used for:

_____ Domestic, _____ Municipal, _____ Irrigation, _____ Stock,
_____ Commerical/Industrial, _____ Fish Pond, _____ Mining,
_____ Recreation, _____ Other

Wells (*From well logs*)

Nearest well _____ miles

Number of wells within _____ 0-1/4 miles _____ 1/4-1/2 miles _____ 1/2-1 mile _____ 1-2 miles
_____ 2-3 miles _____ 3-4 miles of site

Sensitive Environments

List any sensitive environments (as listed in the HRS) within 2 miles of the site or along receiving stream for 15 miles downstream of site (*wetlands, wilderness, national/state park, wildlife refuge, wild and scenic river, T&E or T&E habitat, etc*):

Population (*From census data*)

Population within _____ 0-1/4 miles _____ 1/4-1/2 miles _____ 1/2-1 mile _____ 1-2 miles
_____ 2-3 miles _____ 3-4 miles of site

Public Interest

Level of Public Interest: _____ Low, _____ Medium, _____ High

Is the site under regulatory or legal action? _____ Yes, _____ No

Other sources of information (MILs #, MRDS #, other sampling data, etc):

APPENDIX II

ABANDONED - INACTIVE MINE SITES
WITH POTENTIAL TO AFFECT
THE DEERLODGE NATIONAL FOREST

CODE	MINE NAME	QUADRANGLE	CODE	MINE NAME	QUADRANGLE
V	16:1	DELMOE LAKE	V	BISMARCK TAILINGS	NOBLE PEAK
X	2 PERCENT	PHILPSBURG	V	BISON CANYON MINE	BISON CANYON
X	2ND CHANCE ORE	MAXVILLE	V	BLACK BEAR	MOUNT THOMPSON
U	6354	DELMOE LAKE	X	BLACK CHIEF IRON	WEST VALLEY
X	A&B	LOCKHART MEADOWS	U	BLACK EAGLE	FRED BURR LAKE
V	A&M PROSPECT	MAXVILLE	X	BLACK MOON	SILVER LAKE
V	ABBOT	SILVER LAKE	S	BLACK SHIRT	SILVER LAKE
V	ADA	BASIN	V	BLACK-EYED MAY	BAGGS CREEK
V	ADELAIDE	BASIN	S	BLACKBIRD CLAIM	ELKHORN
S	ADIT	MOUNT HUMBUG	X	BLACKMAIL	PHILPSBURG
S	AIREDALE PROSPECT	WHETSTONE RIDGE	X	BLER	WEST VALLEY
V	AJAX	RATIO MOUNTAIN	V	BLOOMINGTON	PIKES PEAK
V	ALBION MINE	PIKES PEAK	V	BLOOMINGTON MILL	PIKES PEAK
S	ALDER GULCH PLACER	ALDER GULCH	S	BLUE BIRD MINE	PIKES PEAK
X	ALGONGUIN	PHILPSBURG	V	BLUE BOTTLE	WEST VALLEY
V	ALLPORT	BISON CANYON	V	BLUE DIAMOND	MOUNT THOMPSON
U	ALTURAS	SILVER LAKE	S	BLUE DIAMOND PROSPECT	PIKES PEAK
X	AM SELEY MINE	ALDER GULCH	V	BLUE ROCK LODGE	DELMOE LAKE
V	AMAZON	POZEGA LAKES	V	BLUE-EYED NELLIE	WEST VALLEY
S	AMERICAN BEAUTY	PIKES PEAK	V	BLUEBELL - MARSH	DELMOE LAKE
S	AMERICAN FLAG	FRED BURR LAKE	X	BLUEBELL HEALTH	BASIN
S	AMETHYST PROSPECT	PIKES PEAK	S	BLUEBIRD	CARPP RIDGE
X	ANACONDA QUARRIES	WEST VALLEY	V	BLUEBIRD	PIKES PEAK
X	ANACONDA QUARRIES	WEST VALLEY	S	BLUEBIRD CLAIM PROSPECT	PIKES PEAK
U	ANDERSON PROSPECT	WHETSTONE RIDGE	S	BLUESTREAK	PIKES PEAK
S	ANNIE	HENDERSON MOUNTAIN	S	BM COR	PIKES PEAK
V	ANTELOPE	WEST VALLEY	X	BOAZ	CHESSMAN RESERVOIR
X	ANTELOPE CHROMITE	PONY	X	BOB EVANS MINE	GEORGETOWN LAKE
X	ANTONIOTI QUARRY	TUCKER CREEK	U	BOB LODGE - 1KM	ELKHORN
X	APEX	SILVER LAKE	X	BOMES MINE	MAXVILLE
X	APEX #2	WICKIUP CREEK	V	BONANZA	BAGGS CREEK
V	APOLLO	MOUNT THOMPSON	X	BONANZA	HENDERSON MOUNTAIN
V	APRIL	SHEEPSHEAD MOUNTAIN	X	BONANZA JACK	BASIN
V	AQUIRIUS	BASIN	X	BONANZA MINE	MANHEAD MOUNTAIN
S	ARCHEGAN	MAXVILLE	V	BOULAWAY - BULWER	ELKHORN
S	AREA NORTH	WEST VALLEY	V	BOULDER	BASIN
V	ARGO	SPINK POINT	U	BOULDER	BOULDER WEST
V	ARGUS	BAGGS CREEK	V	BOULDER CHIEF	MOUNT THOMPSON
S	ARROWHEAD & SOUTH AMERICA	MOUNT POWELL	V	BOULDER COBALT	NOBLE PEAK
V	ATLANTIC AND PACIFIC MINE	PONY	V	BOULDER COBALT SHAFT	NOBLE PEAK
V	ATLANTIC AND PACIFIC TAILINGS	PONY	V	BOULDER COBALT WEST	OLD BALDY MOUNTAIN
V	ATTOWA	RATIO MOUNTAIN	S	BOULDER CREEK	MAXVILLE
V	AURORA	BASIN	U	BOULDER CREEK	PIKES PEAK
X	AUTUMN PLACER	SILVER LAKE	S	BOULDER CREEK GRAPHITE	POZEGA LAKES
X	B GROUP	SILVER LAKE	X	BOULDER IRON	TACOMA PARK
V	B&H	OLD BALDY MOUNTAIN	X	BOULDER RIVER PLACER	BASIN
V	B&H TAILINGS	OLD BALDY MOUNTAIN	S	BOURARD LODGE	DUNKLEBERG CREEK
X	BAIER	PHILPSBURG	U	BROONZE LODGE	SILVER LAKE
V	BAKAMA	MOUNT THOMPSON	V	BROOKLYN MILL TAILINGS	PIKES PEAK
U	BALLARAT	PIPESTONE PASS	V	BROOKLYN MINE	PIKES PEAK
S	BALLARD	ROCK CREEK LAKE	V	BROOKS	PIPESTONE PASS
V	BANKER CLAIM	MAXVILLE	X	BROWN PROSPECT	TUCKER CREEK
V	BANKER GROUP	LOCKHART MEADOWS	S	BROWNS QUARRY	WEST VALLEY
V	BANNER MINE	MOOSE LAKE	X	BRYAN	PHILPSBURG
S	BANNER TAILINGS	MOOSE LAKE	V	BUCKEYE	THREE BROTHERS
S	BARBARA ANN	CARPP RIDGE	V	BULL ELK	WEST VALLEY
U	BARICH MINE	PIKES PEAK	V	BULLION	BASIN
X	BARRY DEAN	SUGARLOAF MOUNTAIN	X	BUNKER HILL	HENDERSON MOUNTAIN
V	BASIN	PHILPSBURG	X	BUSTER	BASIN
S	BASIN BELL	BASIN	U	BUTTE & PHILADELPHIA	SHEEPSHEAD MOUNTAIN
S	BASIN CREEK PLACER	BASIN	U	BUTTE - ELK PARK or EUREKA	SHEEPSHEAD MOUNTAIN
U	BASIN CREEK PLACER	MOUNT HUMBUG	U	BUTTE TUNGSTEN	ELK PARK PASS
V	BASIN GOLD & SILVER	BASIN	V	C&D	ELKHORN
X	BASIN GOLDFIELDS	BASIN	X	CABE	SILVER LAKE
X	BASIN JIBE MINE	BASIN	S	CABLE MINE	SILVER LAKE
X	BASIN QUARRY	BASIN	S	CABLE PLACER	SILVER LAKE
S	BASIN TOWNSITE	BASIN	X	CADGIE TAYLOR	PHILPSBURG
U	BATTERTON BAR	ROCK CREEK LAKE	X	CALCABE	SILVER LAKE
S	BAYARD	WATERLOO	X	CALVIN MINE	BASIN
S	BEAL LODGE	DICKIE PEAK	X	CAMBELL PROSPECT	SILVER LAKE
U	BEAR & FLOAT	HENDERSON MOUNTAIN	S	CAMERON	WEST VALLEY
S	BEAR CAT	PIPESTONE PASS	V	CAMP VERDE PLACER	ROCK CREEK LAKE
S	BEAR CREEK PLACER	MOUNT HUMBUG	S	CARBONATOR	WEST VALLEY
S	BEAR GULCH PLACER	OLD BALDY MOUNTAIN	V	CARLA, PAULINE, & FAITH GROUP	SHEEPSHEAD MOUNTAIN
V	BEAVER PLACER	RATIO MOUNTAIN	X	CARLESON MINE	BASIN
X	BEE BEE	MAUKEY GULCH	S	CARLSON MINE	THREE BROTHERS
V	BEEF STRAIGHT	DELMOE LAKE	S	CARMICHAEL CLAIMS	PONY
V	BEEF STRAIGHT NORTH	DELMOE LAKE	X	CARMODY GROUP	ELKHORN
S	BELL	BAGGS CREEK	S	CAROLINE & WILLIAM COLEMAN	SUGARLOAF MOUNTAIN
S	BELLAIRE MINE	DUNKLEBERG CREEK	S	CAROLINE CLAIM	MAXVILLE
X	BELLEFLOWER MINE	HENDERSON MOUNTAIN	V	CASCADE	BISON CANYON
X	BELLUM	PHILPSBURG	V	CASTLE ROCK	NOBLE PEAK
U	BEN HARRISON FRACTURE	PONY	V	CATORACT	MOUNT THOMPSON
V	BENTZ	MAUKEY GULCH	S	CATORACT CREEK PLACER	MOUNT THOMPSON
X	BERG	SILVER LAKE	V	CATORACT TAILINGS	MOUNT THOMPSON
S	BERKIN FLAT	THUNDERBOLT CREEK	V	CETO	STORM LAKE
X	BERNICE	LOCKHART MEADOWS	V	CHAMPION MILL TAILINGS	LOCKHART MEADOWS
V	BERTHA MAY	BAGGS CREEK	V	CHAMPION MINE	LOCKHART MEADOWS
V	BI-METALLIC	FRED BURR LAKE	V	CHAMPION PASS PROSPECT	LOCKHART MEADOWS
V	BIELLENBERG LAKE PROSPECT	PIKES PEAK	S	CHAMPION SHAFT	LOCKHART MEADOWS
X	BIESNAHAN & FENNER	WEST VALLEY	U	CHIEF JOSEPH COPPER - 1KM	ELKHORN
X	BIG & LITTLE GOLDIE	BOULDER EAST	X	CHINESE DIGGINGS	BOULDER WEST
V	BIG BEAR	WEST VALLEY	X	CLIFF	PHILPSBURG
S	BIG BILL	FRED BURR LAKE	U	CLIFF	WEST VALLEY
S	BIG BILL PROSPECT	PIKES PEAK	X	CLIFF GULCH	PHILPSBURG
U	BIG CHIEF	DELMOE LAKE	X	CLIMAX	PHILPSBURG
X	BIG EXPECTATION	FRED BURR LAKE	X	CLIMAX	TUCKER CREEK
V	BIG FOOT	RATIO MOUNTAIN	X	CLIMAX GROUP	TUCKER CREEK
S	BIG FOOT CREEK PLACER	RATIO MOUNTAIN	S	CLIPPER	KELLY LAKE
V	BIG FOUR	RATIO MOUNTAIN	X	CLIPPER	PIKES PEAK
V	BIG MAJOR - NEW BALD EAGLE	BOULDER WEST	S	CLIPPER	WICKIUP CREEK
S	BIGFOOT CREEK PLACER	BOULDER WEST	V	COAL CREEK	OLD BALDY MOUNTAIN
V	BILLIE GOAT	FRED BURR LAKE	S	COBERLY SYNCLINE	PIKES PEAK
V	BILLIE T.	MOUNT THOMPSON	V	COLUMBIA	SHEEPSHEAD MOUNTAIN
X	BIMETALLIC TUNNEL	PHILPSBURG	X	COLUMBIA	WICKIUP CREEK
V	BISHOP IRON	WEST VALLEY	V	COLUMBUS	BASIN
S	BISMARCK IRON PROPERTY	POZEGA LAKES	X	COMANCHE EXT	PHILPSBURG
V	BISMARCK MINE	NOBLE PEAK	V	COMBINATION MILL TAILINGS	BLACK PINE RIDGE

CODE	MINE NAME	QUADRANGLE	CODE	MINE NAME	QUADRANGLE
S	COMET	PIKES PEAK	S	FIRST SHOT-LAST SHOT	BASIN
S	COMINCO PHOSPHATE	MAXVILLE	V	FISH CREEK MINE	MOUNT HUMBUG
V	CONGDON MINE	MOUNT EMERINE	S	FISH CREEK PLACERS	PIPESTONE PASS
V	CONNIE JOE	DELMOE LAKE	X	FLAGSTAFF HILL	PHILIPSBURG
U	CONSTELLATION VERMICULITE	PONY	S	FLEECER MTN AREA	DEWEY
V	CONTACT #1	PIKES PEAK	S	FLINT CREEK	SILVER LAKE
U	COPPER CLIFF	BAGGS CREEK	X	FLORENCE	WHITEHALL
V	COPPER CREEK	MAXVILLE	V	FLUME GULCH MINE	OROFINO MOUNTAIN
X	COPPER JACK	PHILIPSBURG	V	FOREST ROSE MILL TAILINGS	DUNKLEBERG CREEK
U	COPPER LODE	MAXVILLE	V	FOREST ROSE MINE	DUNKLEBERG CREEK
S	COPPER LODE	MOUNT POWELL	V	FOX	WEST VALLEY
S	COPPER MTN LODE	KELLY LAKE	V	FRANKLIN	THUNDERBOLT CREEK
U	COPPER QUEEN	BLACK PINE RIDGE	X	FRANKLIN HILL IRON	PHILIPSBURG
S	COPPER RIDGE PROSPECTS	PIKES PEAK	S	FRANZ	HARVEY POINT
X	COPPER STATE MINE	BLACK PINE RIDGE	V	GALENA GULCH MINE	BOULDER WEST
S	COPPER STATE MINE	HENDERSON MOUNTAIN	S	GARDINER	KELLY LAKE
S	COSMOPOLITAN	ROCK CREEK LAKE	S	GARNY HILL AREA	WEST VALLEY
V	COTTONWOOD MINE	LOCKHART MEADOWS	V	GARRETT	SILVER LAKE
S	COUGAR	ROCK CREEK LAKE	U	GENERAL JACKSON MINE	NOBLE PEAK
X	COYLE	PHILIPSBURG	X	GENERAL WHASHINGTON PLACER	HENDERSON MOUNTAIN
V	CRACKER	MOUNT THOMPSON	V	GEORGE	WEST VALLEY
V	CRAIG PROSPECT	NOBLE PEAK	X	GEORGETOWN PLACERS	SILVER LAKE
U	CREDIN MINES?	BASIN	X	GERMAN GULCH	DICKIE PEAK
V	CRESCENT	CHESSMAN RESERVOIR	X	GERTRUDE	PHILIPSBURG
U	CRYSTAL BUTTE	NOBLE PEAK	V	GIANT	OLD BALDY MOUNTAIN
V	CRYSTAL MINE	BASIN	S	GILT EDGE PROSPECT	PIKES PEAK
S	CULUER MINE	DUNKLEBERG CREEK	X	GIRD CREEK	MAXVILLE
V	CURLY BILL	NOBLE PEAK	X	GIRD CREEK SYNCLINE	MAXVILLE
V	CURLY GULCH ADITS	MOUNT HUMBUG	S	GMLC FRIDAY	SPINK POINT
V	CUSTER	MOUNT THOMPSON	S	GOAT MOUNTAIN	PIKES PEAK
V	DAILY WEST MINE	BASIN	S	GOLD CREEK SYNCLINE	PIKES PEAK
X	DALY GULCH	SILVER LAKE	X	GOLD DUST	MOUNT HUMBUG
X	DALY PLACER	SILVER LAKE	V	GOLD HILL	MOUNT HUMBUG
V	DANIELSVILLE	POZEGA LAKES	V	GOLD HILL MILL	MOUNT HUMBUG
V	DARK HORSE	MOUNT POWELL	X	GOLD HILL MINES	WHITEHALL
V	DARK HORSE MILL	MOUNT POWELL	V	GOLD KING MINE	MAXVILLE
S	DAUGHTERS PROSPECT	PIKES PEAK	V	GOLD LEAF	WHETSTONE RIDGE
X	DAY & HARVEY	MOUNT HUMBUG	U	GOLD PRINCE	MAUKEY GULCH
V	DEAD COW ADIT	OROFINO MOUNTAIN	V	GOLD REEF MINE	MAXVILLE
S	DEAD END	THUNDERBOLT CREEK	X	GOLDEN CURRY MINE	ELKHORN
U	DECIEVER	ROCK CREEK LAKE	V	GOLDEN EAGLE	SILVER LAKE
S	DEER HUNTER PROSPECT	HENDERSON MOUNTAIN	V	GOLDEN GIRL #4	WHITETAIL PEAK
V	DEER LODGE BASIN PROSPECTS	PIKES PEAK	V	GOLDEN GLOW	THREE BROTHERS
S	DELTA	SILVER LAKE	V	GOLDEN JUBILEE	FRED BURR LAKE
V	DENNY PROSPECT	PIPESTONE PASS	V	GOLDEN MOSS MINE	ELKHORN
X	DERBY MORNING	PHILIPSBURG	U	GOLDEN SURPRISE	MOUNT HUMBUG
S	DEWEY PROSPECT	PIKES PEAK	X	GOLDEN VALLEY/MINNIE WILSON	DELMOE LAKE
U	DG CLAIMS	POZEGA LAKES	V	GOPEL HILL ADIT	LOCKHART MEADOWS
V	DIAMOND CITY	RATIO MOUNTAIN	S	GOULD CARRY LODE	FRED BURR LAKE
X	DIAMOND PLACER	ANACONDA NORTH	V	GRANITE	FRED BURR LAKE
V	DING BAT & BLUE-EYED MAGGIE	BAGGS CREEK	X	GRANITE BELL	FRED BURR LAKE
V	DING BAT - BLUE EYED MAGGIE	SUGARLOAF MOUNTAIN	S	GRANITE CREEK PROSPECT	POZEGA LAKES
X	DISSETT MINE	PHILIPSBURG	V	GRANITE RUBY SHAFT	FRED BURR LAKE
S	DOLE PROSPECT	ROCK CREEK LAKE	X	GRANITE TAILING	PHILIPSBURG
U	DORA LEIGH & MCCAULEY LEAD	WILSON PARK	X	GRAVEL PIT	PHILIPSBURG
U	DORA LEIGH & MCCAULEY LEAD	WILSON PARK	V	GRAY LEAD	MOUNT THOMPSON
V	DORIS	BASIN	X	GRAY ROCK / BUNG YOUR EYE	WEST VALLEY
V	DOUBLE EAGLE PROSPECT	BLACK PINE RIDGE	V	GREAT EASTERN	ANACONDA NORTH
V	DOUGHERTY MILL	SILVER LAKE	S	GREAT SHIELD URANIUM	MOUNT THOMPSON
X	DOUGLAS CREEK	PHILIPSBURG	X	GREAT WEST/SHOOFLY	PHILIPSBURG
S	DOUGLAS CREEK SYNCLINE	MAXVILLE	V	GREATER NEW YORK	FRED BURR LAKE
V	DOUGLAS MILL	HENDERSON MOUNTAIN	V	GROUSE MINE	OLD BALDY MOUNTAIN
V	DOUGLAS MINE	HENDERSON MOUNTAIN	S	GRUBSTAKE	SILVER LAKE
V	DRY BOULDER IRON	NOBLE PEAK	X	GYP PROSPECT	SILVER LAKE
X	DRY COTTONWOOD CREEK	OROFINO MOUNTAIN	X	H & H CLAIM	PHILIPSBURG
S	DRY GULCH PLACER	MOUNT POWELL	S	H.O. GROUP	PIKES PEAK
X	DUMAS	GRACE	V	HALFWAY PARK PLACER	WHITETAIL PEAK
V	DUMERTIORITE PROSPECT	BASIN	S	HAM GULCH	MAXVILLE
U	DUNKLEBERG	DUNKLEBERG CREEK	S	HAMILTON	OLD BALDY MOUNTAIN
X	DUNSTONE	ELKHORN	V	HANNA	FRED BURR LAKE
X	DURAND	MAXVILLE	V	HANNA	MOUNT THOMPSON
X	DURANGO	PHILIPSBURG	V	HANNA TAILINGS	FRED BURR LAKE
X	DURANGO & MOONLIGHT GROUP	PHILIPSBURG	V	HANNON - CLAY CHARLIO	SILVER LAKE
U	E.X.L.	PIPESTONE PASS	V	HANSON MELOY SILVER MOSS	SILVER LAKE
V	EAGER	WICKIUP CREEK	X	HARDCASH	ELKHORN
X	EAGLE BUTTE MINE	ELKHORN	S	HARRY MILLER CLAIM	MAXVILLE
S	EAGLE CLAIM	HENDERSON MOUNTAIN	S	HATTA MINE & MAGNET MINES	DUNKLEBERG CREEK
U	EAGLE HILL & IRON BAR LODES	ELKHORN	V	HATTIE FERGUSON	MOUNT THOMPSON
V	EAST MOUNTAIN LION	MAXVILLE	V	HAWKEYE	THREE BROTHERS
S	EAST RIDGE GROUP	ELK PARK PASS	X	HEADLIGHT	PHILIPSBURG
X	EAST SOAP GULCH IRON	WICKIUP CREEK	X	HEAGAN	ELKHORN
U	ECLIPSE CLAIM	ELKHORN	V	HEANEY MINE	WHETSTONE RIDGE
X	EDNA - KIBLER PROSPECT	PIPESTONE PASS	V	HECTOR	BASIN
S	EDWIN E. GRAUPHER PROSPECT	PIKES PEAK	X	HEILMAN CLAIM	MAXVILLE
V	ELDERADO	PIKES PEAK	X	HELEHAN PROSPECT	DEWEY
X	ELIZABETH	PHILIPSBURG	S	HELL'S CANYON PLACER	TABLE MOUNTAIN
V	ELIZABETH - LITTLE EMERY	BAGGS CREEK	V	HELPER MINE	BASIN
X	ELIZABETH SHAFT	PHILIPSBURG	X	HENDERSON CREEK	HENDERSON MOUNTAIN
V	ELKHORN BUCKHORN	MOUNT HUMBUG	X	HENDERSON MINE	HENDERSON MOUNTAIN
S	ELKHORN CREEK PLACER	TACOMA PARK	V	HENRY	DUNKLEBERG CREEK
X	ELKHORN MINE	ELKHORN	U	HENRY THOMAS	GRIFFIN CREEK
V	ELKHORN PEAK IRON	ELKHORN	V	HERCULESE	BAGGS CREEK
S	ELKHORN QUEEN	TACOMA PARK	X	HESPARIA & MINORIA	WEST VALLEY
X	ELKHORN RIDGE PROSPECT	ELKHORN	V	HIDDEN LAKE TAILINGS	SILVER LAKE
V	ELMER	BASIN	S	HIDDEN LAKE TUNGSTEN	KELLY LAKE
V	EMERY	SUGARLOAF MOUNTAIN	V	HIDDEN TREASURE	BASIN
S	EMERY RIDGE PROSPECT	ROCK CREEK LAKE	V	HIGH UP	ELKHORN
V	EMMA DARLING	BAGGS CREEK	V	HIGHLAND	BASIN
V	ENTERPRISE	THREE BROTHERS	V	HIGHLAND	MOUNT HUMBUG
V	ERUBSTAKE	DELMOE LAKE	S	HIGHLAND MARY PROSPECT	MANHEAD MOUNTAIN
S	EUREKA	BISON CANYON	S	HIGHLAND MOUNTAINS AREA	MOUNT HUMBUG
V	EVA MAY	MOUNT THOMPSON	V	HIGHLAND TAILINGS	MOUNT HUMBUG
V	EVA MAY TAILINGS	MOUNT THOMPSON	V	HIGHLAND VIEW	PIPESTONE PASS
U	EVENING STAR & GOLDEN ASSETS M	BASIN	V	HLM	SILVER LAKE
X	FAST KATIE	BASIN	U	HOBO GULCH PROSPECT	ELKHORN
X	FIELD	PHILIPSBURG	V	HOBO/T HAYES	PHILIPSBURG
X	FIELDS	MAXVILLE	X	HOLDFAST	SILVER LAKE
S	FINLAY BASIN PROSPECT	POZEGA LAKES	S	HOMER CLAIM	MAXVILLE

CODE	MINE NAME	QUADRANGLE	CODE	MINE NAME	QUADRANGLE
V	HOMESTAKE	PIKES PEAK	V	LOWER HATTIE FERGUSON	MOUNT THOMPSON
V	HOMESTAKE	WEST VALLEY	V	LOWER HIDDE HAND	BAGGS CREEK
X	HONORAH G	SILVER LAKE	V	LOWER VERA & MARIE	MOUNT THOMPSON
U	HOPE	BISON CANYON	V	LOWER WHITE CHIEF	MANHEAD MOUNTAIN
X	HOPE HILL	PHILIPSBURG	V	LUCKY ARROWHEAD	WEST VALLEY
X	HOPE KATIE, KATIE EXT	BASIN	X	LUCKY BLUE	SILVER LAKE
V	HORSHOE BEND	SILVER LAKE	S	LUCKY SEVEN	CARPP RIDGE
X	HORTON & SANDERS	PHILIPSBURG	U	LUCKY STRIKE	MOOSE LAKE
X	HOWARD CLAIM	MAXVILLE	X	LUCY	PHILIPSBURG
X	HUFFFMAN	PHILIPSBURG	S	LUKE	WARREN PEAK
V	HUGHES	PIKES PEAK	S	LUKE SI QUARRY	WEST VALLEY
U	HUMBOLT	WHITETAIL PEAK	V	LULA BELL	THREE BROTHERS
X	IB	PHILIPSBURG	X	LUXANBURG	ELKHORN
V	IDA M.	MOUNT THOMPSON	X	LUXEMBURG	SILVER LAKE
V	IDA MAY	CHESSMAN RESERVOIR	S	LYON PLACER	MAXVILLE
X	ILLGON	PHILIPSBURG	V	M&M PLACER	PIKES PEAK
S	INCLINE	BAGGS CREEK	V	M&T + MYERS	MOOSE LAKE
V	INDEPENDENCE	PIKES PEAK	V	M. FK. DOUGLAS CREEK PHOSPHATE	PIKES PEAK
V	INDIAN HEAD ROCK DEPOSITS	BASIN	S	MACFARLAND PLACER	PIKES PEAK
A	INDIANA PROSPECT	WHETSTONE RIDGE	S	MAIN RANGE BERYL	MOUNT EVANS
X	INDUSTRIAL SILICA	MOUNT THOMPSON	X	MAMMOTH MINE	MANHEAD MOUNTAIN
V	INFINITE	THUNDERBOLT CREEK	V	MANHATTAN	MOUNT THOMPSON
V	INHA PROSPECT	NOBLE PEAK	V	MANTLE & S. MANTLE	MOUNT THOMPSON
X	IRON AGE MINE	PHILIPSBURG	V	MARGUERITE	BASIN
V	IRON CLIFF	PIPESTONE PASS	X	MARIE CLAIM	PHILIPSBURG
X	IRON KING	WHITEHALL	X	MARONEY CLAIM	PHILIPSBURG
S	IRON MOUNTAIN	THUNDERBOLT CREEK	S	MARY ANN	MOUNT HUMBURG
S	IRON MOUNTAIN PLACER	TABLE MOUNTAIN	V	MARY ANNE	BASIN
X	ISABELLA	PHILIPSBURG	X	MARY B	PHILIPSBURG
X	ISABELLE	SILVER LAKE	X	MARY FRANCIS CLAIM	TUCKER CREEK
U	IVANHOE LAKE	KELLY LAKE	V	MASCOT	DELMOE LAKE
S	IVANHOE MINE	PIKES PEAK	V	MASCOT EXTENSION	DELMOE LAKE
U	JACK CREEK	WILSON PARK	S	MASTER MINE	PIKES PEAK
S	JACK CREEK RIDGE	BASIN	V	MATHESON	BAGGS CREEK
U	JACK MINE	RATIO MOUNTAIN	X	MAXVILLE TAILINGS	MAXVILLE
S	JACK MTN IRON	BASIN	V	MAY DAY	BOULDER WEST
X	JACQUELINE	DICKIE PEAK	S	MAY LITTY	THREE BROTHERS
X	JAMES R. KEENE	ELKHORN	X	MAYFLOWER / GOLD CROWN	WEST VALLEY
S	JASPER & MATTHICH	WARREN PEAK	S	MAYFLOWER LODE	KELLY LAKE
V	JEFFERSON	MAXVILLE	S	MAYFLOWER PROSPECT	WHETSTONE RIDGE
V	JESSIE	BASIN	V	MAYFLOWER VEIN	MAXVILLE
X	JETTY MINE	WEST VALLEY	S	MAYVILLE PHOSPHATE	MAXVILLE
X	JIB SHAFT	BASIN	S	MAYWOOD PLACER	MAXVILLE
V	JIM JR.	WHITETAIL PEAK	X	MCDONALD MINE	MAUKEY GULCH
X	JOE HANKS CLAIM	HENDERSON MOUNTAIN	U	MCKAY ADIT	SILVER LAKE
X	JOE METESH LESSEE	BASIN	V	MEMPHIS	SHEEPSHEAD MOUNTAIN
V	JOHN G. CARLISLE	PIKES PEAK	X	MERRY WIDOW	MOUNT THOMPSON
V	JOHN T.	MOUNT THOMPSON	X	MIDDLE OF THE ROAD PYRENEES	SILVER LAKE
S	JOHNSON CLAIM	HENDERSON MOUNTAIN	V	MIDNIGHT	NOBLE PEAK
V	JOKER PROSPECT	WHETSTONE RIDGE	V	MIKE	MOUNT THOMPSON
S	JOLEAN PROSPECT	PIKES PEAK	V	MILLERS PROSPECT	WHETSTONE RIDGE
S	JOSEPHINE	THREE BROTHERS	X	MINE	ALDER GULCH
S	JP PROSPECT	WHETSTONE RIDGE	S	MINER'S GULCH PLACER	ALDER GULCH
V	JULIA LEE	TABLE MOUNTAIN	U	MINERAL HILL	PONY
V	JUMBO	MOUNT THOMPSON	X	MINNCHAH & HORSHOE GROUP	SILVER LAKE
X	JUPITER	DELMOE LAKE	V	MINNEAPOLIS	MOUNT THOMPSON
X	KASERMAN	WICKIUP CREEK	V	MINNIE LEE	STORM LAKE
V	KELLERS HEM DEPOSIT	BASIN	X	MITCHELL	PHILIPSBURG
S	KELLY & IRVING PITS	ROCK CREEK LAKE	U	MOCCASON	BASIN
X	KENNEDY MINE	MAUKEY GULCH	S	MODESTY CREEK	MOUNT POWELL
V	KENT	MOUNT EMERINE	V	MODOC	FRED BURR LAKE
U	KENTUCKY IRISHMAN	DELMOE LAKE	V	MOGULLIAN	NOBLE PEAK
X	KING & QUEEN CLAIMS	WICKIUP CREEK	V	MOHAWK	WEST VALLEY
V	KING MINE	DELMOE LAKE	V	MONARCH MINE	DUNKLEBERG CREEK
V	KIRKENDAL / KOSKI	PIKES PEAK	S	MONITOR MINE	DUNKLEBERG CREEK
V	KIT CARSON	SHEEPSHEAD MOUNTAIN	S	MONK - HEADACHE	STORM LAKE
V	KLONDYKE	MOUNT THOMPSON	V	MONTANA MINE	FRED BURR LAKE
S	KOHR'S & BIELENBERG PIT	ROCK CREEK LAKE	X	MONTANA MINE	SILVER LAKE
S	KOHR'S & BIELENBERG PLACER	ROCK CREEK LAKE	V	MONTREAL STAR	ELK PARK PASS
X	KRUEGER	OLD BALDY MOUNTAIN	S	MOONDYNE	PIKES PEAK
S	KURT PEAK OCCURRENCE	STORM LAKE	S	MOONEY CLAIM - UR	BUXTON
X	L. FROST CREEK	PHILIPSBURG	S	MOONLIGHT	SILVER LAKE
S	LADY HENNESSY	THREE BROTHERS	S	MOOSE CREEK	MOUNT HUMBURG
V	LADY LEITH	THREE BROTHERS	S	MOOSE FISH CREEK TRAVERSE	PIPESTONE PASS
S	LAKE VIEW PROSPECT	ROCK CREEK LAKE	V	MOOSE LAKE TAILINGS	MOOSE LAKE
S	LANCASTER PROSPECT	PIKES PEAK	S	MOOSE TRAIL	MAUKEY GULCH
V	LARK	POZEGA LAKES	X	MOREAU	ELKHORN
X	LAST CHANCE	BASIN	V	MORGAN EVANS	WEST VALLEY
X	LAST CHANCE	HENDERSON MOUNTAIN	V	MORNING GLORY	MOUNT THOMPSON
S	LAST CHANCE MINE	HENDERSON MOUNTAIN	V	MORNING GLORY TAILINGS	MOUNT THOMPSON
S	LAST CHANCE PROSPECT	WHETSTONE RIDGE	V	MORNING MARIE	MOUNT THOMPSON
S	LEAD STREAK	MAXVILLE	V	MORNING MINE	BASIN
V	LEADVILLE	SUGARLOAF MOUNTAIN	V	MORNING STAR	PIKES PEAK
U	LEROY QUARTZ LODE	TACOMA PARK	V	MORNING STAR MINE?	BASIN
S	LETUS	FRED BURR LAKE	X	MOSCOW MINE	GRACE
X	LEVI BURR	PHILIPSBURG	S	MOTHER VEIN CLAIM	HENDERSON MOUNTAIN
X	LIMESTONE	DICKIE PEAK	X	MOUNTAIN BOY	MANHEAD MOUNTAIN
S	LIMESTONE PROSPECTS	SILVER LAKE	S	MOUNTAIN CHIEF	DUNKLEBERG CREEK
V	LIMESTONE QUARRY	PIPESTONE PASS	V	MOUNTAIN LION MINE	MAXVILLE
X	LITTLE DANDY	PHILIPSBURG	S	MOUNTAIN PARK TUNGSTEN	PIKES PEAK
S	LITTLE DARLING	OROFINO MOUNTAIN	V	MOUNTAIN QUEEN	RATIO MOUNTAIN
X	LITTLE EMMA & HOMESTEAD	PHILIPSBURG	S	MOUNTAIN TOP CLAIMS	PIKES PEAK
S	LITTLE GOLD CREEK PLACER	PIKES PEAK	U	MOUNTAIN VIEW COPPER	HENDERSON MOUNTAIN
S	LITTLE JOE	CARPP RIDGE	V	MT THOMPSON	MOUNT THOMPSON
S	LITTLE WONDER PROSPECT	WHETSTONE RIDGE	X	MTN BOY & WEHGER #2	PHILIPSBURG
V	LIZZIE OSBORNE	MOUNT THOMPSON	V	MTN CHIEF	MOUNT THOMPSON
V	LOG CABIN	WHETSTONE RIDGE	X	MTN VIEW	GEORGETOWN LAKE
V	LOIS	PIKES PEAK	S	MUDHOLE	PIKES PEAK
X	LONDON BERRY	MAXVILLE	X	MULLEN & LITTLE GEM	PHILIPSBURG
S	LOOKOUT	WARREN PEAK	S	MULONEY BASIN PROSPECT	CARPP RIDGE
S	LOOKOUT PROSPECT	HENDERSON MOUNTAIN	S	MULONEY MINE	CARPP RIDGE
X	LOST CREEK PLACER	ANACONDA NORTH	V	MYSTERY	OROFINO MOUNTAIN
X	LOTTA	BASIN	X	MYSTERY NG	PHILIPSBURG
V	LOUISE	BASIN	V	McPHAIL	PIPESTONE PASS
S	LOUISE MINE	ELKHORN	U	N462741	BASIN
V	LOWER BROOKLYN	MAXVILLE	S	NANCY LEE PROSPECT	WHETSTONE RIDGE
V	LOWER BUCKEY MILL TAILINGS	THREE BROTHERS	S	NATIONAL TUNGSTEN & SILVER CO	POZEGA LAKES
X	LOWER GEORGETOWN	GEORGETOWN LAKE	S	NE SEC 7 GIRD CREEK PROS	MAXVILLE

CODE	MINE NAME	QUADRANGLE	CODE	MINE NAME	QUADRANGLE
X	NEEDLE GUN CLAIM	FRED BURR LAKE	V	RED ROCK MINE	BASIN
V	NELLIE BARNES	MAXVILLE	X	RED ROSE	SILVER LAKE
U	NELSON PROSPECT	SUGARLOAF MOUNTAIN	V	RED WING	PIPESTONE PASS
S	NEVADA	OROFINO MOUNTAIN	V	REDEEMER	BAGGS CREEK
X	NEW HOPE	SILVER LAKE	X	REDEMPTION	PHILIPSBURG
X	NEW HOPE CLAIM	PHILIPSBURG	X	REDFERN	MOUNT HUMBUG
U	NEW MORNING MINE	BOULDER WEST	X	RELANCE	SILVER LAKE
X	NEW SEATTLE	MAXVILLE	U	RELIEF	ELKHORN
V	NEW YEAR	SILVER LAKE	X	REVENUE	SILVER LAKE
S	NEW YORK	PIKES PEAK	S	RICH STRIKE	WEST VALLEY
X	NEWCOMB	DICKIE PEAK	S	RICHMOND OR ONTARIO	SILVER LAKE
S	NFK FLINT CREEK PLACER	SILVER LAKE	X	RIDGEWAY	PONY
V	NICHOLSON	NOBLE PEAK	S	RISING STAR	SILVER LAKE
U	NICKELODEON	BOULDER WEST	V	ROBINSON MINE	SILVER LAKE
S	NIKI	ELK PARK PASS	V	ROCK CREEK CLAIM	SUGARLOAF MOUNTAIN
S	NILES GULCH PLACER	ALDER GULCH	X	ROCK CREEK MINE JILL MILL	PHILIPSBURG
V	NINETEEN HUNDRED	FRED BURR LAKE	X	ROCK CREEK PROPERTY	MAUKEY GULCH
V	NON-PARIEL MILL TAILINGS	MAXVILLE	S	ROCK CREEK PROSPECTS	PIKES PEAK
X	NORTH ATLANTIC	SILVER LAKE	S	ROCK RABBIT & SUNBEAM	WARREN PEAK
V	NORTH BOULDER LEAD	THUNDERBOLT CREEK	V	ROCKER	MOUNT THOMPSON
S	NORTH FORK GRANITE CREEK	PIKES PEAK	V	ROCKER EXTENSION	MOUNT THOMPSON
U	NORTH LOUISE PROJECT	ELKHORN	V	ROMBAUER	PIKES PEAK
V	NORTH STAR	MAXVILLE	V	ROSE	MOUNT THOMPSON
V	NORTHERN CROSS (CARLIN ONE DIL	POZEGA LAKES	V	ROYAL GOLD MILL	PIKES PEAK
S	NUGGET	PIKES PEAK	X	ROYAL METALS TUNNEL	FRED BURR LAKE
V	O'BRIEN	WHETSTONE RIDGE	V	RUBY	SHEEPSHEAD MOUNTAIN
X	OBELISLE	MOUNT THOMPSON	V	RUBY MINE	LOCKHART MEADOWS
V	OHIO LODE MINE	WATERLOO	X	RUMSEY MILL	PHILIPSBURG
S	OHIO PROSPECT	WHETSTONE RIDGE	X	RUSSEL	HENDERSON MOUNTAIN
S	OKOREOKA	SILVER LAKE	V	RUTH	MOUNT THOMPSON
X	OLD BONANZA	SILVER LAKE	X	RUTH & COPPER	WICKIUP CREEK
V	OLD CABIN PROSPECT	NOBLE PEAK	V	RYAN MINE	PIKES PEAK
V	OLD DOMINION MINE	MOOSE LAKE	X	S. BOULDER RIVER PLACERS	MANHEAD MOUNTAIN
V	OLD DOMINION TAILINGS	MOOSE LAKE	S	S. CLIPPER	KELLY LAKE
X	OLD KENTUCK	PHILIPSBURG	S	S. FK ROCK CREEK PLACER	WHETSTONE RIDGE
S	OLSON GULCH	WEST VALLEY	X	S. FRANK HILL	PHILIPSBURG
S	OLYMPIC MINE	POZEGA LAKES	X	S. HIDDEN LAKE PROSPECT	ELKHORN
S	ONE HUNDRED ACRE MEADOW PROSPE	STORM LAKE	V	SABBATH	BAGGS CREEK
X	ONTARIO	GEORGETOWN LAKE	U	SAGER-MURPHY	WEST VALLEY
U	OPHIR	PIKES PEAK	V	SALLIE MELLEN	HENDERSON MOUNTAIN
U	ORAFINE CREEK PLACER	SUGARLOAF MOUNTAIN	V	SALLY ELLEN	PIKES PEAK
U	OROFINE CREEK PLACER	LOCKHART MEADOWS	X	SALMON	PHILIPSBURG
U	ORPHAN BOY	ROCK CREEK LAKE	S	SAMUEL	DUNKLEBERG CREEK
X	ORPHAN BOY - OROFINO	SILVER LAKE	S	SAMUEL LODE	DUNKLEBERG CREEK
V	OVERLAND CREEK MINE	CHESSMAN RESERVOIR	X	SAN FRANCISCO	PHILIPSBURG
V	OVERLOOK	PIPESTONE PASS	V	SARANAC	MAXVILLE
V	OVERLOOK MILL	PIPESTONE PASS	V	SARATOGA	THUNDERBOLT CREEK
V	OZARK	PIPESTONE PASS	V	SATURDAY NIGHT	BASIN
X	PANDORA	WICKIUP CREEK	X	SAUNDERS	PHILIPSBURG
V	PARK CREEK TAILINGS	MANHEAD MOUNTAIN	S	SAWPIT GULCH PLACER	ALDER GULCH
X	PARNELL	PHILIPSBURG	U	SCENIC	PIPESTONE PASS
X	PATSY ANN MINE	DICKIE PEAK	S	SCHERMERHORN GULCH PLACER	ROCK CREEK LAKE
V	PAY DAY	WEST VALLEY	S	SCHRAMM	ROCK CREEK LAKE
X	PAYOFF	SILVER LAKE	X	SCRATCH ALL	PHILIPSBURG
V	PEACOCK GROUP	HENDERSON MOUNTAIN	S	SE SECTION 5	MAXVILLE
X	PEARL	PHILIPSBURG	V	SEATTLE	MOUNT THOMPSON
V	PEARL	THREE BROTHERS	V	SEC 36 SHAFT	DELMOE LAKE
S	PEARL MINE	DUNKLEBERG CREEK	V	SECTION 18 PROSPECT	OROFINO MOUNTAIN
V	PEN YAN	MOUNT THOMPSON	V	SECTION 8 SHAFT	LOCKHART MEADOWS
S	PERRY PARKS PLACER	THREE BROTHERS	V	SENATE	KELLY LAKE
V	PETE & JOE	OLD BALDY MOUNTAIN	S	SEPTEMBER SNOW	PIKES PEAK
V	PETERSON MEADOW PROSPECT	GEORGETOWN LAKE	V	SHAMROCK	PIKES PEAK
V	PHANTOM	MOUNT THOMPSON	X	SHAPLEIGH	PHILIPSBURG
X	PHILLIPSBURG AREA	PHILIPSBURG	V	SHEILA	SILVER LAKE
S	PHOSPHATE PROSPECT UPPER	POZEGA LAKES	V	SHORT STUFF	STORM LAKE
V	PIERMONT NO. 1 EAST	BASIN	X	SHOULETOWN	PHILIPSBURG
S	PINEAU MINE	PIKES PEAK	S	PIKEA BUTTE	TABLE MOUNTAIN
S	PIONEER GULCH	ROCK CREEK LAKE	U	SILVER BELL	RATIO MOUNTAIN
X	PLACER FIRE CLAY PIT	ANACONDA NORTH	V	SILVER CHAIN	WEST VALLEY
X	PLEIDUS	SILVER LAKE	X	SILVER CHIEF	PHILIPSBURG
U	POHNDERF DEPOSIT - GEMS	MOUNT HUMBUG	V	SILVER GLANCE	MOUNT HUMBUG
X	POHNDORF AMETHYST	GRACE	V	SILVER HEART	SILVER LAKE
S	POLLOCK	SUGARLOAF MOUNTAIN	S	SILVER HILL	SILVER LAKE
X	POLO	PHILIPSBURG	V	SILVER KING	WEST VALLEY
X	POMEROY	SILVER LAKE	V	SILVER KING PLACER	PIPESTONE PASS
U	PONY VERMICULITE	PONY	V	SILVER PROSPECT	WEST VALLEY
V	PORCUPINE	SILVER LAKE	V	SILVER QUEEN	DELMOE LAKE
X	PORNELL GROUP	HENDERSON MOUNTAIN	V	SILVER QUEEN	WEST VALLEY
X	PORPHYRY DIKE	THREE BROTHERS	X	SILVER REEF	SILVER LAKE
V	PORT ROYAL	PIKES PEAK	X	SILVER SPIKE	PHILIPSBURG
V	PORT ROYAL MILL	PIKES PEAK	V	SILVERSMITH	BISON CANYON
V	PORT ROYAL TAILINGS	PIKES PEAK	V	SIRIUS	MOUNT THOMPSON
V	PORTER	FRED BURR LAKE	V	SIXTEEN TO ONE CLAIM	PIKES PEAK
V	POTOSI	PIKES PEAK	V	SKYLINE MINE/LESLIE LAKE GROUP	ELKHORN
S	POWDER GULCH - RE PLACER	BUXTON	U	SMITH PROSPECT	WEST VALLEY
S	PRICE PLACER - RE	BUXTON	V	SNOW BUNNY	PIKES PEAK
S	PRICES GULCH - RE PLACER	BUXTON	S	SNOW WHITE QUARRY	ANACONDA NORTH
V	PRINCESS	LOCKHART MEADOWS	S	SNOW WHITE QUARRY	MOUNT POWELL
V	PRINCETON MINE	MAXVILLE	V	SNYDER'S MINE	NOBLE PEAK
S	PRINCETON PLACER	MAXVILLE	V	SOLAR MINE	THREE BROTHERS
S	PROSPECT	BOULDER WEST	U	SOLEDADA & IRON CROWN CLAIMS	WEST VALLEY
S	PROSPECTS	MOUNT HUMBUG	V	SOUTH BOULDER MILL	MAXVILLE
S	PROSPECTS	MOUNT THOMPSON	V	SOUTH FORK STATE CREEK MINE	RATIO MOUNTAIN
X	PURITAN	FRED BURR LAKE	V	SOUTH SILVERSMITH	BISON CANYON
X	PURITAN	PHILIPSBURG	V	SOUTH SUICIDE CABIN MINE	DELMOE LAKE
X	PYRITE	SILVER LAKE	X	SOUTHERN CROSS	SILVER LAKE
V	QUARTZ CITY PROSPECT	NOBLE PEAK	S	SPARKLING WATER	BASIN
V	QUARTZ CREEK	THREE BROTHERS	V	SPORT LODE (LAME BEAR)	ELKHORN
S	QUEEN	PIKES PEAK	S	SPRING HILL	SILVER LAKE
V	QUEEN ANN CLAIM	ELKHORN	V	SPRINGTIME	BOULDER WEST
S	RACETRACK CREEK IRON	POZEGA LAKES	S	SQUARE GULCH PIT	ROCK CREEK LAKE
S	RAINBOW PASS OCCURENCE	STORM LAKE	V	ST MARY'S	BAGGS CREEK
S	RAINBOW PROSPECT	MOOSE LAKE	V	ST. ANTHONY	RATIO MOUNTAIN
U	RANDY	WEST VALLEY	V	ST. LAWRENCE	BASIN
V	READY CASH	PIPESTONE PASS	V	ST. NICK	BASIN
V	RED LION	FRED BURR LAKE	V	ST. THOMAS	FRED BURR LAKE
V	RED LION MILL	FRED BURR LAKE	X	STAR POINT	PHILIPSBURG
S	RED ROCK CREEK	BASIN	V	STARLIGHT	PIKES PEAK

CODE	MINE NAME	QUADRANGLE	CODE	MINE NAME	QUADRANGLE
V	STATE	FRED BURR LAKE	U	UNNAMED QUARTZ	RATIO MOUNTAIN
V	STATE	RATIO MOUNTAIN	U	UNNAMED RE	BUXTON
V	STERRETT	BAGGS CREEK	X	UNNAMED SMOKEY QUARTZ PROSPECT	RATIO MOUNTAIN
S	STEVE CLAIM	ELKHORN	S	UNNAMED URANIUM	BISON CANYON
X	STEVEN'S PLACER	MAUKEY GULCH	S	UNNAMED URANIUM	THREE BROTHERS
S	STORM LAKE DEPOSITS	STORM LAKE	X	UNNAMED	PONY
S	STORM LAKE TUNGSTEN	STORM LAKE	V	UPPER BUCKEYE MILL TAILINGS	THREE BROTHERS
V	STORMWAY	WEST VALLEY	S	UPPER GRANITE PROSPECT	PIKES PEAK
U	STRAW HAT	WEST VALLEY	V	UPPER MTN LION	PIKES PEAK
X	STRAWN MILL	WATERLOO	V	UPPER WHITE CHIEF PROSPECT	NOBLE PEAK
X	STRAWN MINE	WATERLOO	S	UPPER WILLOW CREEK PLACER	BLACK PINE RIDGE
X	STRIP MINE	PHILIPSBURG	V	VALLEY VIEW	MOUNT POWELL
S	STUCKY RIDGE	ANACONDA NORTH	V	VAN DORSTEN	MOUNT HUMBUG
V	STUMPTOWN SMELTER	WEST VALLEY	V	VELLEJO	SILVER LAKE
V	SUICIDE CABIN MINE	DELMOE LAKE	S	VENUS	THREE BROTHERS
V	SULTANA	NOBLE PEAK	V	VERA & MARIE	MOUNT THOMPSON
S	SUMMIT MINE	DUNKLEBERG CREEK	V	VIKING WESTERN PACIFIC	PONY
U	SUMMIT MINE	THUNDERBOLT CREEK	V	VINDICATOR	BASIN
S	SUMMIT PLACER	WEST VALLEY	X	W. GRANITE STAFF	PHILIPSBURG
S	SUN MINE	DUNKLEBERG CREEK	V	WAKE UP JIM	BAGGS CREEK
V	SUNDAY	PIKES PEAK	U	WAR EAGLE	GEORGETOWN LAKE
V	SUNDAY EXTENSION	PIKES PEAK	S	WARREN PEAK PROSPECT	WARREN PEAK
V	SUNDAY MILL	PIKES PEAK	X	WARREN PROSPECT	TUCKER CREEK
V	SUNLIGHT - COPPER QUEEN	PIKES PEAK	V	WASA	PIKES PEAK
V	SUNRISE MINE	HENDERSON MOUNTAIN	V	WATER GULCH PROSPECT	BOULDER WEST
X	SUNSET	MOUNT HUMBUG	V	WELCH QUARRY	DELMOE LAKE
V	SUNSET MINE	DUNKLEBERG CREEK	V	WELCOME HILL	SILVER LAKE
V	SUNSET PLACER	MAXVILLE	V	WELCOME LODGE	SILVER LAKE
X	SURPRISE MINE	WHITEHALL	X	WEST EXP. MN PROS & LAMONT	FRED BURR LAKE
V	SWAMP GULCH AMALGAMATION MILL	MAXVILLE	V	WEST GALENA GULCH	BOULDER WEST
S	SWAMP GULCH PROSPECTS	FRED BURR LAKE	V	WEST STORMWAY	WEST VALLEY
X	SWEETHORN	PHILIPSBURG	X	WHITE	PHILIPSBURG
X	SWISSMONT	ELKHORN	U	WHITE SWAN MINE	LOCKHART MEADOWS
V	SYLVAN	BASIN	V	WHITETAIL PARK VEIN	WHITETAIL PEAK
V	T MCKAY/HOBO	PHILIPSBURG	X	WIGHT MN MINE	MAXVILLE
S	TACOMA	TACOMA PARK	U	WILD CAT	MOUNT HUMBUG
S	TAMARACK LAKE	CARPP RIDGE	U	WILLIAM BARTH	WHITETAIL PEAK
V	TEMPLEMAN	PIPESTONE PASS	S	WILSON CREEK PLACER	BOULDER WEST
S	THOMPSON LAKE PROSPECT	PIKES PEAK	V	WINTERS CAMP	BASIN
X	THREE METALS	FRED BURR LAKE	U	WJ BRYAN	MAXVILLE
S	THUNDERBOLT MOUNTAIN PROSPECT	THUNDERBOLT CREEK	X	WOODROW WILSON	THREE BROTHERS
V	THURSDAY FRIDAY MINE	PIKES PEAK	U	WOODVILLE DEPOSIT	ELK PARK PASS
S	TIBBET PLACER	PIKES PEAK	X	YELLOW JACKET	OROFINO MOUNTAIN
V	TIBBETTS	PIKES PEAK	U	YELLOW MODUL	FRED BURR LAKE
V	TIM THIRD CHANCE	STORM LAKE	S	YOUNG AMERICAN	PHILIPSBURG
V	TIP TOP	SILVER LAKE	X	ZEUS	PHILIPSBURG
S	TITANIUM PLACER	MOUNT EMERINE	V	ROCKER GULCH	SUGARLOAF MT.
S	TMT PROSPECT	WHETSTONE RIDGE	S	CATLSON & BERKIN FLAT	THUNDERBOLT CREEK
S	TODD PROSPECT	WHETSTONE RIDGE	V	HIDDEN HAND	BAGGS GREEK
V	TOLL MTN LODGE-WAR EAGLE-LENY	PIPESTONE PASS	S	CARPP	CARPP RIDGE
S	TOMMY PROSPECT	SILVER LAKE	V	ELDORADO & PLATEAU	CHESSMAN RESERVOIR
S	TOURMALINE QUEEN MINE	ELKHORN	V	NELLIE-MASCOT	HOMESTAKE
V	TOWNSEND PLACER	WHETSTONE RIDGE	V	MONTANA	HOMESTAKE
V	TOWNSEND PROSPECT	WHETSTONE RIDGE	V	GOLD BUG	HOMESTAKE
X	TREVILLION - JOHNSON	GRACE	S	PAY ROCK	HOMESTAKE
V	TRIGGER	SILVER LAKE	S	GLOWING STAR PLACER	HOMESTAKE
X	TRIGGER MILL	SILVER LAKE	S	HOMESTAKE CREEK PLACER	HOMESTAKE
X	TRILBY CHAMPAIGN	SILVER LAKE	V	HARRIET	HOMESTAKE
X	TROUT	PHILIPSBURG	V	NORTH HARRIET	HOMESTAKE
X	TRUE	PHILIPSBURG	S	FLAG PLACER	HOMESTAKE
S	TUCKER CREEK	MOUNT HUMBUG	S	MOUNTAIN CHIEF	HOMESTAKE
S	TUNGSTEN MINES	POZEGA LAKES	S	NAMMIE BROWN	HOMESTAKE
S	TUSCAVORA PROSPECT	WHETSTONE RIDGE	S	IRENE	HOMESTAKE
V	TUSSLE MINE	PIKES PEAK	S	EVENING STARE	HOMESTAKE
X	TWILIGHT	SILVER LAKE	S	THOMPSON PARK	HOMESTAKE
X	TWILIGHT CYANIDE PLANT	GEORGETOWN LAKE	V	DELAWARE	MAXVILLE
X	TWIN BUTTES	MAXVILLE	V	SNOW CAP	MAXVILLE
S	TWIN PEAKS PROSPECT	FRED BURR LAKE	V	BARNES	MAXVILLE
V	TWOHY	RATIO MOUNTAIN	V	NELLIE	MAXVILLE
V	UNAMED BEAR GULCH ADIT CLUSTER	OLD BALDY MOUNTAIN	V	MOONLIGHT	MAXVILLE
V	UNCLE SAM	BASIN	V	TRAVONIA	MAXVILLE
V	UNION	ELKHORN	V	NON PAREIL	MAXVILLE
X	UNKNOWN	DRY MOUNTAIN	V	MOFFET JOHNSON	OLD BALDY MTN.
V	UNKNOWN LOWLAND	SHEEPSHEAD MOUNTAIN	V	LOWER COAL CREEK	OLD BALDY MTN.
S	UNKNOWN MILL CREEK MINE	MANHEAD MOUNTAIN	V	QUARTZETTE	PIKES PEAK
U	UNNAMED	BAGGS CREEK	V	SUNSHINE	STORM LAKE
X	UNNAMED	BUXTON	V	DOUBLE SHAFT	THREE BROTHERS
S	UNNAMED	ELK PARK PASS	V	MONTANA PRINCES	WHETSTONE RIDGE
S	UNNAMED	MANHEAD MOUNTAIN	V	JIB MILL TAILINGS	BASIN
V	UNNAMED	MOUNT HUMBUG	V	UPPER BULLION MILL TAILINGS	BASIN
V	UNNAMED	MOUNT THOMPSON	V	BULLION TAILINGS ADIT	BASIN
V	UNNAMED	MOUNT THOMPSON	V	SMELTER CREEK ADIT	BASIN
V	UNNAMED	MOUNT THOMPSON	V	JACK CREEK MILL TAILINGS	BASIN
V	UNNAMED	MOUNT THOMPSON	V	JOE'S BOWER'S MINE	BASIN
X	UNNAMED	WHITEHALL	V	MORNING STAR	BASIN

APPENDIX III

MINE AND MILL SITES VISITED
IN THE CATARACT CREEK DRAINAGE
AT WHICH NO IMPACTS WERE EVIDENT
OR AFFECTING THE NATIONAL FOREST

Apollo

One caved adit on private ground appears to follow a N70W quartz-tourmaline-pyrite vein. The dump is composed of quartz monzonite with quartz, sericite, and pyrite alteration products, and is being actively eroded by Cataract Creek. The land is private for several miles downstream.

BaKaMa

One dry caved adit and a series of prospect pits follow a NE-trending vein of quartz, chalcedony, pyrite, chalcopryite, tourmaline, tetrahedrite, and abundant calcite. Although a select vein sample ran only .016 oz/ton Au, 9.26 oz/ton Ag, .870% Cu, .440% Pb, and .154% Zn, in 1918 and 1942 the mine produced 26 tons of ore yielding 1385 oz Ag and 3190 lbs Cu (Roby and others, 1960). This high grade ore probably came from a zone of supergene enrichment.

Billie T.

A caved adit crosscuts to a quartz-pyrite vein in quartz monzonite with quartz-sericite-pyrite alteration. The length of workings probably totals over 1000 feet. Some minor soil contamination occurs below the dump on private land.

Custer

One caved adit and several prospect pits follow a N74E 75N quartz-pyrite-galena-sphalerite (Becraft and others, 1963) vein that is probably the western extension of the Red Wing-Hiawatha vein. Apparently there are about 1500 feet of underground workings. The mine was intermittently active from 1903-1912 with 8472 tons of ore produced with 470 oz Au and 106,065 oz Ag recovered (Roby and others, 1960). Knopf (1913) states that the 30 foot wide vein carried up to 40 oz/ton in silver, but that ore shoots were less than one foot wide.

Elmer

A short caved adit on private land contains a few hundred feet of workings on a N78W vein. A quartz-tourmaline-pyrite-siderite vein was found on the dump.

Eva May

Because the Eva May is well described in the literature (Knopf, 1913; Pardee and Schrader, 1933; Roby and others, 1960; Becraft and others, 1963) and it is on private land with no affected forest service land for miles downstream, it was not examined in detail as part of this project. No discharges exist, and the large tailings pile in the floodplain of Cataract Creek has been mostly removed for reprocessing.

The mine lies at the east end of the Crystal vein and produced over \$2 million dollars in metals before 1910. It was one of the largest producers in the Basin district.

Ida May

A flooded caved shaft with an extensive dump in a marsh mined a N80W zone of altered quartz monzonite cut by stringers of sphalerite and quartz (Becraft and others, 1963). The dump material is slightly anomalous in radioactivity. Because the property is on private land with no discharge, it was not sampled.

John T.

The John T. was a small high-grade silver mine on a quartz-pyrite-galena vein which strikes N87W. The quartz monzonite host rock contains abundant alteration products of quartz, sericite, and pyrite. The adit is caved and probably 1000 feet of workings exist. The only year for which production figures are available is 1917, when 259 tons of ore surrendered 5 oz Au, 4764 oz Ag, 76 lbs Cu, 26,869 lbs Pb, and 35,854 lbs Zn. The property is on DNF administered land.

Jumbo

The Jumbo is on the east end of the Cataract-Sirius vein at the quartz monzonite-andesite contact. Kaolinite is present as an alteration product. It is a short caved adit trending N87E on private land. Some breccia composed of quartz, siderite, and calcite is present on the dump, but Roby and others (1960) reported a vein containing galena and cerussite.

Klondyke (Basin District)

Like the adjacent Sirius mine, the Klondyke is of interest mainly because of its high gold values and its location in an area of closely spaced veins and relatively pervasive alteration. The mine produced for five years between 1907 and 1946 a total of 342 tons of ore relinquishing 192 oz gold, 7650 oz silver, 8342 lbs of copper, 126,309 lbs of lead, and 2500 lbs of zinc (Roby and others, 1960). A select sample of chalcedony-pyrite vein ran .179 oz/ton Au, 3.56 oz/ton Ag, .59% Cu, 1.3% Pb, and .430% Zn. Workings consist of an open 165 foot shaft with 3 levels and 300 feet of drifts (Roby and others, 1960) and numerous short caved adits and prospect pits. The mine is located at the andesite-quartz monzonite contact which strikes east-west and dips 60N. Ownership is mostly private.

Lizzie Osborne

Two caved adits with more than 500 feet of workings mined a N75W vein 4 feet wide (Roby and others, 1960). The vein is composed of quartz, pyrite, tourmaline, sphalerite, galena, and chalcopryite; a select sample had .152 oz/ton Au, 7.01 oz/ton Ag, .900% Cu, 2.3% Pb, and 2.78% Zn. Wallrock is quartz monzonite altered to quartz, sericite, and pyrite.

Louise

The Louise is comprised of only one very short caved adit that trends N10W in iron stained quartz monzonite. National Forest land.

Manhattan

The Manhattan includes some reclaimed workings along the same structure as the Minneapolis. Becraft and others (1963) include an underground map showing several hundred feet of workings along 2 parallel veins of quartz, galena, sphalerite, pyrite, and malachite. The lower adit has a small discharge, but it affects only private and BLM land.

Mike #14

A caved adit with more than 500 feet of workings crosscuts to the Cataract-Sirius vein. More than 50% of the dump is unaltered quartz monzonite; the remainder contains quartz, sericite, and pyrite alteration products. A select sample of quartz-pyrite-galena-sphalerite vein from the ore bin had .144 oz/ton Au, 6.02 oz/ton Ag, .178% Cu, 7.29% Pb, and 3.98% Zn. Mosses and sedges near the portal indicate a slight seasonal discharge on national forest lands.

Minneapolis

Two caved adits and several prospects mark the site of the Minneapolis on private land. Both Roby and others (1960) and Becraft and others (1963) describe the property. Workings total at least 4000 feet in length along a N75E zone with quartz, sphalerite, galena, and pyrite veins up to 6 feet wide. Host rock is quartz monzonite intruded by a post-mineralization quartz porphyry dike. The Minneapolis produced intermittently from 1905 to 1949. 1113 tons of ore was produced from which 97 oz Au, 19,031 oz Ag, 6640 lbs Cu, and 149,364 lbs Pb was produced.

Quartz Creek

A caved adit follows a west striking quartz-siderite-calcite vein in unaltered quartz monzonite. Workings probably total less than 200 feet in length.

Saint Lawrence

Originally, the Saint Lawrence patented property contained two shafts (unpublished information, MBMG files) on the Crystal-Bullion vein. Today there are several large flooded open cuts that probably provide much of the recharge for water in the Crystal and Bullion mines.

Saint Nick

A short caved shaft and numerous trenches explore an east-west trending zone with narrow quartz-pyrite-sphalerite-chalcopryite veins in quartz monzonite with kaolinite alteration products. The site is on private land on the northwest side of the Hattie Ferguson-Sirius mineralization area.

Saturday Night

The Saturday Night is perched on a dry hillside above Cataract Creek. Most of the dump has already been eroded away. It consists of a caved shaft and a caved adit that mined an east-west vertical vein which apparently contained some gold. Production from 1936-1939 was 232 tons containing 31 oz Au, 2868 oz Ag, 268 lbs Cu, and 1723 lbs Pb (Roby and others, 1963).

Seattle

A series of caved adits and numerous prospect pits appear to follow a vertical north striking structure in a creek bottom. Vertical east striking structures are also present, but it is impossible to determine the relation of the mineralization to structures. Vein material on the dump contained quartz, tourmaline, pyrite, galena, sphalerite, and marcasite (?). A select vein sample ran only .060 oz/ton Au, 2.98 oz/ton Ag, .084% Cu, 2.40% Pb, and 2.35% Zn.

Sylvan

The Sylvan site, on national forest lands, contains one dry caved adit with approximately 2200 feet of workings (unpublished information, MBMG files). They apparently explore two parallel veins up to two feet thick (Ruppel, 1963) within a N87E 83SE shear zone. Pieces of vein on the dump contain quartz, tourmaline, pyrite, and siderite.

APPENDIX IV

ASSAY DATA
CATARACT CREEK DRAINAGE

DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
ASSAY RESULTS

Assay Results (%)

Sample ID	Location	Description	Au	Ag	Cu	Pb	Zn
CADW10H	Ada, Jefferson Co., Dump.	Composite, Qtz-py vn, qtz-ser-py Kgm, & Fe-op st Kgm. both ox & unox.	0.004	3.750	0.057	0.320	0.005
CBBW10H	Black Bear Jefferson Co. Dump	Composite Homogenous wallrock altered to qtz-ser-py (10%)	0.050	2.070	0.032	0.175	0.176
CBCW10H	Boulder Chief, Jefferson Co., Dump	Composite of main dump. Wallrock (Kvl alt to qtz-ser-py) same vein -qtz-chal-10%py	0.010	1.140	0.019	0.470	0.190
CBCT10H	Boulder Chief, Jefferson Co., Tailings	Composite of tailings- very coarse wallrock (alt) & qtz vein	0.018	4.340	0.055	2.320	3.870
CBDW10H	Blue Diamond, Jefferson Co. Dump (N)	Composite Course Rock, Ku altered to qtz-ser-py-coal	0.004	0.240	0.011	0.006	0.008
CBDW20H	Blue Diamond, Jefferson Co. Dump (S)	Composite Course Rock Ku altered to qtz-ser-py-coal	0.042	1.140	0.119	0.760	0.056
CGLT10H	Gray Lead, Jefferson Co. Dump	Composite mostly Kqm Altered to-qtz-ser-py	0.031	0.570	0.014	0.345	0.386
CMGT10H	Morning Glory, Jefferson Co., Tailings	Composite Varied from coarse unox sul-bearing sand to dk gy clays	0.016	1.640	0.027	0.150	0.200
CROW10H	Rocker Mine, Jefferson Co. Dump	Select of vein, Vuggy-Qtz-py-sph-tef-cpy-gal-aspy-tovr	0.092	6.670	0.440	1.620	1.600
CSIW10H	Sirius Mine, Jefferson Co., Dump	Composite, Kgm wallrock alt to qtz-ser-py. Unox	0.040	0.980	0.029	0.910	0.057
CUNW10H	Unknown Cataract #1 Jefferson Co. Dump	Composite Ox+unox-Kqm-altered to-qtz-ser-py+Fe-ox-clay	0.003	1.250	0.013	0.128	0.024
CSUW10H	Uncle Sam, Jefferson Co., Dump.	Select sample of vein, Qtz-py-tr gal-tr sph. Included a couple pcs of 100% gal-sph	0.456	15.820	0.144	3.100	1.600
CVMW10H	Vera & Marie, Jefferson Co., Dump	Composite of all dumps - mostly kgm alt to Fe-ox stain qtz-ser sm vn w/ ab py	0.012	0.700	0.011	0.089	0.046

APPENDIX V

WATER QUALITY AND SOIL CHEMISTRY
CATARACT CREEK DRAINAGE

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Water Quality Results - Dissolved Concentrations

MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
CRESCENT MINE																				
CCSS10M	95Q0029	Caved adit discharge onto USFS Property	3.15	0.290	1.920	<.5	127.0	<.05	0.3	3820.0	<1	5.70	19.30	75.90	<2	1775.0	0.05	<.05	1227.00	15097.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	1	0	-	0	0	1	-
NO. EXCEEDED CWA-SECONDARY			1	0	1	0	0	-	0	1	0	-	-	-	-	1	-	-	-	1
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	1	0	0	-	1/1	0	1/1	0	0/0	1/1	1/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	+	0	-	1/1	0	1/1	+	0/0	1/1	1/1
ELDORADO AND PLATEAU MINE																				
NEPS10H	94Q0642	Seep on west side of mine cut	4.66	0.008	3.360	4.7	223.0	0.9	0.2	625.0	<1	<1	109.00	104.00	<2	540.0	0.15	26.00	50.00	10090.0
NEPS80H	94Q0644	Duplicate of NEPS10H, west side seep	4.66	0.011	3.280	4.7	239.0	0.4	0.2	615.0	<1	<2	110.00	105.00	<2	535.0	0.17	26.00	51.30	9880.0
NEPS20M	94Q0641	Seep on north side of mine cut	7.47	0.007	0.002	<.2	13.3	<.05	0.1	<30	<1	<1	29.60	<2	<2	11.4	0.17	25.90	<2	64.0
NEPS30H	94Q0645	Ponded water near waste rock	5.95	0.006	0.964	1.3	105.5	0.2	0.1	<30	<1	<1	40.00	34.50	<2	65.0	0.14	8.90	2.80	3527.0
NEPS40H	94Q0647	Flooded pit at toe of waste rock dump	5.39	0.013	0.309	1.4	100.0	0.6	0.1	46.0	<1	4.00	56.90	24.70	<2	73.1	0.15	7.80	5.30	2840.0
NEPS50M	94Q0646	Spring downhill from cabin	6.31	0.013	<.002	<2	13.8	0.5	0.1	<30	<1	<1	55.60	<2	<2	<2	0.16	<2	<2	37.5
NEPS60L	94Q0648	Nellie Grant Cr upstream of site	6.68	0.094	0.007	<.2	2.0	0.1	0.1	53.0	<1	1.20	22.90	<2	<2	8.6	<.1	<2	<2	19.0
NEPS70L	94Q0658	Nellie Grant Cr downstream of site	6.34	0.091	0.003	<.2	3.1	0.1	0.1	49.0	<1	1.40	25.20	<2	<2	12.8	<.1	<2	<2	18.9
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	4	0	-	0	2	2	-
NO. EXCEEDED CWA-SECONDARY			6	0	4	0	0	-	0	3	0	-	-	-	-	0	-	-	-	2
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	4/4	0/0	4/4	0	0/0	0/0	4/4
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	+	0	-	4/4	0/0	5/5	+	3/2	3/2	4/4
OVERLAND CREEK MINE																				
COCS10L	92Q720	Overland Cr 100' below east shaft	7.51	0.024	0.003	-1.0	5.7	-0.1	0.2	-50.0	-0.60	10.01	9.83	-0.60	-0.90	2.5		-2.40	0.86	26.8
COCS20L	92Q721	Overland Cr 20' upstream of west adit	7.31	0.028	0.002	-1.0	5.2	0.1	0.1	-50.0	-0.60	2.42	10.95	1.09	-0.90	-1.4		-2.40	-0.40	-2.7
COCS30M	92Q722	Overland Cr east mine shaft	6.48	0.027	0.131	-1.0	20.6	-0.1	0.2	50.0	-0.60	5.33	15.68	5.87	-0.90	14.5		2.59	2.22	384.3
COCS40M	92Q723	Overland Cr west mine shaft	6.54	0.021	0.016	0.3	9.4	-0.1	0.2	79.0	-0.60	18.46	6.09	-0.60	-0.90	2.8		-2.40	-0.40	47.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	1	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			1	0	1	0	0	-	0	2	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	1/0	0/0	0/0		0/0	0/0	1/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	1/1	0/0	1/1		0/0	0/0	1/1
ADA MINE																				
CADS20L	92Q684	Rocker Cr 10' upstream of confl. w/seep	7.15	0.071	0.018	-1.0	6.8	-0.1	0.2	59.0	-0.60	1.45	8.36	-0.60	-0.90	-1.4		-2.40	-0.40	-2.7
CADS40L	92Q688	West Ada Adit	6.67	0.019	0.006	1.3	24.5	-0.2	0.5	-50.0	-0.60	82.82	1.14	4.31	-0.90	21.6		-2.40	-0.40	527.8
CADS60H	92Q685	East adit seepage, West Ada Mine	2.57	189.6	16.8	3.7	733.0	-0.1	0.4	2030.0	1.14	1555.00	10.51	50.29	1.35	4127.0		41.44	125.00	6160.0
CADS30L	92Q687	Rocker Cr 10' downstream of confl. w/seep	6.78	0.180	0.121	-0.5	12.5	-0.1	0.2	-50.0	-0.60	1.67	9.86	-0.60	1.78	2.8		-2.40	-0.40	-2.7
CADS50L	92Q686	Rocker Cr downstream of site	5.82	0.065	0.350	-0.5	33.0	-0.1	0.2	100.0	-0.60	0.70	7.84	1.70	-0.90	159.4		-2.40	-0.40	189.8
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	2	0	1	0	-		0	1	-
NO. EXCEEDED CWA-SECONDARY			2	1	3	0	1	-	0	3	0	-	-	-	-	1		-	-	1
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	1	0	1	-	2/1	0/0	3/2		0/0	1/0	3/2
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	1+	1	0	3/2	0/0	3/3		0/0	1/1	3/3

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Water Quality Results - Dissolved Concentrations

MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
ROCKER MINE																				
CROS10H	92Q689	Adit seepage	3.35	9.8	3.6	0.8	154.0	-0.1	0.1	2090.0	-0.60	2.48	30.77	19.89	-0.90	851.4		30.47	15.33	2453.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	1	0	-		0	1	-
NO. EXCEEDED CWA-SECONDARY			1	1	1	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	1	0	0	-	1/1	0/0	1/1		0/0	0/0	1/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	+	0	-	1/1	0/0	1/1		0/0	1/1	1/1
ROCKER EXTENSION MINE																				
CRES10L	94Q0364	Rocker Cr 30' upstream of site	9.01	0.520	0.146	0.5	12.6	-0.1	0.2	258.0	-1.00	4.66	6.19	-2.00	-2.00	58.79		-2.00	-2.00	98.74
CRES20L	94Q0363	Adit seepage	8.56	0.813	1.2	1.4	30.0	-0.1	0.3	-50.0	-1.00	3.75	14.33	-2.00	-2.00	2.00	<.1	2.33	-2.00	173.94
CRES30L	94Q0362	Seep at toe of waste dump	8.54	0.058	0.385	1.5	34.6	-0.1	0.2	-50.0	-1.00	-1.00	6.05	-2.00	-2.00	10.00	<.1	2.06	-2.00	244.81
CRES40L	94Q0366	Rocker Cr 30' downstream of site	8.60	0.477	0.137	-0.2	13.2	-0.1	0.1	220.0	-1.00	4.33	6.15	-2.00	-2.00	52.50		-2.00	2.24	86.55
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			4	3	4	0	0	-	0	2	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	2/2		0/0	0/0	2/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	+	0	-	+0	0/0	2/2		0/0	0/0	2/1
GRAY LEAD MINE																				
CGLS10L	92Q662	Caved adit discharge	7.39	0.028	0.010	0.3	5.2	-0.1	0.1	-50.0	-0.60	14.67	4.92	4.78	-0.90	-1.4		-2.40	4.58	353.0
CGLS20L	92Q663	Seep at base of waste rock dump	7.16	0.062	0.070	2.0	6.4	-0.1	0.1	-50.0	-0.60	22.76	12.47	6.99	-0.90	3.1		-2.40	15.46	555.0
CGLS30L	92Q665	Seep downstream of mine	7.21	0.270	0.220	1.2	3.4	-0.1	0.1	-50.0	-0.60	79.39	6.47	1.64	-0.90	6.7		-2.40	24.68	295.8
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	1	0	1	0	-		0	2	-
NO. EXCEEDED CWA-SECONDARY			0	0	2	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	2/0	0/0	0/0		0/0	0/0	3/3
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	2/2	0/0	0/0		0/0	3/2	3/3
UNNAMED #4 MINE																				
CUXS10L	92Q661	Site is 1 mi No of Eva May Mine, discharge	7.24	0.072	0.046	0.4	21.9	-0.1	0.2	-50.0	-0.60	14.54	51.03	1.61	-0.90	3.6		-2.40	2.51	322.9
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	0	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	1/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	1/0	0/0	0/0		0/0	0/0	1/1
UNNAMED #2 MINE																				
CUKS10L	92Q660	Discharge from the caved adit	7.05	0.009	0.520	0.5	58.8	-0.1	0.2	-50.0	-0.60	10.40	5.45	0.63	-0.90	-1.4		-2.40	-0.40	102.0
CUKS20L	92Q664	Seep below waste rock dump	6.99	2.8	0.900	0.8	179.0	-0.1	0.2	-50.0	-0.60	146.11	15.48	0.82	-0.90	2.9		3.23	0.99	95.5
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	1	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	1	2	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	0/0

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Water Quality Results - Dissolved Concentrations

MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
UNNAMED #1 MINE																				
CU1S10H	92Q623	Base of main dump	7.53	0.214	0.113	0.3	35.2	-0.1	0.1	-50.0	-0.60	1.01	13.31	1.41	-0.90	4.8		-2.40	-0.40	23.1
CU1S20L	92Q624	Upstream of the site on the tributary str.	7.69	0.024	-0.002	0.3	6.3	-0.1	-0.1	50.0	-0.60	4.86	11.13	-0.60	-0.90	2.1		-2.40	-0.40	9.4
CU1S30L	92Q625	Cataract Cr below confl. of trib str. and Cataract	7.76	0.195	0.024	0.3	6.3	-0.1	0.1	-50.0	-0.60	1.98	12.20	-0.60	-0.90	3.1		-2.40	0.56	13.3
CU1S40L	92Q626	Cataract Creek above confl of trib str. and Cataract and below beaver ponds	7.47	0.200	0.028	0.3	6.2	-0.1	0.1	-50.0	-0.60	2.01	12.98	-0.60	-0.90	3.0		-2.40	-0.40	14.2
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	1	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	1	0	0	-	0/0	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	0/0
BLUE DIAMOND - OCCIDENTAL MINE																				
CBDS10L	92Q657	Discharge from the Occidental Mine									-0.60	-0.70	28.68	-0.60	-0.90	-1.4		-2.40	-0.40	31.7
CBDS20L	92Q658	Discharge from the Blue Diamond Mine	6.55	0.020	0.010	0.6	11.1	-0.1	0.2	-50.0	-0.60	1.57	17.84	1.07	1.10	3.5		-2.40	2.23	78.6
CBDS30L	92Q659	From Hoo Doo Cr. downstream of mine sites	7.12	0.065	0.055	0.3	10.7	0.4	0.1	85.0	-0.60	1.26	16.80	-0.60	-0.90	2.8		-2.40	-0.40	40.9
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	0	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	0/0
BLACK BEAR MINE																				
CBBS10L	92Q668	Unnamed stream above mine	6.95	0.021	-0.002	0.2	4.4	-0.1	0.1	-50.0	-0.60	1.89	7.06	-0.60	-0.90	-1.4		-2.40	-0.40	20.2
CBBS20M	92Q671	Downstream from site on same trib. to Cataract Cr.	6.77	0.026	0.260	0.3	18.8	-0.1	0.1	445.0	-0.60	4.86	9.56	7.58	-0.90	61.3		-2.40	-0.40	714.4
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	1	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	0	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	1/0	0/0	1/1		0/0	0/0	1/1
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	+	0	-	1/1	0/0	1/1		0/0	0/0	1/1
UNNAMED #3 MINE																				
CU3S10M	92Q669	Caved adit (?) in disturbed area above pond	6.11	0.016	0.004	0.3	4.5	-0.1	0.1	-50.0	-0.60	77.62	24.64	0.94	-0.90	3.0		-2.40	-0.40	140.4
CU3S20M	92Q670	Near waste rock dump below flooded shaft	6.46	0.141	0.130	0.6	6.8	-0.1	0.1	87.0	-0.60	3.66	8.78	1.09	-0.90	-1.4		-2.40	2.60	47.4
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	1	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			2	0	1	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	1/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	+	0	-	0/0	0/0	0/0		0/0	0/0	1/0
CATARACT MINE -TAILINGS																				
CCAS10L	92Q483	Cataract Cr upstream	7.62	0.120	0.006	0.4	6.0	-0.1	0.1	-50.0	-0.60	2.24	17.50	9.52	-0.90	7.6		-2.40	0.59	34.6
CCAS20L	92Q487	Cataract Cr downstream soil/tail wash area	7.71	0.130	0.008	0.4	6.2	-0.1	0.1	-50.0	-0.60	2.15	16.43	-0.60	-0.90	7.8		-2.40	-0.40	38.6
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	1	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	0	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	1/1	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	1/1	0/0	0/0		0/0	0/0	0/0

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
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MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
BOULDER CHIEF MINE																				
CBCS10H	92Q569	Adit discharge point of the Boulder Chief	2.63	66.8	31.5	3.7	646.0	-0.3	0.5	15300.0	3.84	1.59	21.99	1137.00	2.19	4506.0		13.84	36.16	18540.0
CBCS20H	92Q570	downhill from adit where springs are seeping	6.18	0.011	0.013	0.4	16.5	0.1	0.1	-50.0	-0.60	0.89	5.96	11.14	-0.90	18.4		-2.40	61.81	1410.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	+	0	0	2	0	-		0	2	-
NO. EXCEEDED CWA-SECONDARY			2	1	1	0	0	-	0	1	0	-	-	-	-	1		-	-	1
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	1	0	0	-	2/2	0/0	2/2		0/0	0/0	2/2
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	1+	0	-	2/2	0/0	2/2		0/0	2/2	2/2
IDA M MINE																				
CIMS10H	92Q656	base of main dump where springs seep from beneath dump	2.98	10.1	4.3	2.1	270.0	-0.1	0.8	6200.0	-0.60	2.20	34.09	156.86	-0.90	95.1		35.62	244.59	18090.0
CIMS20H	92Q571	at adit on top of main dump	5.43	0.792	6.1	0.6	129.0	0.1	0.5	746.0	-0.60	-0.70	35.43	93.44	-0.90	164.5		17.29	80.30	5287.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	2	0	-		0	2	-
NO. EXCEEDED CWA-SECONDARY			2	2	2	0	0	-	0	2	0	-	-	-	-	0		-	-	2
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	2	0	0	-	2/2	0/0	2/2		0/0	1/1	2/2
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	+	0	-	2/2	0/0	2/2		0/0	1/1	2/2
HATTIE FERGUSON MINES																				
CHFS10H	92Q488	Lower Hattie Ferguson adit discharge	6.87	0.640	0.680	-2.5	55.4	-0.1	0.3	-50.0	-0.60	6.75	51.44	-0.60	1.52	-1.4		-2.40	-0.40	17.5
CHFS20L-A	92Q486	Cataract Cr below adit discharge	7.69	0.130	0.010	0.5	6.7	-0.1	0.1	-50.0	-0.60	2.80	17.93	-0.60	-0.90	17.9		-2.40	1.29	42.1
CHFS20M	92Q506	Upper Hattie Ferguson at adit	7.02	0.020	0.148	0.4	46.2	-0.1	0.1	-50.0	-0.60	30.11	21.43	1.30	-0.90	-1.4		-2.40	-0.40	227.5
CHFS30L	92Q505	Upstream of site on un-named creek	7.67	0.020	0.009	0.5	67.0	0.2	0.2	-50.0	-0.60	4.87	51.72	3.64	-0.90	1.5		3.39	-0.40	1135.0
CHFS40M	92Q504	At the lower adit on the un-named creek	7.09	0.008	0.003	0.3	54.8	-0.1	0.1	-50.0	-0.60	8.85	39.69	0.96	-0.90	-1.4		-2.40	-0.40	183.0
CHFS50M	92Q503	Bel confl Un-named Cr & seep @ lower dump	7.72	0.005	0.004	0.3	68.3	-0.1	0.2	-50.0	-0.60	6.71	46.01	2.12	-0.90	-1.4		-2.40	-0.40	610.0
CHFS60M	92Q502	Bel confl Un-named Cr & seep @ upper dump	7.91	0.007	-0.002	0.4	73.0	0.1	0.2	-50.0	-0.60	4.87	47.70	2.54	-0.90	1.7		2.72	-0.40	806.0
CHFS70L	92Q501	Downstream of site, creek crosses main road	7.18	0.141	0.069	0.4	17.0	-0.1	0.1	-50.0	-0.60	2.33	14.85	1.92	-0.90	8.0		-2.40	1.19	400.3
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	1	3	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	6/4
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	5/3	0/0	0/0		0/0	0/0	6/5
SIRIUS MINE																				
CSIS10H	92Q508	Located at main adit.	4.44	0.063	1.8	0.5	103.0	-0.1	0.3	629.0	-0.60	-0.70	14.63	30.46	-0.90	65.0		6.91	13.87	4559.0
CSIS30H	92Q507	Duplicate of CSIS10H - adit sample.	4.44	0.056	1.8	0.4	107.0	-0.1	0.2	620.0	-0.60	-0.70	15.26	31.36	-0.90	65.3		6.81	13.61	4472.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	2	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			2	0	2	0	0	-	0	2	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	2/2	0/0	2/2		0/0	0/0	2/2
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	+	0	-	2/2	0/0	2/2		0/0	2/2	2/2
CRACKER MINE																				
CCRS10L	92Q474	Surface-water grab sample of discharge of main adit	7.39	0.030	3.9	0.7	74.8	-0.1	0.2	-20.0	-0.60	-0.70	15.23	12.06	-0.90	2.2		3.43	-0.40	1886.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	1	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	2/2
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	1/1

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Water Quality Results - Dissolved Concentrations

MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
MTN CHIEF MINE																				
CMCS10L	92Q484		7.42	0.136	0.450	1.2	28.3	-0.1	0.3	-50.0	-0.60	6.77	11.41	1.25	-0.90	-1.4		-2.40	0.64	167.6
CMCS20L	92Q485		7.06	0.198	0.120	1.2	26.1	-0.1	0.3	150.0	-0.60	11.36	26.68	2.25	1.15	4.7		2.74	2.70	81.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	2	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	1/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	1	+	0	-	2/1	0/0	0/0		0/0	0/0	1/0
VERA & MARIE MINE																				
CVMS10L	92Q477	Up drainage nearest the adit	7.23	0.021	0.005	0.9	22.2	-0.1	0.2	-50.0	-0.60	1.61	20.82	-0.60	-0.90	-1.4		-2.40	-0.40	-2.7
CVMS20L	92Q478	Upstream of site on str. in drainage away from site	6.97	0.015	0.005	0.9	19.2	-0.1	0.2	-50.0	-0.60	1.74	18.06	-0.60	-0.90	-1.4		-2.40	-0.40	-2.7
CVMS30L	92Q479	Main stream above confl with Cataract	7.68	0.034	0.018	0.9	21.3	-0.1	0.2	-50.0	-0.60	1.88	17.29	-0.60	-0.90	-1.4		-2.40	-0.40	7.5
CVMS40M	92Q480	Base of main waste rock dump above confl	6.51	2.55	1.7	1.0	40.7	-0.1	0.3	68.0	-0.60	4.47	22.17	0.62	0.98	2.9		8.86	0.92	49.5
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	1	1	0	0	-	0	1	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	0/0
UNCLE SAM GULCH & MINE																				
CUSS10L	92Q638	Cataract Cr, seep from hill bel. Crystal Mine	7.66	0.043	0.009	0.4	13.6	-0.1	0.1	-50.0	-0.60	10.57	17.38	0.67	-0.90	3.5		-2.40	1.29	25.0
CUSS20L	92Q639	Uncle Sam Gulch downstream of Crystal Mine	3.52	4.5	4.3	0.7	186.0	-0.1	0.1	4500.0	-0.60	6.52	23.08	242.32	-0.90	3546.0		11.59	89.75	6824.0
CUSS30L	92Q640	Uncle Sam Gulch 10' abv conf w/ Cataract Cr	7.15	0.008	0.700	0.4	52.8	-0.1	0.1	-50.0	-0.60	1.63	27.83	44.57	-0.90	90.6		3.23	1.47	2756.0
CUSS40L	92Q641	Cataract Cr 20' abv conf w/ Uncle Sam Gulch	8.02	0.116	0.006	0.4	10.9	-0.1	0.1	-50.0	-0.60	4.90	27.32	0.91	3.00	10.1		-2.40	0.96	59.6
CUSS50L	92Q642	Cataract Cr 20' belw conf w/ Uncle Sam Gulch	7.89	0.087	0.080	0.4	15.4	-0.1	0.1	80.0	-0.60	4.76	28.35	7.09	-0.90	38.1		-2.40	1.40	498.4
CUSS60L	92Q643	Cataract Cr 1000' below Phantom Mine	7.70	0.071	0.084	0.4	17.0	-0.1	0.1	-50.0	-0.60	3.88	23.05	7.44	-0.90	38.1		-2.40	1.34	511.4
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	4	0	-		0	1	-
NO. EXCEEDED CWA-SECONDARY			1	1	4	0	0	-	0	2	0	-	-	-	-	1		-	-	1
NO. EXCEEDED AQLC-ACUTE(1)			-	1	-	-	-	-	-	1	0	0	-	4/2	0/0	4/4		0/0	1/0	4/4
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	2	+	0	-	4/4	0/0	4/4		0/0	1/0	4/4
PHANTOM MINE																				
CPHS10L	92Q475	Adit discharge	7.43	0.062	0.188	0.9	37.4	-0.1	0.2	-50.0	-0.60	-0.70	18.81	-0.60	-0.90	-1.4		-2.40	-0.40	-2.7
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	0	0	0	0	-		0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	1	0	0	-	0	0	0	-	-	-	-	0		-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	0/0		0/0	0/0	0/0
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	+	0	-	0/0	0/0	0/0		0/0	0/0	0/0

US FOREST SERVICE - DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Water Quality Results - Dissolved Concentrations

MINE/ SAMPLE ID	LAB ID	Sample Site Location	pH (field)	Fe (mg/l)	Mn (mg/l)	Cl (mg/l)	SO4 (mg/l)	NO3 (mg/l)	F (mg/l)	Al (ug/l)	Ag* (ug/l)	As* (ug/l)	Ba* (ug/l)	Cd* (ug/l)	Cr* (ug/l)	Cu* (ug/l)	Hg* (ug/l)	Ni* (ug/l)	Pb* (ug/l)	Zn* (ug/l)
SOUTH MANTLE MINE																				
CMAS20M	94Q0767	Cataract Cr 600' upstream of Mantle Mine	7.90	0.121	0.052	0.7	12.5	0.3	0.1	43.0	<1	2.20	12.80	3.20	<2	44.9	<1	<2	<2	278.0
CMAS10M	94Q0765	Cataract Cr 1600' dwnstrm of Mantle Mine	8.20	0.124	0.050	0.8	12.5	0.2	0.1	41.0	<1	2.10	13.00	3.40	<2	39.5	<1	<2	<2	277.0
CSMS20H	94Q0771	Big Limber Cr 400' abv conf Cataract Cr&SMM	7.75	0.026	0.004	3.3	34.3	0.2	0.2	<30	<1	1.30	47.20	<2	<2	<2	<1	<2	<2	4.9
CSMS10M	94Q0769	Cataract Cr 1600' dwnstrm of So Mantle Mine	7.80	0.109	0.043	0.6	12.7	0.2	0.0	45.0	<1	2.20	12.90	3.10	<2	40.7	<1	<2	<2	252.0
NO. EXCEEDED CWA-PRIMARY			-	-	-	-	-	0	0	-	-	-	0	0	0	-	0	0	0	-
NO. EXCEEDED CWA-SECONDARY			0	0	2	0	0	-	0	0	0	-	-	-	-	0	-	-	-	0
NO. EXCEEDED AQLC-ACUTE(1)			-	0	-	-	-	-	-	0	0	0	-	0/0	0/0	3/3	0	0/0	0/0	3/3
NO. EXCEEDED AQLC-CHRONIC(1)			-	-	-	-	-	-	-	0	0	0	-	3/3	0/0	3/3	+	0/0	0/0	3/3

A minus (-) sign before a number means the concentration is less than the Method Detection Limit (MDL), for that analyte.
Value shown is the MDL, per SOW 200.8.

* Critical elements, lab data has been qualified according to QAPP.

(1) Where two values are listed, criteria is hardness dependent.

Values are calculated on hardness of 100 and 200 mg/l, respectively.

+ MDL is above Chronic Aquatic Life Criteria.

DEERLODGE NATIONAL FOREST
CATARACT CREEK DRAINAGE
Soil and Waste - rock analyses (qualified data)
all values are mg/Kg

Sample	Lab id		Cr C	Ni C-1	Cu C-2	Zn C-3	As C-4	Ag C-5	Cd C-6	Ba C-7	Pb C-8
ADA											
CADD10H	92S692	below waste-rock dump	3.047657 B	1.975413 B	123.2974	108.8874	2953.488	3.287361 B	0 U	65.55459 B	154.2727
CADD20H	92S693	west side of waste-rock dump	3.220573 B	1.609232 B	61.97124	101.5777	2260.939	0 U	0 U	72.23826 B	153.05
BLACK BEAR											
CBBD10H	92S672	near stream below dump	1.95445 B	1.797433 B	29.93862 B	159.7463	1081.055	0 U	0.481381 B	39.56005 B	156.5688
BOULDER CHIEF											
CBBD11H	92S572	near CBCS20H at seep area	3.7219 B	3.241166 B	188.1344	4402.52	38.81302	37.96288	36.42453	39.63027 B	3258.877
CATARACT											
CCAD10H	92S482	tailings-soil mix area	0.833405 U	1.36355 B	668.3911	1040.701	1139.764	95.65742	6.121374 B	185.2653 B	3582.969
CRACKER											
CCRD10L	92S472	below waste-rock dump	2.245918 B	1.492105 B	155.0393	1792.952	117.0915	8.440484 B	13.01657	55.12144 B	1897.736
GRAY LEAD											
CGLD10H	92S666	lower extent of tailings	2.99229 B	0.692167 U	352.1318	1963.871	4360.65	24.84612	33.40503	57.31673 B	3825.552
PHANTOM											
CPHW10L	92S471	below waste-rock dump	4.724599 B	7.63016 B	28.52348 B	183.6359	23.81447	0 U	1.689901 B	29.28494 B	102.2535
ROCKER											
CROD10H	92S691	below waste-rock dump	4.974636 B	4.105374 B	114.5135	90.83081	1016.727	1.377119 B	0 U	64.76948 B	356.6101
CROD20H	92S690	soil near adit discharge	4.728565 B	4.343558 B	162.107	110.8458	691.3872	0 U	0.33821 B	42.88679 B	99.05525
SIRIUS											
CSID10H	92S510	below waste-rock dump	0 U	0 U	53.21786	233.3666	1255.923	3.147246 B	1.060698 B	12.17516 B	1607.833