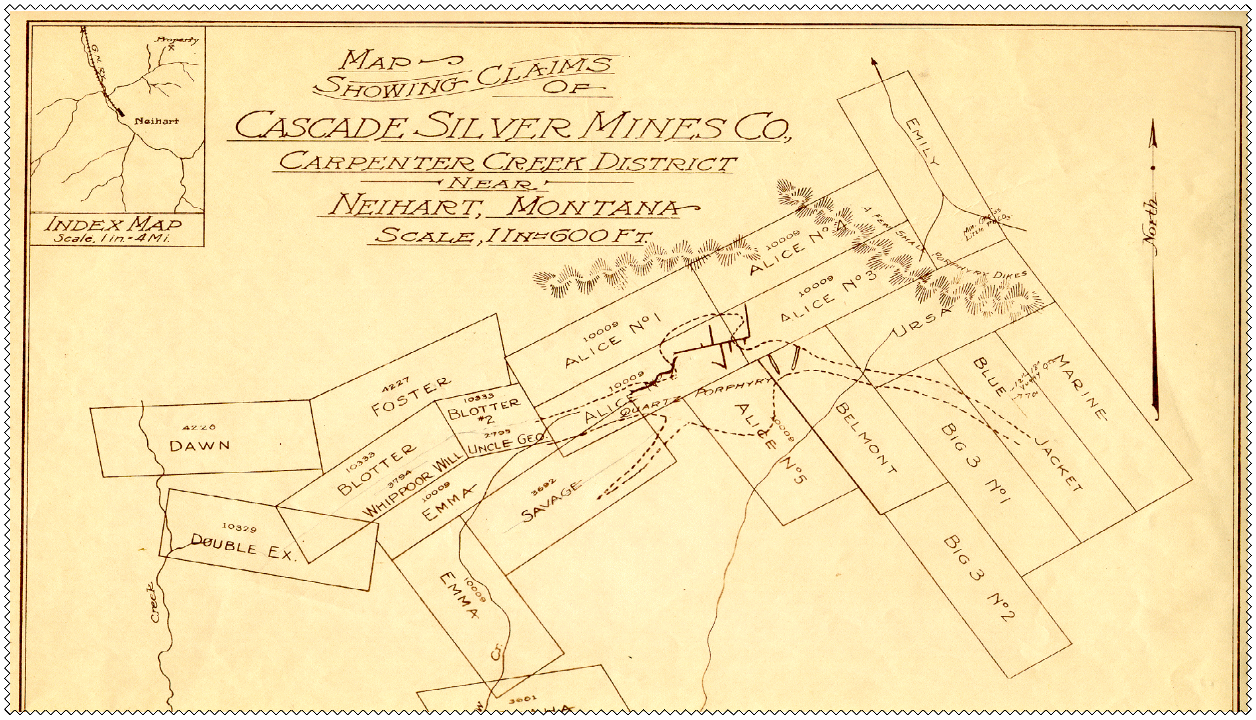
Abandoned-Inactive Mines on
Lewis and Clark National Forest-Administered Land



Montana Bureau of Mines and Geology
Abandoned-Inactive Mines Program
Open-File Report MBMG 413

Phyllis A. Hargrave
Michael D. Kerschen
Geno W. Liva
Jeffrey D. Lonn
Catherine McDonald
John J. Metesh
Robert Wintergerst

Prepared for the U.S. Department of Agriculture
Forest Service-Region 1

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Introduction

To fulfill its obligations under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Northern Region of the U. S. 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. Concurrently, 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 entered into a series of participating agreements to accomplish this work. The first forest inventoried was the Deerlodge National Forest, followed by the Helena National Forest, then the Beaverhead, the Kootenai, and the Lewis and Clark Forests (table 1).

Table 1. List of previous inventories and open-file report (OFR) numbers.

National Forest-Volume	Drainage	MBMG OFR #
Deerlodge-Volume I	Basin Creek	321
Deerlodge-Volume II	Cataract Creek	344
Deerlodge-Volume III	Flint Creek and Rock Creek	345
Deerlodge-Volume IV	Upper Clark Fork River	346
Deerlodge-Volume V	Jefferson River	347
Helena-Volume I	Upper Missouri River	352
Helena-Volume II	Blackfoot-Little Blackfoot Rivers	368
Beaverhead	Entire Forest	379
Kootenai	Entire Forest	395
Bureau of Land Management	Entire State	365

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 have 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 pro-actively respond to governmental and public interest group concerns.

In addition to the USFS objectives, 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 various safety, health, and environmental problems that 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; 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 (appendix I-Field Form), the hydrologic environment appears to be affected to the greatest extent. Therefore, this investigation focused most heavily on impacts to surface and ground water from the mines.

Metals are often transported from a mine by water (ground-water or surface-water 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 metal solubility. 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 as follows:

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 that affect the other five elements.

Most geochemists would add to this list mineral availability, such as calcite, which can neutralize the acidity. These six components occur not only within the mines but can exist within mine dumps and mill-tailings piles making waste material sources of contamination as well.

Acid-mine drainage is formed by the oxidation and dissolution of sulfides, particularly 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 ($SO_4^{=}$), and reduced iron (Fe^{2+}). Mining of sulfide-bearing rock exposes the sulfide minerals to atmospheric oxygen and oxygen-bearing water. Consequently, the sulfide minerals are oxidized, and acid-mine waters are produced.

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 sulfide minerals, such as arsenopyrite (FeAsS), chalcopyrite ($CuFeS_2$), galena (PbS), tetrahedrite ($[CuFe]_{12}Sb_4S_{13}$), and sphalerite ([Zn,Fe]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 Solubilities of Selected Metals

At a pH above 2.2, ferric hydroxide ($Fe[OH]_3$) precipitates to produce a brown-orange stain in surface waters and forms a similarly 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 ($KAl_3[SO_4]_2[OH]_6$) and jarosite ($KFe_3[SO_4]_2[OH]_6$) 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 ($MnO[OH]$) is precipitated. Manganese is found in mineralized environments as rhodochrosite ($MnCO_3$) and its weathering products.

Aluminum solubility is most often controlled by alunite ($KAl_3[SO_4]_2[OH]_6$) or by gibbsite ($Al[OH]_3$), 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 silver solubility 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 present in solution in higher pH waters. At a pH 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 ($Cu_{12}As_4S_{13}$), to name a few.

Cadmium solubility data are limited. In soils, cadmium solubility is controlled by the carbonate species octavite ($CdCO_3$) at a soil-pH above 7.5 and by strengite ($Cd_3[PO_4]_2$) 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 ($Cu_2[OH]_2CO_3$) and azurite ($Cu_3[OH]_2[CO_3]_2$) control solubility when CO_3 is available in sufficient concentrations. In soil, copper complexes readily with soil iron to form cupric ferrite. Other compounds in soil such as sulfate and phosphates also may control copper solubility. Copper is present in many ore minerals, including chalcopyrite ($CuFeS_2$), bornite (Cu_5FeS_4), chalcocite (Cu_2S), and tetrahedrite ($Cu_{12}Sb_4S_{13}$).

Mercury readily vaporizes under atmospheric conditions and thus, is most often found in concentrations well below the 25 µg/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 (Hg), and as Hg in human-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 µg/L at a pH 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 a pH greater than eight, the equilibrium concentration of zinc in waters with a high bicarbonate content is less than 100 µg/L. Franklinite may control solubility at pH less than five 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.

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 have 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 strongly depends on the presence of dissolved iron. Cadmium and lead also may exceed standards in waters having pH values within acceptable limits.

Reliance on SC as an indicator of site conditions also can lead to erroneous conclusions. The SC value of a sample represents 55 to 75% 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% 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 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 for all known mines in Montana. The MBMG plotted the published location(s) of the mines on USFS maps. From the maps, the MBMG developed an inventory of all known mines located on or that could affect National Forest System lands in Montana. The following data sources were used:

1) the MILS (mineral industry location system) data base [U.S. Bureau of Mines (USBM)],
2) the MRDS (mineral resource data systems) data base [U.S. Geological Survey (USGS)],
3) published compilations of mines and prospects data,
4) state publications on mineral deposits,
5) USGS publications on the general geology of some quads,
6) recent USGS/USBM mineral resource potential studies of proposed wilderness areas,
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 located in the field.

1.4.2 Pre-Field Screening

Field crews visited only sites with the potential to release hazardous substances and sites that lacked information to make that determination without a field visit. For problems to exist, a site must have 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. Sites on dry ridgetops were assumed to have no mechanism for water transport and mines described in the literature as small prospects were considered to have inconsequential hazardous-materials sources; thus, neither type was visited.

In addition, the MBMG and the USFS developed screening criteria (table 2) 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. USFS mineral administrators used these criteria to "screen out" several sites using their knowledge of an area.

Table 2. 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 flood plain 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

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 further.

Mine sites that were not visited were retained in the data base along with the data source(s) consulted (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 verified.

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 to 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

Sites that could not be screened out as described above were visited. All visits were conducted in accordance with a health and safety plan that was developed for each forest. An MBMG geologist usually made the initial field visit and gathered information on environmental degradation, hazardous mine openings, presence of historical structures, and land ownership. Some site locations were refined using conventional field methods or by USFS Global Positioning System (GPS) crews. Each site is located by latitude/longitude and by tract-section-Township-Range as indicated in figure 1.

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

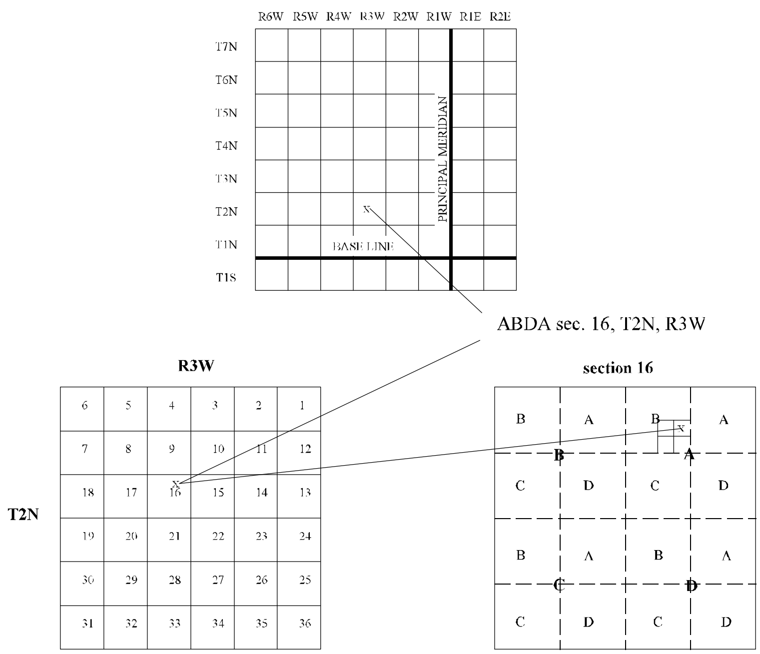


Figure 1. The location of a mine is found as shown using a counterclockwise progression of decreasing quarters of a section of land. The resulting tracts in this case are ABDA.

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 that 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) were mapped by the geologist using a Brunton compass and tape. The maps show locations of 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 verify the availability of metals for leaching when exposed to water. Assay samples were only taken to provide some information on the types of metals present and a rough indication of their concentrations. Outcrops and mine waste were not sampled extensively enough to provide reliable estimates of tonnages, grades, or economic feasibility.

1.4.4 Field Methods

A MBMG 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 soil and water sampling locations.

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/or soil sampling locations based on field parameters (SC, pH, Eh, etc.) and observations (erosion and staining of soils/streambeds) and 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 to assess conditions on National Forest System lands; therefore, samples sites were located on National Forest System lands to the extent ownership boundaries were known.

Because monitoring wells were not installed as part of this investigation, the evaluations of impacts to ground water were limited to strategic sampling of surface water and soils. Background water-quality data are 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 Collection of Water and Soil Samples

Sampling crews collected soil and water samples, and took field measurements (stream flow) in accordance with the following:

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

Quality Assurance Project Plan (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.

1.4.4.3 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 sampling and analysis plan (SAP) for each mine site or development area that 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 seven-character identifier based on its location, sample type, interval, and relative concentration of dissolved constituents. The characters were defined as follows:

D DA T L I C where:

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.

1.4.4.4 Existing Data

Data collected in previous investigations were neither qualified nor validated under this project. The quality-assurance managers and project hydrogeologists determined the usability 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 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 standards for various metals. To 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 Soil Standards

There are no federal standards for metal concentrations and other constituents in soils; acceptable limits for such are often based on human and/or environmental risk assessments for an area. Because no assessments of this kind have been done, metals concentrations in soils were compared to the limits postulated by the EPA and the Montana Department of Health and Environmental Sciences (MDHES) for sites within the Clark Fork River basin in Montana. The proposed upper limit for lead in soils is 1,000 mg/kg to 2,000 mg/kg, and 80 to 100 mg/kg for arsenic in **residential** areas. The Clark Fork Superfund Background Levels (Harrington-MDHES, written commun., 1993) are listed in table 3.

Table 3. Clark Fork Superfund background levels (mg/kg) for soils.

Reference	As	Cd	Cu	Pb	Zn
U.S. Mean soil	6.7	0.73	24.0	20.0	58
Helena Valley Mean soil	16.5	0.24	16.3	11.5	46.9
Missoula Lake Bed Sediments	-	0.2	25.0	34.0	105
Blackfoot River	4.0	<0.1	13.0	-	-
Phytotoxic Concentration	100	100	100	1,000 (500)	500

A more recent level of 500 mg/kg for lead was provided for state superfund programs (Judy Reese, MDEQ, written commun., 1999). The 1,000 level is an upper limit for lead and was not used at CFR sites.

For reference, Reese also provided the following Clark Fork Superfund **phytotoxicity** levels listed in table 4.

Table 4. Various levels of toxicity for lead (ARWWS : Anaconda Regional Water and Waste Standards, a part of the Anaconda National Priorities List).

Source		ppm
ARWWS ecological RA	low pH<6.5	94 (Natural Resource Damage #)
ARWWS ecological RA	low pH>6.5	179 (Natural Resource Damage #)
ARWWS ecological RA	high pH<6.5	250
ARWWS ecological RA	high pH>6.5	250
Kabata-Pendias & Pendias (1992)		100-400
CH2MHill (1987)		1,000

1.4.6.2 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 water-quality standards (acute and chronic) 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 5. In some state investigations, the standards are applied to samples collected as total-recoverable metals. Because total-recoverable-metals concentrations are difficult if not impossible to reproduce, this investigation used dissolved metals concentrations.

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 are presented in appendix IV.

The data for this project were integrated with existing data and incorporated into a new MBMG abandoned-inactive mines data base. The data base will eventually include mines and prospects throughout Montana. It is designed to be the most complete compilation available for information on the location, geology, production history, mine workings, references, hydrogeology, and environmental impact of each of Montana's mining properties. The data fields in the current data base are compatible with the MBMG geographic information system (GIS) package.

Table 5. 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		0.05-0.2	0.75	0.087
Arsenic	0.05[9]		0.34	0.15
Barium	2			
Cadmium	0.005		0.0043[6]	0.0022[6]
Chromium	0.1		1.7[6,7]	0.21[6,7]
Copper	1.3[8]	1.0	0.013[6]	0.009[6]
Iron		0.3		1
Lead	0.015[8]		0.065[6]	0.0025[6]
Manganese		0.05		
Mercury	0.002		0.0014	0.00077
Nickel			0.47[6]	0.52[6]
Silver		0.1	0.0034[6]	
Zinc		5	0.12[6]	0.12[6]
Chloride		250	860	230
Fluoride	4.0	2.0		
Nitrate	10 (as N)			
Sulfate		250		
pH (Standard Units)		6.5-8.5		6.5-9.0

(1) 40 CFR 141; revised through 7/1/99.
(2) 40 CFR 143; revised through 7/1/99.
(3) Priority Pollutants, EPA Region VIII, April 1999.
(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.
(7) Cr^{+3} species.
(8) Action level, EPA Current Drinking Water Standards, National Primary and Secondary Drinking Water Regulations, April, 1999.
(9) The Safe Drinking Water Act, as amended in 1996, requires EPA to revise the existing drinking water standard for arsenic. Planned for Spring 2000.

1.5 Lewis and Clark National Forest

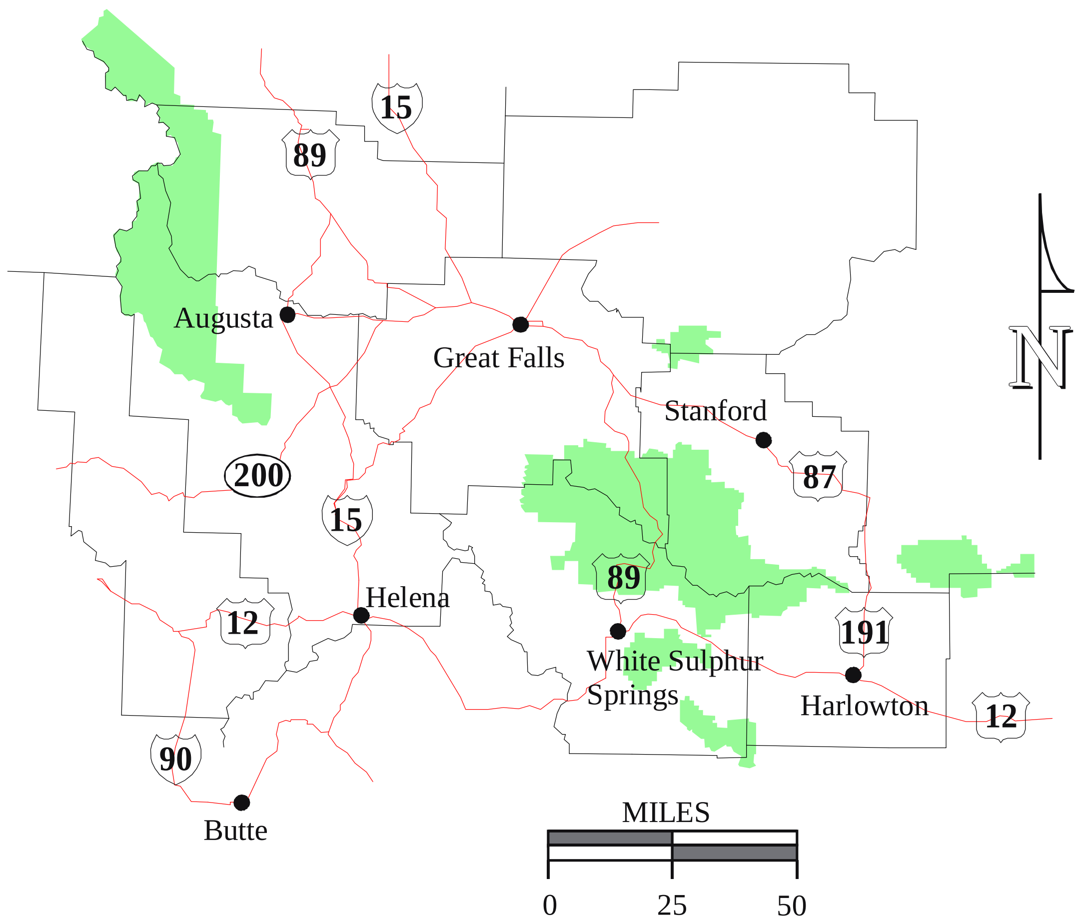
Approximately 1.8 million acres are administered by the USFS, Lewis and Clark National Forest (LCNF). The area lies east of the Continental Divide in west-central Montana (figure 2) and includes fragments divided into a northern "Rocky Mountain" division and a more southern "Jefferson" division. The regional office is located in Missoula, Montana, with the Supervisor's office in Great Falls and District offices located in Choteau (Rocky Mountain), White Sulphur Springs (Kings Hill), Stanford (Judith), and Harlowton (Musselshell). The southern half of the Great Falls 1° x 2°, a portion of the Cut Bank 1° x 2°, the area east of the Continental Divide on the Choteau 1° x 2°, the Roundup 1° x 2°, and the eastern half of the White Sulphur Springs 1° x 2° quadrangles cover the area. Lewis and Clark National Forest-administered land lies within portions of Meagher, Judith Basin, Pondera, Teton, Cascade, Fergus, and Lewis and Clark Counties.

The topography is typical of southwestern Montana's Basin and Range province, grading from semiarid grass/sagebrush-vegetated valleys to coniferous forests and alpine peaks above timberline. The Big Snowy, Highwood, Castle, and Little Belt Mountains lie within the Jefferson division of the LCNF. Typical mountain elevations in the LCNF range from 9,204 ft on Scapegoat Mountain in the Scapegoat Wilderness, 8,887 ft at Slategoat Mountain in the Bob Marshall Wilderness, and 8,091 ft at Half Dome Crag at the north end of the Forest. In the Little Belts, Long Mountain is 8,621 ft elevation and the Castle Mountain's Long Peak is 8,566 ft in elevation. Valley elevations are about 5,200 ft elevation to the north and 5,700 ft surrounding the Castle Mountains.

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. Silver in Barker and gold in Yogo Gulch were discovered in 1879, 15 years after many of the occurrences in Helena were first discovered (Schafer, 1935). Mining in Neihart was most active between 1882 and 1887. The Queen of the Hills claim, along with the Mountain Chief, Galt and Ball, were early mines. A railroad branch reaching the area in 1891 sparked renewed interest. The average silver price in 1890 was $1.05 per ounce and the price dropped to $0.99 in 1891, $0.87 in 1892, $0.78 in 1893, with a low of $0.52 in 1909. It did not begin a steady recovery until 1916 — a recovery that lasted until 1930 when the price crashed again. The area was idle again between 1930 and 1933 when there was renewed interest in the area. The Silver Dyke Mine has consistently had the most active workings since it was developed in 1921, with the Big Seven/Benton Mines being other major producers.

The Lewis and Clark National Forest includes all or part of more than six mining districts as defined by Hill (1912) and Sahinen (1935). These districts include: Cascade County-Montana (Neihart) (Ag, Au, Pb, (Cu)), and Sand Coolee (Fe); Meagher County-Castle Mountain (Pb, Ag, Cu), Musselshell (Copperopolis) (Cu, Au, Ag); Judith Basin County-Barker (Hughesville)(Pb,



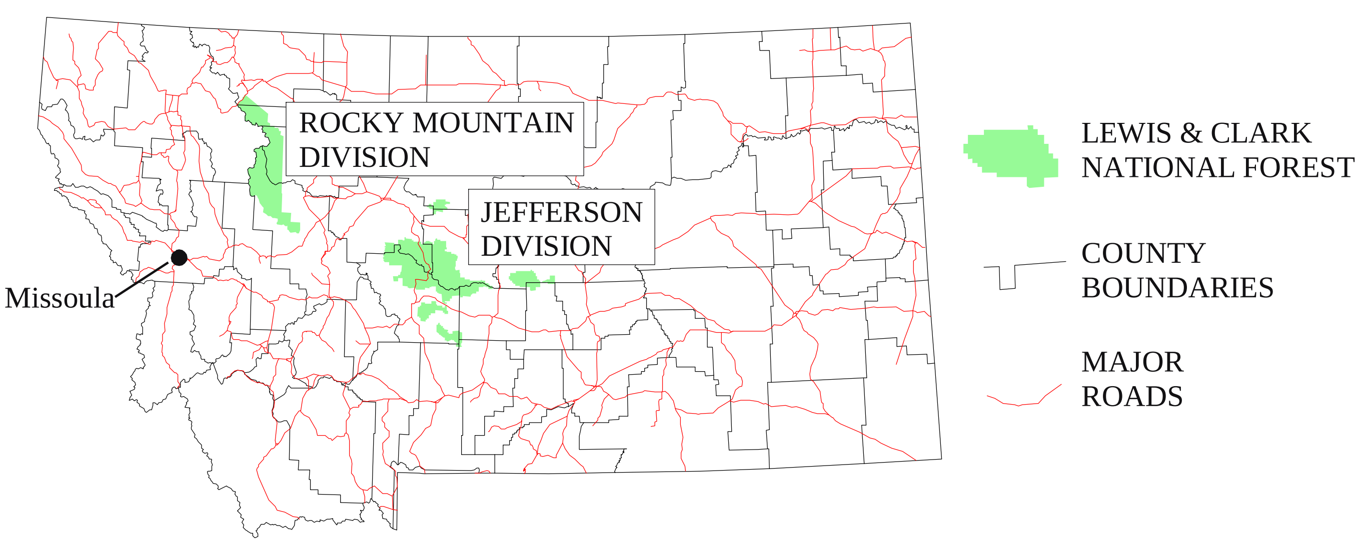


Figure 2. The Lewis & Clark National Forest and associated wilderness areas cover nearly 1.8 million acres in west-central Montana.

Ag) also partly in Cascade County, Yogo and Running Wolf(Au, Ag, Cu, Pb, Fe, sapphire). Robertson (1951) also included the Carbonate (Logging Creek) district in Cascade County (Pb, Zn, Au, Ag). Scattered mines occur elsewhere but not in organized mining districts. The northern, Rocky Mountain division of the LCNF does not have any organized mining districts.

Placers in the area were few and far between. Lyden (1987) estimated production from Cascade County as 11.56 ounces of gold in the years from 1904 to 1945. The majority of this gold came from the Neihart mining district. Judith Basin County was estimated to have produced 21.13 fine ounces of gold between 1921, when the county was formed, and 1948 (Lyden, 1987). A small amount was found in Dry Wolf Creek and Yogo Gulch. Yogo Gulch deposits were discovered in 1862, but the heyday of Yogo Gulch was from 1879 to 1883 (Indians drove out the first prospectors). The sapphire placers (and sapphire-bearing dike) at Yogo were discovered in 1894 (Dahy, 1988). Meagher County had minimal placer gold production associated with the LCNF, primarily from Placer Creek, a tributary of Tenderfoot Creek.

Placers in Montana reached their maximum production before 1872, when the richest ones began to play out; production was primarily by hydraulicking and sluicing. 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 increased 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.

1.5.1.1 Production

The total value (at the time they were mined) of minerals produced from all mines within the Lewis and Clark National Forest boundaries was probably about $32,000,000 with approximately $1 million from placers and the rest from lode mines (table 6). The estimated values reflect the prices of commodities at the time of production and not current prices. A more current estimate at today’s metal prices would total $221,418,905 but again this is a “ballpark” figure. This estimate does not account for metals mined since 1950, but this amount would be small in comparison to the production before 1950.

Table 6. Production from the three main counties of the Lewis and Clark National Forest.

County	Total Value	Gold (oz)	Silver (oz)	Copper (lb)	Lead (lb)	Zinc (lb)
Cascade 1889-1948	$20,093,595	35,312	15,697,412	7,882,328	65,523,298	15,156,496
Judith Basin 1921-1948*	$5,946,294	3,994	2,656,987	858,818	46,219,587	17,913,553
Meagher 1883-1947	$6,044,511	5,278	14,017	703,573	29,439,740	34,207

Production statistics from:
Robertson (1951)-Cascade County.
Robertson and Roby (1951)-Judith Basin County.
*Production from 1889 to 1920 is combined with Cascade County (prior to Judith Basin County organization).
Roby (1950)-Meagher County.

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 that is either the commodity or a concentrate that is shipped off site to other facilities for further refinement, and 2) mill waste, which is called tailings.

In the 1800's, 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 USFS-administered land). Gold was commonly removed from free-milling ores at the mill by mercury amalgamation. Cyanidation arrived in the United States 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 Lewis and Clark National Forest Investigation

A total of 227 sites were initially identified in or near the Lewis and Clark National Forest

(LCNF) by using the USBM MILS data base as a basic reference. Other sources of information include Roby (1950), Robertson and Roby (1951), Robertson (1951), Garverich (1995), Dahy (1988) and Blumer (1969). Table 7 summarizes the process by which the final results were achieved in the Lewis and Clark National Forest inventory.

Table 7. Summary of Lewis and Clark National Forest investigation.

Total Number of Abandoned/Inactive Mines Sites that were:	
PART A-Field Form	
Located in the general area from MILS	227
Deleted as a duplicate site	1
Added by MBMG from literature or field visits	53
	279
PART B-Field Form (Screening Criteria)	
Screened out by LCNF minerals administrator or by description in literature	139
Unable to locate	7
Visited by MBMG geologist	133
Screened out by geologist	114
PART C-Field Form	
Sampled (Water and/or Soil)	19

These numbers are accurate to the extent that the data base is updated and will change, reflecting current progress in database entry.

An individual discussion of each of the 19 sites referred to the hydrogeologists and sampled by them is included in this report on the Lewis and Clark National Forest. Some sites were on private lands (especially in the Neihart mining district) and were sampled collectively at sites located on LCNF-administered land. Most of the 279 sites inventoried as possibly affecting LCNF-administered land are listed in appendix II of this volume.

1.7 Mining Districts and Drainage Basins

The Lewis and Clark National Forest includes at least six mining districts as defined by several authors including: Hill (1912), Sahenin (1935), Roby (1950), Robertson (1951), and Robertson and Roby (1951). These boundaries are subject to interpretation, change, and often the same district is known by various names, as in the case of the Montana or Neihart district, or the Barker or Hughesville districts. Some mines are not located in traditional districts, so for the purposes of this study, all the mines studied have been organized by drainage basin. This is a convenient way to separate the National Forest into manageable areas for discussion of geology and hydrogeology, and perhaps more important, it is an aid to the assessment of cumulative environmental impacts on the drainage.

Smith, Belt, Judith, Musselshell and Other Drainages

The Smith River, Musselshell River, Arrow Creek, Belt Creek, and Judith River drainages are in the Lewis and Clark National Forest, east of the Continental Divide (figure 3); all are in the Missouri River Basin. Major tributaries within the southern area of the Lewis and Clark National Forest include Belt Creek which flows north from the Hughesville and Neihart areas and joins the Missouri River north of Great Falls. The Smith River flows north-northwest and joins the Missouri River just south of Great Falls, as does Arrow Creek. The Musselshell and Judith Rivers drain the area to the east and also join the Missouri River.

Sun River, Teton, and Dearborn Drainages

The northern part of the LCNF drains into the Teton, Sun and Dearborn Rivers from the Rocky Mountain front in a series of relatively small, northwest-trending drainages (figure 4). These rivers all eventually join the Missouri. A small portion of LCNF-administered lands drains to the Shields and Missouri (south of Canyon Ferry) Rivers but no mines are located in these drainages.

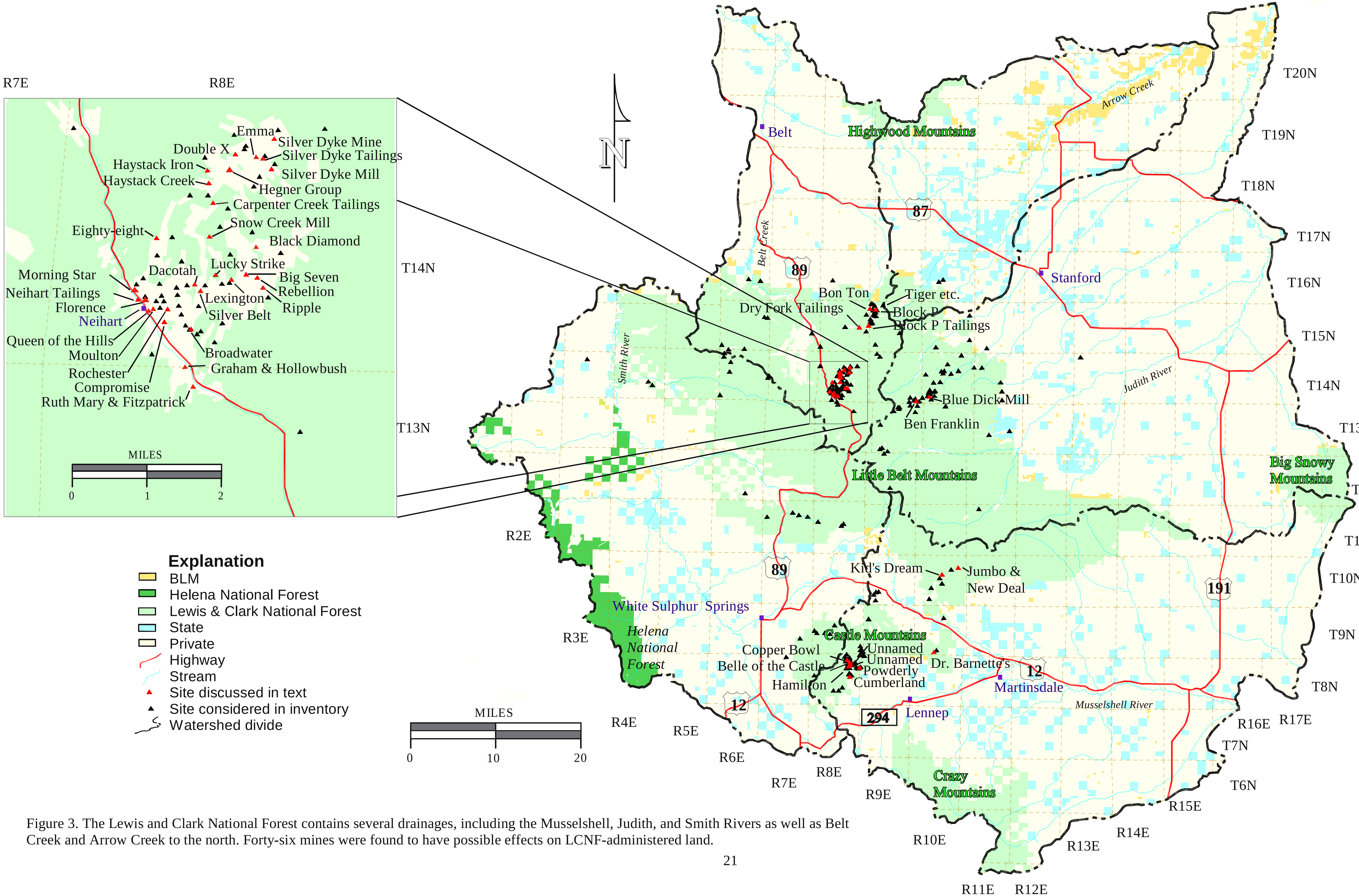


Figure 3. The Lewis and Clark National Forest contains several drainages, including the Musselshell, Judith, and Smith Rivers as well as Belt Creek and Arrow Creek to the north. Forty-six mines were found to have possible effects on LCNF-administered land.

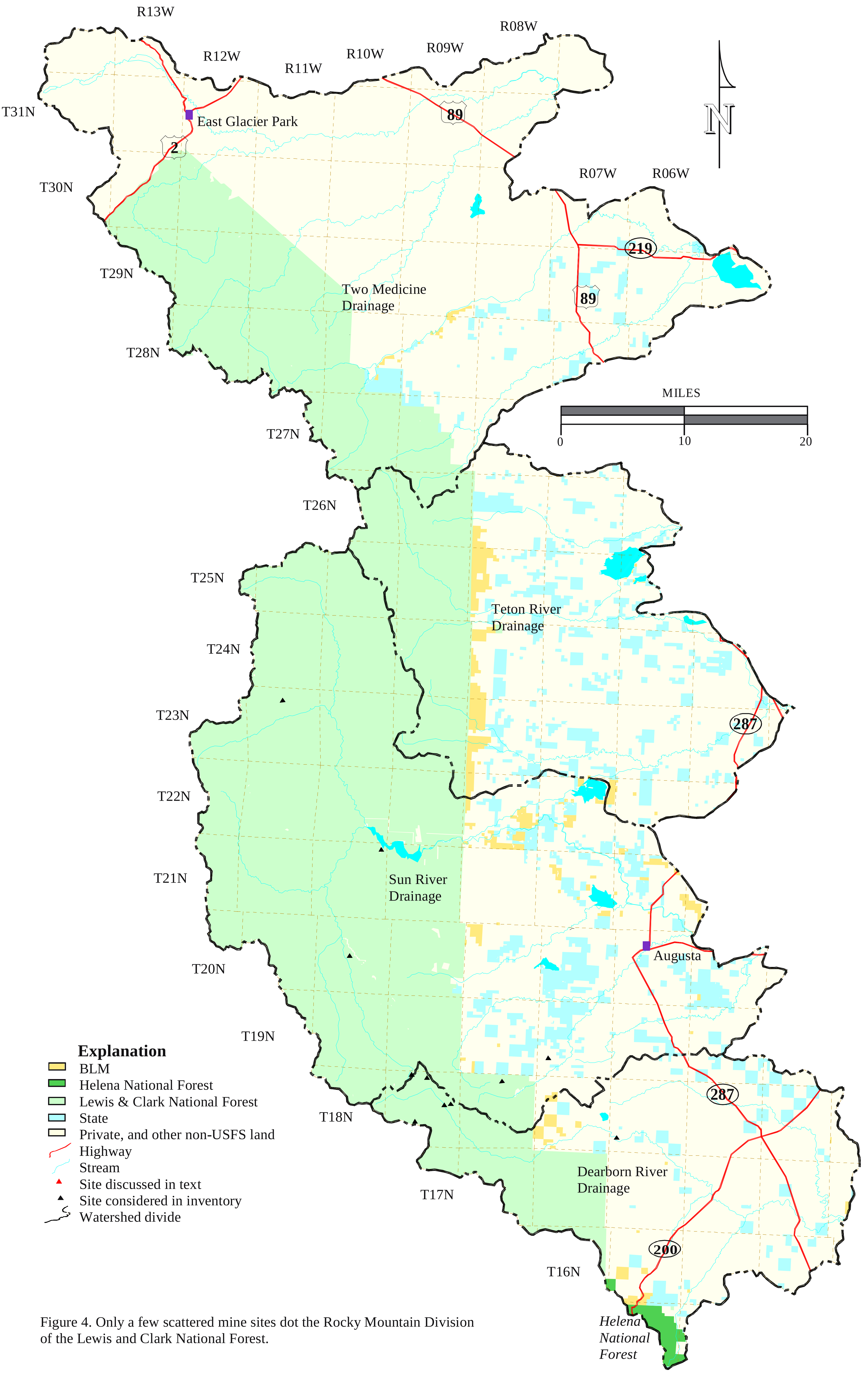


Figure 4. Only a few scattered mine sites dot the Rocky Mountain Division of the Lewis and Clark National Forest.

2.1 Geology

The area of the Jefferson Division of the Lewis and Clark National Forest lies near the east edge of the sediments from the Precambrian Belt Sea; sediments were deposited in a trough known as the Helena embayment (figure 5a, Zieg, 1986). Godlewski and Zieg (1984) show a closer look at the general configuration of the eastern margin of the Belt Series rocks (figure 5b). The Little Belt Mountains dominate the Jefferson Division of the Lewis and Clark National Forest, and the Castle Mountains host the second largest cluster of mines in the south-central portion of the Forest. The Little Belts were formed in the Cretaceous or Paleocene as an anticline cored by basement rocks (Baker and others, 1991). Laramide (Eocene) felsic igneous intrusions resulted in numerous laccoliths, bysmaliths, stocks, sills, dikes, and diatremes. Some of the domal structures are capped by fairly flat-lying sedimentary rocks, primarily the Belt Series' basal Neihart quartzite but also Cambrian to Cretaceous sedimentary rocks. Other domes have exposed cores of igneous rocks. In a small area to the north of Neihart, a window of Archean gneisses and schists have been exposed resulting from the erosion of the over-lying Belt, Cambrian and younger rocks. The Highwood Mountains to the north of the Little Belt Mountains are composed of dark basaltic extrusives and stocks of granular intrusives (Robertson and Roby, 1951).

The Castle Mountains are chiefly granitic and the intrusion has altered the surrounding limestone and shales (Roby, 1950). Volcanics also crop out in the southern part of the Lewis and Clark Forest area but do not have economic deposits associated with them.

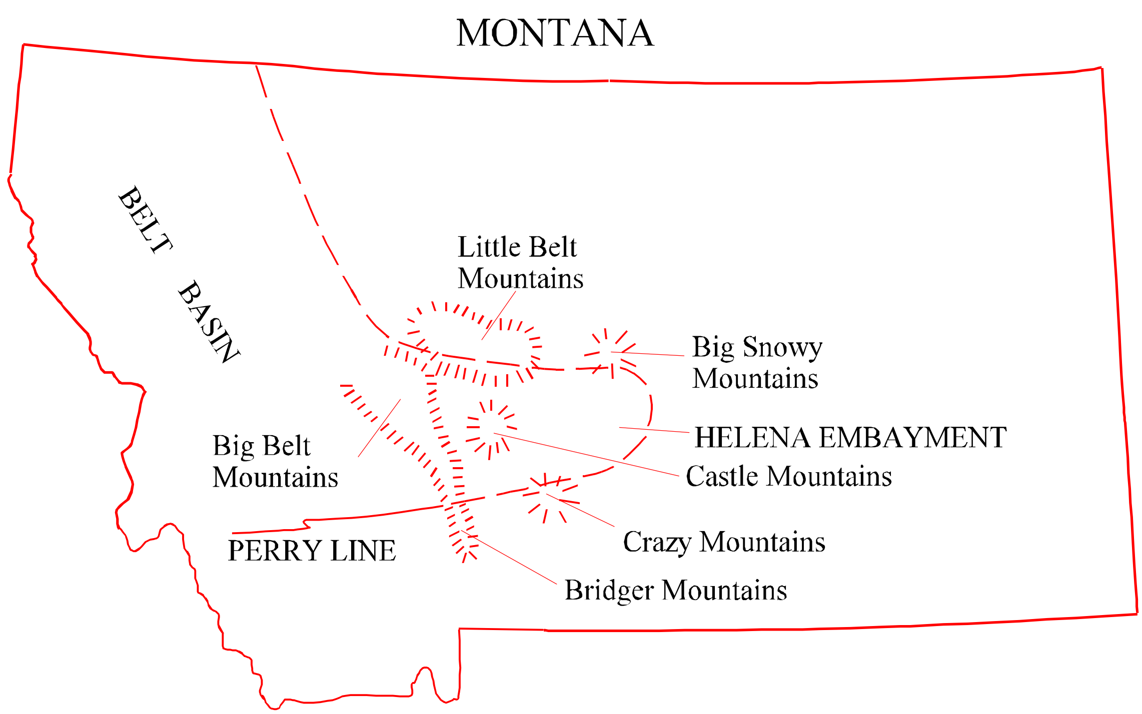


Figure 5a. Extent of the Belt Basin sea in Montana, from Zeig, 1986.

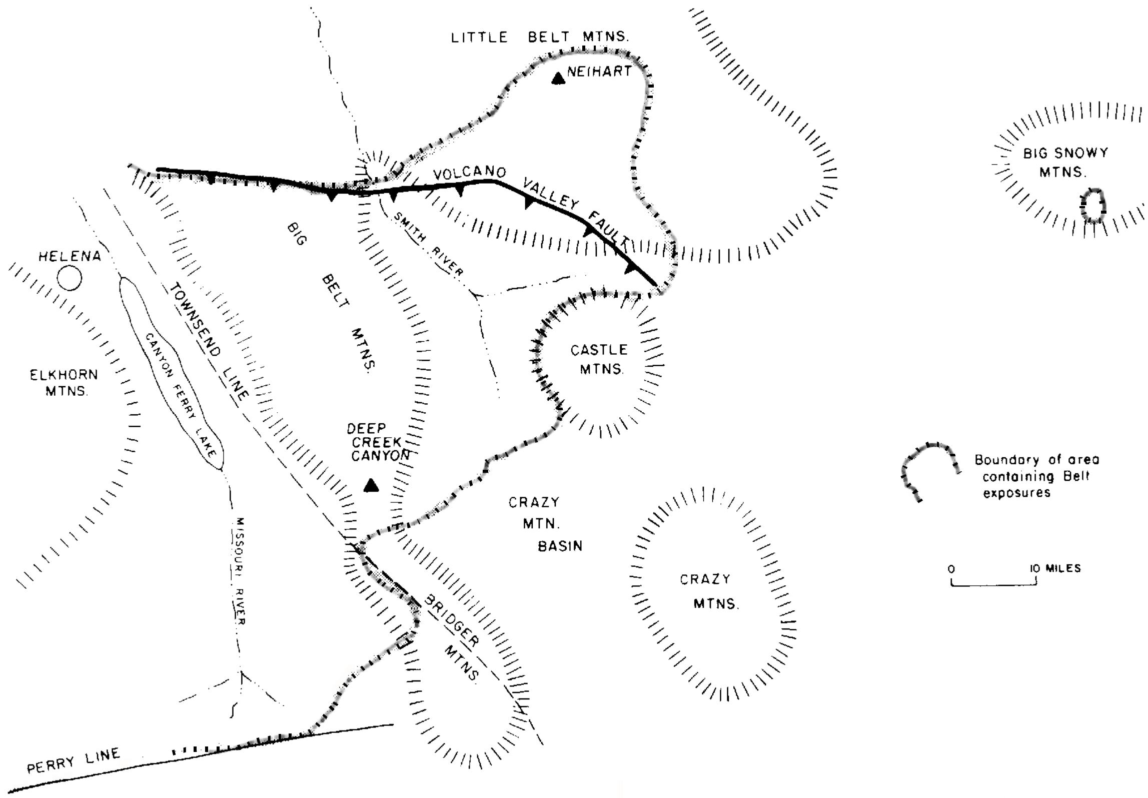
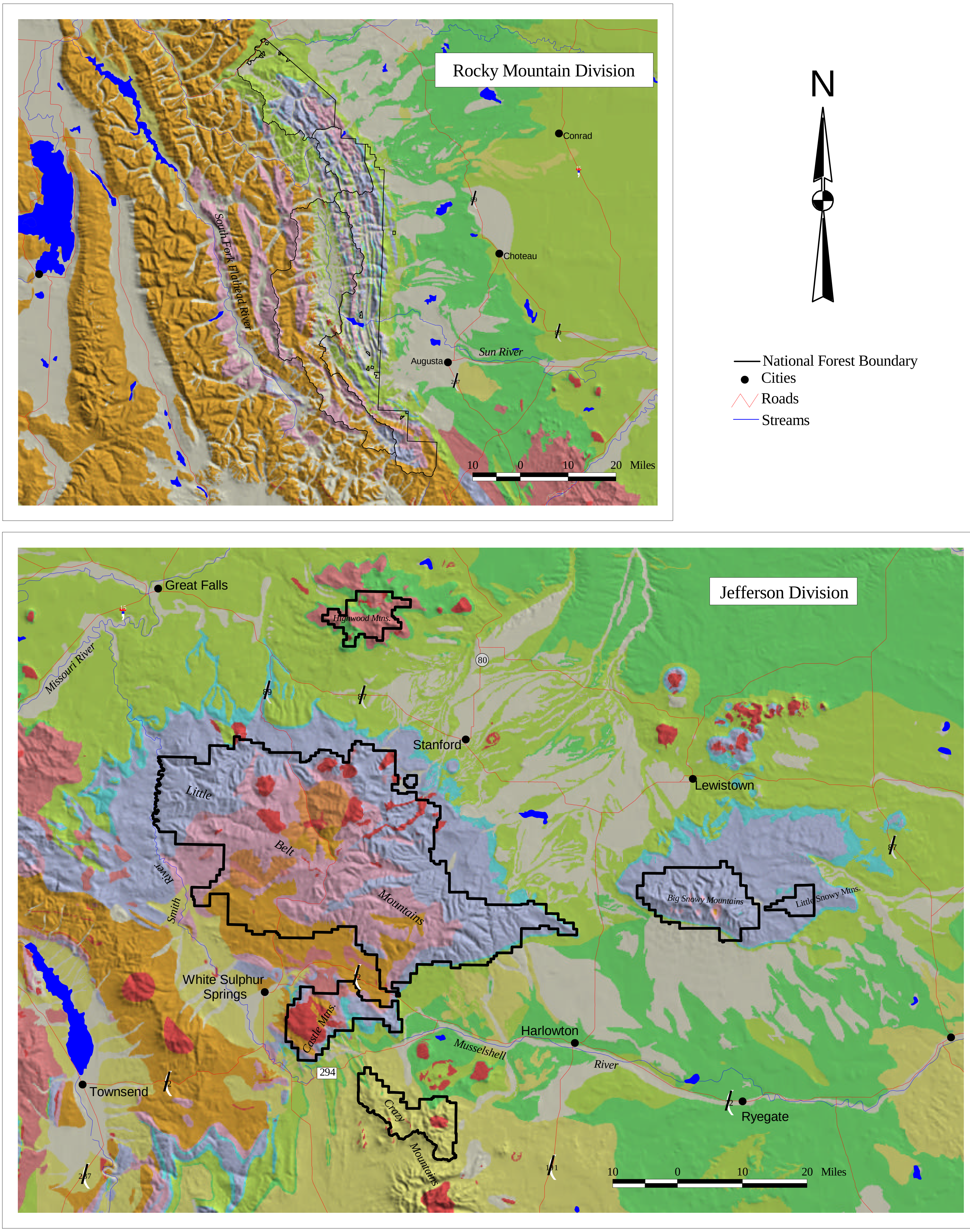


Figure 5b. Limit of Precambrian Belt rocks in the Helena embayment, from Godlewski and Zieg (1984).

The following maps (figure 6) are taken from Ross and others (1959) and show the geology associated with the three counties in the Southern Division of the Lewis and Clark Forest as well as the Rocky Mountain Division. A window of Precambrian gneisses and schists is exposed near Neihart. Numerous Tertiary-Cretaceous intrusions occur in the Little Belt Mountains and in the Castle Mountains. Devonian through Cretaceous rocks surround the Tertiary-Cretaceous intrusive masses. Remnants of Belt rocks crop out in the southern portion of the area. Excellent descriptions of the major mining districts in the area can be found in Baker and Berg (1991). These include the Yogo and Running Wolf districts, Barker (and Hughesville) mining district, and the Big Ben molybdenum deposit near Neihart.



EXPLANATION

- Quaternary - gravel
- Tertiary - sandstone, gravel
- Cretaceous - Montana Group and equivalents: sandstone, shale
- Cretaceous - Kootenai Fm and Colorado Group: shale, sandstone
- Jurassic - sandstone, limestone, shale
- Mississippian, Pennsylvanian and Permian - limestone, sandstone, shale
- Cambrian, Ordovician and Devonian - limestone, shale, siltstone
- Proterozoic - Belt Supergroup: argillite, siltite, limestone, ortho-quartzite
- Archean and Early Proterozoic - gneiss, amphibolite, diorite, metagabbro
- Igneous extrusive
- Igneous intrusive

Figure 6. Generalized geologic map of the Rocky Mountain and Jefferson divisions of the Lewis and Clark National Forest (modified from Ross and others, 1955).

2.2 Economic Geology

The portion of Lewis and Clark National Forest in the Jefferson Division contains all or part of many mining districts: Castle Mountain, Neihart (Montana), Hughesville/Barker, Yogo/Running Wolf and Carbonate (Logging Creek) districts, with many small unnamed prospects in the other drainages (Sahinen, 1935). Figure 3 represents the mines and mills within the Lewis and Clark National Forest in the Belt, Smith, Musselshell, and Judith River drainages.

Castle Mountain

The Castle Mountain district has been studied by many authors, including Weed (1896), Roby (1950), Sahinen (1935), and Winters (1969). Sahinen (1935) lists the most productive period in the Castle Mountains as those years before 1891. The Cumberland Mine was the most productive in the district. The ore was found in dark brown siliceous jasper as replacement deposits associated with the Castle Mountain granite intrusive, the Robinson diorite, and Paleozoic limestone. Winters (1968) lists a chronological list of the history of development and production in the Castle Mountain district.

Neihart (Montana)

The lode mines near Neihart were discovered in 1881-1882 and total production to 1930, predominantly from silver, was estimated at $16,000,000 (in 1935 dollars)(Sahinen, 1935). The deposits in this area occurred in veins in the gneisses and also in later dikes as disseminated occurrences. Sahinen divided the area into three types of deposits. The most productive mines were located in the Snow Creek drainage (including the Big Seven and Cornucopia) in fissure veins in gneiss, Pinto diorite and quartz porphyry, and were high in gold content but low in base-metal content. The upper part of Carpenter Creek was characterized by low grade but relatively high copper percentage, and deposits were found associated with dikes in the area. Mines characteristic of this area included the Silver Dyke and the Double X. The lowest area topographically included mines like the Broadwater and Moulton, and had higher base-metal concentrations with ore found in fissure veins in Pinto diorite and gneiss.

Barker/Hughesville

The Hughesville/Barker mining districts are adjacent in the Galena Creek and Dry Fork Belt Creek drainage. The Block P Mine was the largest producer in the area (Baker and others, 1991). Most of the mines in the Barker/Hughesville area, like the May and Edna, and the Tiger, etc. group, are in replacement deposits (and sometimes ‘chimneys’ in the Jefferson Formation) in sedimentary rocks or, like the Barker, and the Wright and Edwards mines, are in veins in the intrusives (specifically the Hughesville quartz monzonite stock). Younger porphyries (felsic laccoliths and dikes) intruded the quartz monzonite and also hosted some of the mineralization. Other targets of exploration were in the Gold Run tuff which formed as a diatreme (Baker and others, 1991) The district was mined intermittently from its discovery in 1879 to the 1940's. Weed (1900) described in detail the early and most intensive efforts at mining in the area. Robertson and

Roby (1951) and Walker (1991) summarized the later efforts at mine development in the area.

Yogo/Running Wolf

The Yogo, Running Wolf, and Dry Wolf mining districts are in Judith Basin County. Yogo Gulch was the site of a small gold boom in 1879 that lasted until 1883 then, beginning in 1895, was the focus of many years of sapphire production. Yogo was never a large producer of gold but has continued to be a focus of exploration and production of sapphires (and to a lesser degree, metals). Ore minerals included pyrite, chalcopyrite and galena in limestone or near the contact of the limestone with the Yogo stock. The Running Wolf mining district was smaller than the Yogo district. It had three producers–the Woodhurst-Mortson, the Mountainside, and the Sir Walter Scott. The mines here were also in replacement deposits associated with intrusive contacts hosted by Madison Limestone. The Dry Wolf mining district was known best for its iron deposits.

2.3 Hydrology and Hydrogeology

Average annual precipitation in the Belt Creek drainage ranges from 10 to14 inches in valleys to greater than 30 to 40 inches in the Little Belt Mountains (Bergantino, 1978). Average annual precipitation is 14.85 in. at White Sulphur Springs and 21.41 in. at Neihart (Western Regional Climate Center, 1998). Snowfall annually averages 132.8 in. at White Sulphur Springs; in January, the average snow depth is 5 inches. Neihart annually averages 118.6 in.; the average snow depth is 11 inches in January. July and August are listed as the only snow-free months. Temperatures in Neihart vary from an average low of 10.9°F during the winter to an average maximum temperature of 78°F during July and August (Western Regional Climate Center, 1998).

The Belt Creek drainage descends southwestward from nearly 8,000 ft above sea level in the headwaters, to 5,635 ft above sea level at Neihart, to approximately 4,600 ft above sea level at Monarch. The principal aquifers are listed as sandstones and carbonate-rock aquifers (USGS web-page, 2000).

The USGS currently does not maintain streamflow gaging stations within the Belt Creek and Dry Fork Belt Creek drainages. The gaging station at Monarch (06090500) was begun in 1952 and was discontinued in 1982. It had a drainage area of 368 sq. mi. The closest active gaging stations are on the Missouri River up river or down river from where Belt Creek enters at Fort Benton and at Virgelle. These stations are too far removed from the study area to provide any meaningful numbers in regards to drainage area. Likewise, there are no active USGS gaging stations on the Judith River. The Musselshell River has a stream-gaging station at Harlowton, but again the flows measured here are not extremely meaningful to the study of the mine related effects on the drainage. The drainage basin at this station is 1,125 sq. mi. in area.

2.4 Summary of the Smith, Belt, Judith, and Musselshell Drainages

There are 279 mine and mill sites on or near the Lewis and Clark National Forest within the drainages. Of these, 44 were determined to have a potential to have adverse effects on soil or water quality on LCNF-administered land. Of the 44 that have a potential of affecting LCNF-administered land, 27 sites have one or more discharges from workings or waste material and 33 sites exhibited signs of water or wind erosion.

The sites listed in **bold** in table 8 exhibited one or more environmental problems and are discussed in the following sections. The mines in these drainages are presented generally upstream to downstream. The Belt Creek drainage is discussed first because it drains into the Missouri and is the farthest upstream toward the Missouri's headwaters. Next, the mines of the Judith River drainage and then the Musselshell River drainage are discussed, again, upstream to downstream.

All of the sites inventoried are presented in table 8. If mine openings or other dangerous features (unstable structures, highwalls, steep waste-rock dumps) were observed at a site on LCNF-administered land, it was identified (Y) under the hazard heading in each table. In general, only those sites at which samples were collected were evaluated. Of the 279 sites inventoried, 51 sites on or partially on LCNF-administered land were identified as having potential safety problems.

Table 8. Summary of sites in the Lewis and Clark National Forest by county.

Name	Visit	Owner	Sample	Hazard	Remarks
CASCADE COUNTY					
Albright Deposit	N	M	N	NE	limestone/ dimension stone
Albright Group /Last Chance, Valley	N	M	N	NE	
Benton Mine / Rebellion /Spokane	**Y**	**P**	**N**	**NE**	**significant AMD into creek, at least 2 adits discharging**
Big Ben Deposits	Y	N	N	NE	three short caved adits, dry
Big Seven	**Y**	**P**	**N**	**NE**	**discharge, streamside tailings and waste, private**
Blackbird / Black Bird / Maud S.	Y	P	N	NE	no visible impacts
Black Diamond	**Y**	**P**	**N**	**NE**	**discharge of 1-3 gpm, mill building but no tailings**
Blizzard	N	P	N	NE	location inaccurate
Block 'P' Tailings	**Y**	**M**	**N**	**NE**	**visible impacts**
Boss Mine / Atlantus	N	M	N	NE	location inaccurate, unable to locate, dry hillside
Boss Mine	N	M	N	NE	location inaccurate-unknown ownership
Broadwater (Liberty?)/Lower Broadwater	**Y**	**P**	**N**	**NE**	**one adit discharge on private, upper is dry**
Broken Hill	N	M	N	NE	location inaccurate, unable to locate, dry hillside
Bull of the Woods Mine	Y	P	N	NE	part of Broadwater Mine
Carpenter Creek Tailings	**Y**	**M**	**N**	**NE**	**upper tailings mostly USFS; lower tailings private**
Champion "B"	Y	P	N	NE	caved adit, no visible impacts
Compromise Claim	**N**	**P**	**N**	**NE**	**no access**
Concentrated and Monarch	Y	P	N	NE	part of Florence Mine
Copes / Ajax 1 & 2/ Leadville 1 & 2	N	M	N	NE	location inaccurate
Cornucopia Mine	Y	P	N	NE	many pits & short adits, dry, private
Cowboy / Isabelle	Y	M	N	NE	two short caved adits, dry
Cumberland	Y	P	N	NE	no visible impacts
Dacotah Mine	**Y**	**P**	**N**	**NE**	**may have small fragment of USFS, adit discharge**

Name	Visit	Owner	Sample	Hazard	Remarks
Dawn and Foster	Y	P	N	NE	four or five caved adits, dry
Double X (XX)	**Y**	**P**	**N**	**NE**	**streamside waste, one open adit, private**
Dry Fork Belt Creek-Lower Tailings	**Y**	**N**	**N**	**NE**	**streamside tailings**
Eighty Eight / 88 / Eighty-eight	**Y**	**P**	**N**	**NE**	**dumps eroded by Carpenter Creek**
Emma	**Y**	**P**	**N**	**NE**	**mill with tailings, possible effects on LCNF-land**
Equator Mine	Y	P	N	NE	no visible impacts
Fairplay & Bon Ton	**N**	**P**	**N**	**NE**	**unstable slopes on waste dumps**
Fairplay Mine	Y	P	N	NE	no visible impacts
Florence Mine	Y	P	N	NE	small discharge, no visible impacts
Frisco	Y	P	N	NE	no visible impacts
Galt-Queen	Y	P	N	NE	huge mine site, dry
Gavander / Gold Bug	N	P	N	NE	also called the Logging Creek district
Graham & Hollowbush / S & R	**Y**	**P**	**N**	**NE**	**some waste is in contact with Belt Creek, private**
Harner & Davis Prospect	N	M	N	NE	location inaccurate
Hartley	Y	P	N	NE	dry, private, large mine site, three or more caved adits
Hatchet	Y	P	N	NE	no visible impacts
Haystack Iron Spring	**Y**	**N**	**N**	**NE**	**spring that precipitates iron oxides**
Haystack Creek Mine	**Y**	**P**	**N**	**NE**	**colorful adit discharge, private**
Hegener Group / Vilipa	Y	P	N	NE	iron stained seeps; may impact Mackay Creek, private
Hidden Treasure	Y	M	N	NE	only prospect pits found
Hoover Creek Quarry	N	N	N	NE	sand and gravel quarry
Hurricane and Tornado / Edna	N	M	N	NE	three claims
Ingersoll	Y	P	N	NE	no visible impacts, 7 short caved adits
IXL / I.X.L. / Eureka	N	P	N	NE	dry ridgetop, observed from a distance
Johannesburg	N	P	N	NE	no access; posted private land
Leroy	N	P	N	NE	same as Johannesburg
Lexington / Union/ Mountain View	Y	P	N	NE	no visible impacts
Lexington #2	Y	N	N	NE	discharge sinks into ground, not enough water to sample
Liberty	N	M	N	NE	unable to locate
Lizzie	Y	P	N	NE	caved, private, no visible impacts
London	N	P	N	NE	observed from below; workings on dry hillside
Lucky Strike / Commonwealth /	**Y**	**P**	**N**	**NE**	**discharge restricted to private land**
Lucy Creek	Y	P	N	NE	
Minute Man-Last Hope-Westgard	Y	P	N	NE	no visible impacts, private, 3 caved adits
Mogul Lode	Y	P	N	NE	caved adit, dry, no structures
Morning Star Mine	Y	P	N	NE	mill but no tailings
Moulton / Molton Group / Compromise	**Y**	**P**	**N**	**NE**	**discharge into Rock Creek, private**
Mountain Chief	Y	P	N	NE	no visible impacts
Neihart Tailings	**Y**	**P**	**N**	**NE**	**streamside waste**
Nevada	Y	P	N	NE	no visible impacts, dry caved adit
New Alicia & New Rodwell Claims	N	M	N	NE	dry ridgetop
Nilson	Y	P	N	NE	no visible impacts
Palmetto No. 2	N	M	N	NE	location inaccurate
Peabody	N	M	N	NE	location inaccurate
Ponderosa Mine	N	M	N	NE	location inaccurate
Poverty	Y	P	N	NE	private, dry caved adit
Prospect-sec. 23	Y	N	N	NE	adit 6 ft in length in limestone cliff
Queen of the Hills	**Y**	**P**	**N**	**NE**	**<1 gpm discharge, private**
Ripple	Y	P	N	NE	caved adit
Rochester and Unity	N	P	N	NE	no visible impacts, viewed from the Nevada

Name	Visit	Owner	Sample	Hazard	Remarks
Ruth Mary and Fitzpatrick	**Y**	**P**	**N**	**NE**	**some mine waste eroded by Belt Creek**
Savage	Y	P	N	NE	no visible impacts, part of Silver Dyke Mill?
Sherman	Y	P	N	NE	private, dump cut by Berg Creek probably no effect
Silver Bell	N	P	N	NE	no visible impacts
Silver Belt	**Y**	**P**	**N**	**NE**	**AMD into Rock Creek**
Silver Dyke Mill	**Y**	**P**	**N**	**NE**	**visible impacts**
Silver Dyke Mine	**Y**	**P**	**N**	**NE**	**discharge is source of Squaw Creek**
Silver Dyke Tailings	**Y**	**P**	**N**	**NE**	**large volume of tailings mostly eroded away**
Silver Horn	N	P	N	NE	location inaccurate
Snow Creek Mill	**Y**	**N**	**N**	**NE**	**small volume of dry tailings**
Spotted Horse	N	N	N	NE	no visible impacts
Sunshine Mine	N	M	N	NE	location inaccurate
Thorson Hoover Creek	N	N	N	NE	commodity was silicon
Unnamed Quarry	N	N	N	NE	quarry
Unnamed Quarry	N	N	N	NE	quarry only
Venus	N	M	N	NE	no visible impacts
Whippoorwill Mine / Blotter Claim	Y	M	N	NE	five short caved adits
JUDITH BASIN COUNTY					
Adit in sec. 29, T14N, R10E	Y	N	N	NE	one caved adit with small waste dump
American-Kunisaki Yogo Sapphire	N	P	N	NE	active
Bell Mines	N	P	N	NE	
Blacktail Hills	N	M	N	NE	location inaccurate
Block P Mine / Grey Eagle	**Y**	**P**	**N**	**NE**	**no visible impacts**
Blue Dick Mine	Y	N	N	NE	ore bins only; adit collapsed; recent drill roads
Blue Dick Mill	**Y**	**N**	**N**	**NE**	**mill tailings**
California (Harriet)	Y	N	N	Y	collapsed adit immediately adjacent to road; one fenced shaft with fence falling down
Carter	N	P	N	NE	
Danny T	N	P	N	NE	open but gated adit
Della and Quaker City	Y	N	N	NE	location inaccurate
Dockter Kalloch	N	P	N	NE	
Edwards	N	P	N	NE	
Forest	Y	P	N	NE	no visible impacts
Galena	N	M	N	NE	
Hell Creek Claims	N	N	N	NE	location inaccurate
Iron ore deposits near Yogo Peak	N	N	N	NE	near New Deal & Blue Dick mines; otherwise inaccurate location
Iroquois Prospect	N	M	N	NE	location inaccurate
J.W. Sisson Gypsum Deposit	N	P	N	NE	gypsum deposit on private land
King Creek Mines	N	M	N	NE	location inaccurate
Liberty Mine / Owner Faith Mining	N	P	N	NE	
Magnolia & St. Louis	N	P	N	NE	
Marcelline	N	M	N	NE	shaft discharge
May & Edna	Y	P	N	NE	no visible impacts
Middle Fork / Dry Fork Belt Creek	N	M	N	NE	commodity was silicon; location inaccurate
NE SE S7 (Lucky Strike)	N	P	N	NE	
New Deal	Y		N	NE	visited general area; location uncertain. 2 cabins + outbuildings including sauna
New Mine Sapphire Syndicate Mine	N	M	N	NE	sapphire mine; mostly; if not all; private
Overlook Claim	Y	N	N	NE	partially open adit; 1 ft x 2 ft opening

Name	Visit	Owner	Sample	Hazard	Remarks
Paragon	Y	P	N	NE	no visible impacts
Pierce-Higbee / Dry Wolf	N	P	N	NE	
Pig Eye Basin Gypsum	N	M	N	NE	commodity was gypsum
Queen Esther	N	P	N	NE	
Ruby / Snowball / Yellowbell	N	M	N	NE	commodity listed as silver; stone; or marble location inaccurate
Silver Gulch	N	P	N	NE	
Skunk Creek Deposit	N	N	N	NE	location inaccurate
South Fork Placer	N	N	N	NE	location inaccurate
Tiger Moulton and T.W. / Harrison	N	M	N	NE	
Top Hand	N	P	N	NE	
Unnamed Gypsum Occurrence	N	P	N	NE	commodity is gypsum
Unnamed Gypsum	N	P	N	NE	gypsum deposit; inaccurate location
Willow Creek Deposit	N	M	N	NE	may be patented?
Wolf Butte Deposit	N	P	N	NE	commodity is gypsum
Wright Lode	N	P	N	NE	
Yogo Creek Placer	Y	M	N	NE	placer
LEWIS and CLARK COUNTY					
Babe Prospect	N	N	N	NE	location inaccurate
Burrell and Evans	N	N	N	NE	location inaccurate
Chief of the Mtns. Claim	N	P	N	NE	commodity listed as silicon; sandstone
Cinnamon Lode	N	N	N	NE	location inaccurate
Dexter Lode	N	N	N	NE	location inaccurate
Goat Ridge Prospect	N	N	N	NE	commodity is dimension stone; stone
Jessie Prospect	N	N	N	NE	two pits only, hematite and limonite staining in sandstone
Jewel Mountain Mining Co. / Jewell	N	N	N	NE	insignificant mineralization
Magma	N	M	N	NE	location inaccurate
Ready Money Mine	N	P	N	NE	location inaccurate
Roosevelt Claim	N	N	N	NE	Scapegoat Wilderness; no workings
MEAGHER COUNTY					
Adit in sec. 25, T9N, R8E	Y	N	N	NE	viewed from across valley; remote
Alabama-Cleveland Mine	N	P	N	NE	no visible impacts
Alice Mine	Y	P	N	NE	waste in floodplain on patented land; all limestone
American	Y	N	N	NE	no visible impacts
Annie Maude	Y	P	N	NE	shaft and highwall
Antelope	Y	N	N	NE	prospects only
Belle-of-the-Castle	**Y**	**M**	**N**	**NE**	**discharging adit**
Biesel Mine	N	P	N	NE	location inaccurate
Blackhawk-Alice Property	Y	P	N	NE	highwalls only
Broadway	Y	P	N	NE	walked general area; no discharging adits
California / California-Hendricks	Y	P	N	NE	prospects only
Calumet-Jamison and Hecla	N	P	N	NE	
Castle Lead	N	M	N	NE	location inaccurate
Clara Barton / Clara Burton	Y	N	N	Y	one partially open shaft
Cleopatra / Forget-me-not	Y	N	N	Y	shaft was fenced by DSL-AMRB
Cook's Flat Manganese	Y	N	N	NE	open cut on hillside
Copper Duke	N	P	N	NE	downstream from any USFS-administered land
Copperopolis	N	P	N	NE	no visible impacts
Copper State Mine	Y	P	N	NE	two collapsed shafts and some mineralized waste rock

Name	Visit	Owner	Sample	Hazard	Remarks
Cumberland Mine	**Y**	**M**	**N**	**NE**	**smelter site, mostly private**
Ducolin-Potter Prospect / Ducolon	N	N	N	NE	location inaccurate
Etta Claim	Y	P	N	NE	no visible impacts
Felix Cexent / Felix Crexent	Y	N	N	NE	prospects only
Golden Eagle	Y	P	N	NE	no visible impacts
Grasshopper	Y	P	N	NE	partially caved shaft with waste rock dump. Dry ridge.
Great Eastern & Great Western	Y	P	N	NE	patented claims
Hamilton Mine	**Y**	**M**	**N**	**Y**	**adit discharge, steamside waste**
Hidden Treasure Claim	Y	P	N	NE	shaft not deep but is open
Homestake Mine	Y	P	N	NE	consists of Homestake; Mary Anderson; Mills Bill; Bluebird; Hamden; Hamden no.
Iron Chief	Y	P	N	NE	large open pit with highwalls; some prospects
Iron Cliff	N	M	N	NE	location inaccurate
Iron Mines Park	Y	N	N	NE	prospects on dry ridge, no structures
Iron Mountain	N	N	N	NE	small prospect, pits and bulldozer trenches
Spring Creek	N	M	N	NE	calcium/limestone occurrence; no visible impacts
Judge Mine	Y	P	N	NE	fenced shaft
Jumbo Mine	Y	P	N	NE	no visible impacts
Kid's Dream Prospect	**Y**	**N**	**N**	**NE**	**highwall only, sampled drums of ore**
King Group	N	M	N	NE	location inaccurate
Legal Tender	Y	P	N	NE	prospects only
Little Belt Mine	Y	N	N	NE	highwalls only; open pit
Lucky Boy	Y	N	N	NE	filled-in shaft
Lucky Dollar Mine / Silver Spoon	Y	N	N	Y	recent operation; shaft is open; lots of trash
Lynn Mine / High Tariff	N	M	N	NE	dry, no visible impacts
Manger Manganese	N	P	N	NE	may be same as Alabama-Cleveland Mine
Maybe Mine	Y	P	N	NE	hazardous collapsed shaft plus several smaller workings
Merrimac / Merrimac #1	Y	P	N	NE	no visible impacts
Milwaukee Mine	Y	N	N	Y	fenced shaft
Montana Copper / Dr. Barnette	**Y**	**N**	**N**	**Y**	**one partially open adit; waste in contact with creek**
Montcana Group	N	M	N	NE	location inaccurate
New Deal & Jumbo Mines / Boss	**Y**	**N**	**N**	**NE**	**open shafts with standing water**
NF Site on Hensley Creek	**Y**	**N**	**N**	**NE**	**discharging adit**
Open Cut sec. 33, T9N, R10E	Y	N	N	NE	highwalls in open cuts
Placer Creek Deposit	N	N	N	NE	placer
Placer Creek	N	N	N	NE	placer
Powderly (Silver Dollar)	**Y**	**N**	**N**	**Y**	**waste in floodplain; open shaft and adit**
Princess	Y	P	N	NE	partially collapsed shaft & numerous prospects on dry ridgetop
Prospects NE of Hidden Treasure	Y	N	N	NE	prospects only
Prospects sec. 2, T8N, R8E	Y	N	N	NE	prospects only
Prospects in sec. 5	N	N	N	NE	prospects on dry ridge top
Prospects in sec. 6, T8N, R9E	Y	M	N	NE	prospects only
Prospects in sec. 36, T9N, R8E	Y	N	N	NE	prospects only
Queen-Hensley Grp /Copper Bowl	**Y**	**N**	**N**	**NE**	**sampled under the name Belle of the Castles**
Ringling Mine / Willow Creek Iron	N	M	N	NE	small prospect
Sec. 11 Prospects	Y	N	N	NE	prospects only
Shaft sec. 2, T8N, R8E	Y	N	N	NE	
Shaft in sec. 7, T9N, R9E	Y	N	N	NE	shafts caved
Shaft in sec. 11, T8N, R8E	Y	N	N	NE	inclined shaft
Shaft sec. 35,T9N, R8E	Y	N	N	NE	shack or mine building over a third caved shaft or prospect

Name	Visit	Owner	Sample	Hazard	Remarks
Silver Spoon (See Powderly)	**Y**	**N**	**N**	**NE**	**streamside waste**
Silver Star	Y	P	N	NE	~20 ft+ deep
Skidoo	N	U	N	NE	location inaccurate
Solid Silver	Y	P	N	NE	prospects only
Top Lode / Tip Top / Copper Top	N	M	N	NE	location inaccurate
Twentieth Century Claim	N	P	N	NE	location inaccurate
Unnamed BDCA sec. 20, T9N R8E prospect	Y	N	N	NE	three dry prospect pits
Unnamed BDDC sec. 19, T9N, R8E prospect	Y	P	N	NE	caved shaft w/several prospect trenches nearby. Two shallow pits contain standing water.
Unnamed DAAA sec. 20, T9N, R8E prospect	N	N	N	Y	hazardous pit/shaft next to pack trail; 30-40 ft deep
Unnamed DCAA sec. 2, T8N, R8E	**Y**	**P**	**N**	**NE**	**streamside waste dump**
Unnamed Pumice	N	M	N	NE	location inaccurate
Unnamed sec. 27 prospect	Y	N	N	NE	
Vandor / Ruby Adit	Y	N	N	NE	
Voss Mine	N	M	N	NE	location inaccurate
Whitetail Adit	Y	N	N	NE	one shaft; one adit
Whittaker 1901 Claim	N	P	N	NE	location inaccurate
Yellowstone Mine	Y	P	N	NE	fenced shaft
Yellowstone Mine	N	N	N	NE	location inaccurate
TETON COUNTY					
Biggs Creek Prospects	N	N	N	NE	location inaccurate

1) Mines in **bold** may pose environmental problems and are discussed in the text; others are included only in appendix II (all mines).
2) Administration/Ownership Designation
NF: LCNF-administered land
PRV: Private
MIX: Mixed (LCNF-administered land and private)
3) Solid and/or water samples (including leach samples).
4) Y: Physical and/or chemical safety hazards exist at the site.
NE: Physical and chemical safety hazards were not evaluated.
5) Mill site present

2.5 Silver Dyke

2.5.1 Site location and Access

The Silver Dyke Mine and mill site is located approximately 3.25 miles up the Carpenter Creek road (FS 3323) to Squaw Creek and then northeast another 0.5 mile in CD sec. 10 and B sec. 15, T14N, R8E. The site is almost entirely on private, patented land with only small fractions of LCNF-administered land. Access is via an improved gravel road to the downstream sample site. The up stream sample site was reached by walking approximately ¼-mile past a wash-out on Forest Road 3323 where a side drainage has cut through the tailings before entering Carpenter Creek.

2.5.2 Site History-Geologic Features

The most active mining at the Silver Dyke spanned the years from 1921 when it was first developed to 1929 when the mine was closed. It has been operated intermittently since then with the cabin presently inhabited. It was classified by Schafer (1935) as a “Type I” which signifies that the ore is siliceous and has a high base-metal to precious-metal ratio (1% lead to 3 opt silver with high copper also). The quartz porphyry country rock is altered to sericite, quartz and kaolin with predominantly galena, pyrite, chalcopyrite sphalerite and tetrahedrite as ore minerals. (Schafer, 1935). A 500-ton per day (tpd) mill was replaced in 1926 by a 950-tpd capacity mill. Total production equaled 1,167,125 tons from 1921 to 1948 (Robertson, 1951) producing 1736 ounces gold, almost 3,200,000 ounces of silver, approximately 16,400,000 pounds of lead, and nearly 7,500,000 pounds of copper. A large glory hole was connected by raises to an adit, with a second, lower 1,000 foot long adit and subsequent drifts driven later.

2.5.3 Environmental Condition

A cursory examination of the Silver Dyke tailings from the public access road revealed streamside tailings that were deeply eroded. An adit discharge, estimated at one cfs, was reported by Pioneer Technical Services (1995). The flow in Squaw Creek largely stems from this discharge.

2.5.3.1 Site Features-Sample Locations

The site was sampled on 05/26/98; only one sample was taken on Squaw Creek because most of the disturbances were on private land. Squaw Creek was sampled (BSQS10H) approximately 20 ft upstream from FS road 3323 and about 50 ft west of the turn off to the Silver Dyke Mine. This sample site is approximately 1,600 ft downstream from the discharging mine adit. The Silver Dyke mine is an open pit/glory hole with a discharging adit downhill from the main workings. No upstream sample was taken on Squaw Creek but a background level was estimated from a sample taken upstream on Carpenter Creek. Site features and sample locations are shown in figure 7; photographs are shown in figures 7a and 7b.

2.5.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.5.3.3 Water

The water had a slightly milky appearance and light orange iron hydroxides coated the stream bed. The TSS level (<1.0) was the same in the upstream and the Squaw Creek sample. The temperature of the water was 14.2°C– two to four degrees warmer than most of the other creeks in the area. The geologist guessed that the stream flow was primarily made up of the adit discharge. The Squaw Creek sample showed increased levels of cadmium, copper, lead, and zinc. The SC upstream on Carpenter Creek measured 60 µmhos while the Squaw Creek sample measured 860 µmhos. The

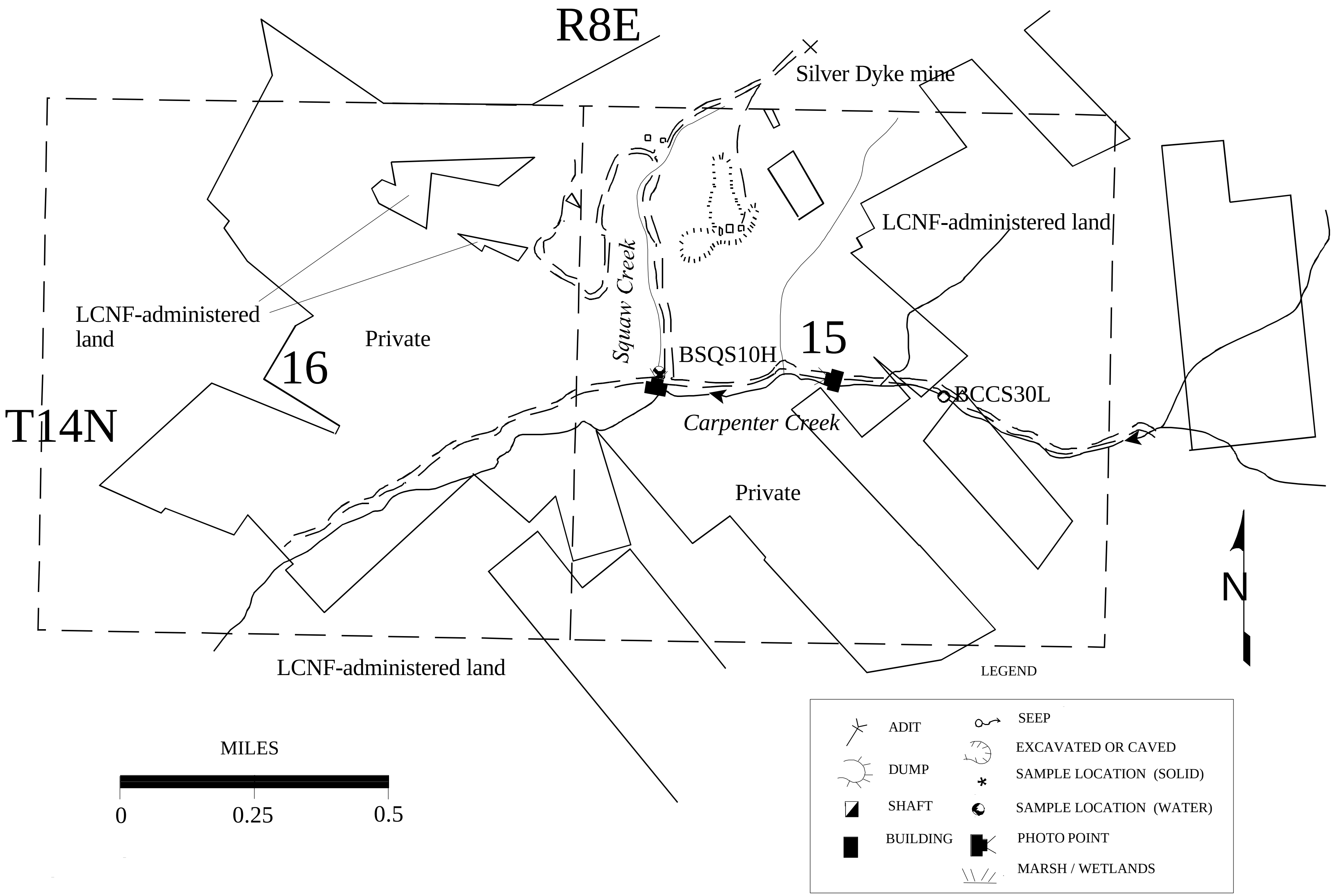


Figure 7. Schematic of sample sites near the Silver Dyke mine as visited 05/26/98, from the Neihart 7.5-min. quadrangle. Access to Carpenter Creek is limited because of private land.

Figure 7a. Carpenter Creek actively erodes the Silver Dyke tailings and runoff has formed rills in the tailings.

Figure 7b. The adit discharge from the Silver Dyke Mine forms the majority of the flow in Squaw Creek. Sample BSQS10H was taken here.

downstream sample on Squaw Creek exceeded the primary MCL for sulfate (table 9); this was the only sample to do so. It is fairly uncommon for water to exceed this standard.

Table 9. Water-quality exceedences at the Silver Dyke Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BCCS30L-upstream on Carpenter Creek																			S*
BSQS10H-downstream on Squaw Creek				PAC		SAC		PAC					SAC				P		S

Exceedence codes:
- P-Primary MCL
- S-Secondary MCL
- A-Aquatic Life Acute
- C-Aquatic Life Chronic
- S*-Field pH exceeded standard but the lab pH was above the lower limit.

Note: The analytical results are listed in Appendix IV.

2.5.3.4 Vegetation

The vegetation on the banks of Squaw Creek was not greatly affected. Grasses on the banks appeared healthy, although areas of recent disturbance and waste rock were not vegetated.

2.5.3.5 Summary of Environmental Condition

Dissolved metals concentrations greatly increased in the flow in Squaw Creek compared to the sample from Carpenter Creek. The tailings and waste piles on private land are actively being eroded. The tailings that lie adjacent to Forest Road 3323 contain deep gullies and rills and are unvegetated.

2.5.4 Structures

The structures were not evaluated as a part of this study because they were all on private land. Vehicles were parked near the mine and it looked like someone was staying in the cabins at the site. Robertson (1951) stated that the mill had been dismantled by 1951.

2.5.5 Safety

Safety issues were all on private land. Pioneer Technical Services (1995) did note that the fence erected by DSL was down in places. The large glory hole, as noted in literature, had steep and hazardous highwalls.

2.6 Double X or XX Mine

2.6.1 Site location and Access

The Double X Mine is located approximately 2.4 miles up the Carpenter Creek road (FS 3323) turning at Mackay Creek and then traveling northeast another 0.5 mile in AACC sec. 16, T14N, R8E. The site is almost entirely on private, patented land with only small fractions of LCNF-administered land. Access is via an improved gravel road to the downstream sample site.

2.6.2 Site History-Geologic Features

Robertson (1951) described the Double X (or XX) Mine as a silver/lead/zinc vein deposit following a fracture along a gneiss/porphyry contact. He listed minerals as quartz, silver sulfides, galena, sphalerite, pyrite and lesser chalcopyrite. Workings, according to Robertson, included a 300–500 foot adit which were last worked in 1934. Schafer (1935) states the mine occurs in either the Snow Creek or Carpenter Creek porphyry in a massive sphalerite/galena/chalcopyrite vein. Schafer quotes Weed as stating that “the ores are all secondary sulphide enrichment”. He lumps this mine in the same category as the Dawn and Foster, Vilippa, Whippoorwill and Hegner properties.

2.6.3 Environmental Condition

Several adits and their waste piles are adjacent to, or in contact with, Mackay Creek. Most of these workings are on private land and so were not assessed. The Hegner group, Dawn and Foster, and Whippoorwill mines all consist of two to five caved adits. The Double X consists of seven short, caved adits with the main working open with abundant pyrite on the waste dump. Adits on private land were discharging and at least one was open.

2.6.3.1 Site Features-Sample Locations

The Double X and the effects of the other mines in the drainage were sampled by taking an upstream and downstream sample. The only public land where an upstream sample could be taken is a small irregular fraction in A sec. 16, T14N, R8E. The upstream sample was taken approximately 50 upstream from a discharging adit. The downstream sample was taken approximately 10 ft upstream from the culvert on Forest Road 3323. Site features and sample locations are shown in figure 8; photographs are shown in figures 8a and 8b.

2.6.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

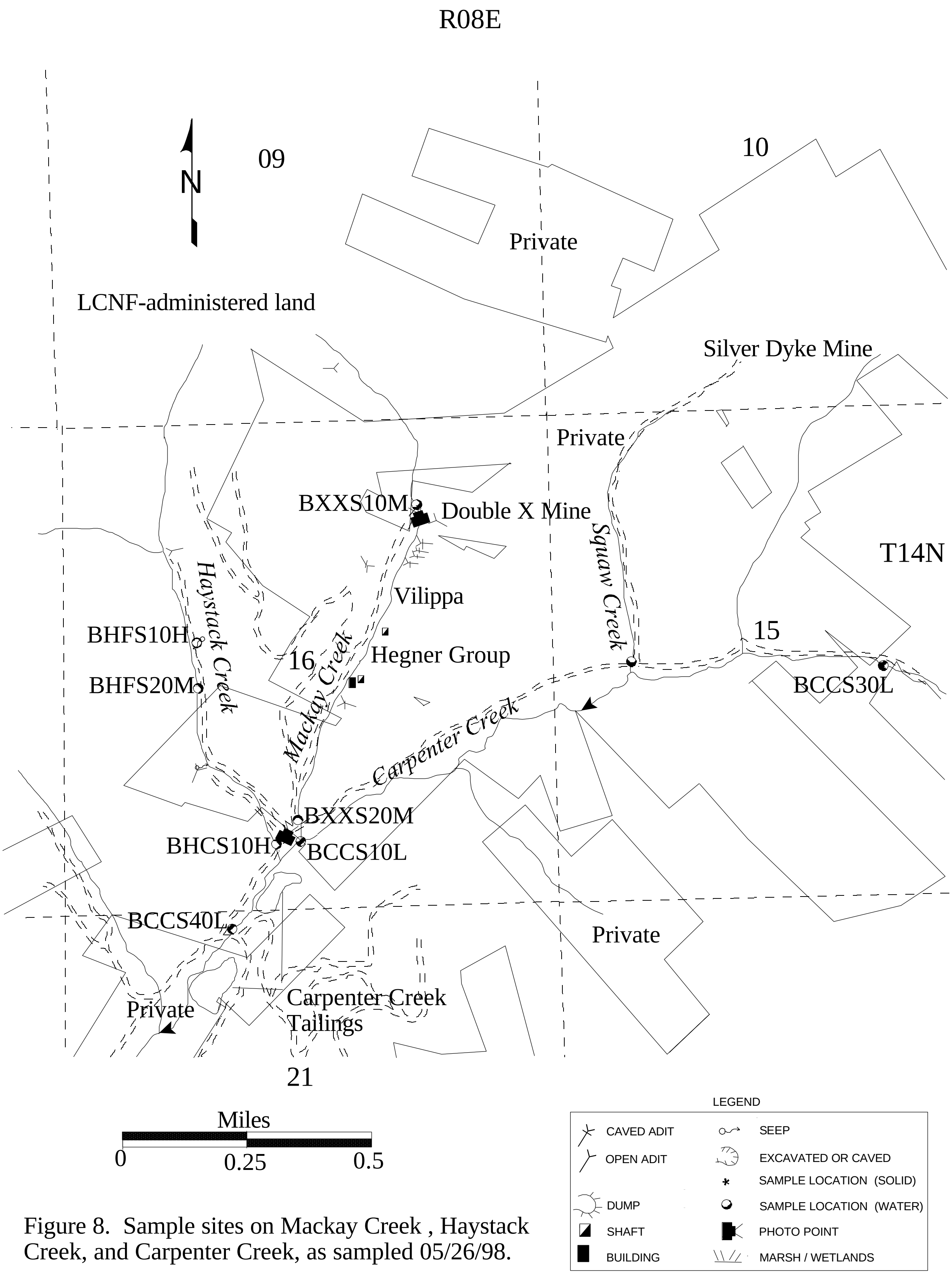


Figure 8. Sample sites on Mackay Creek , Haystack Creek, and Carpenter Creek, as sampled 05/26/98.

Figure 8a. At the Double X, small flow on a fraction of LCNF-administered land provided a place to sample (BXXS10M) the upper reaches of Mackay Creek.

Figure 8b. The lower stretches of Mackay Creek are clear, as sampled (BXXS20M) upstream of the culvert on Forest Road 3323.

2.6.3.3 Water

The numerous mines along Mackay Creek contribute metals to the flow. The upstream sample showed no exceedences but the downstream sample had exceedences in four metals (table 10). The pH was slightly lower in the downstream sample but was still above the MCL and ALCs. The field pH upstream was 7.34 (7.1-lab) and downstream was 6.9 (7.02-lab). The SC increased slightly downstream but was consistently in the 120 to 150 µmhos range. The TSS also increased slightly downstream, from <.05 to 2.0.

Table 10. Water-quality exceedences at the Double X Mine.

Sample Site	**Al**	**As**	**Ba**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Ag**	**Zn**	**Cl**	**F**	**NO_3**	**SO_4**	**Si**	**pH**
BXXS10M-upstream																			
BXXS20M-downstream	S					AC			S				AC						

Exceedence codes:
S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic
Note: The analytical results are listed in Appendix IV.

2.6.3.4 Vegetation

The vegetation along the creek does not appear visibly affected by the mining along the creek. The waste dumps were not well vegetated but the effects were local.

2.6.3.5 Summary of Environmental Condition

The mines along Mackay Creek contribute metals to the creek, with copper and zinc exceeding both aquatic and chronic water quality criteria. Secondary MCLs were exceeded for aluminum and manganese.

2.6.4 Structures

No hazardous structures were noted on LCNF-administered land. Cabins were located on private land. Pioneer Technical Services (1995) noted several structures, some in fair condition, on private land in this drainage.

2.6.5 Safety

No unsafe features were noted on LCNF-administered land. Safety concerns were not evaluated on private land. Pioneer Technical Services (1995) noted several open shafts and adits in this drainage including those at the Vilippa (figure 8).

2.7 Haystack Creek Mine and Iron Spring

2.7.1 Site location and Access

A discharging adit is located approximately 2.4 miles up the Carpenter Creek road (FS 3323) turning left at Haystack Creek and then northwest another 0.5 mile in CACC sec. 16, T14N, R8E. The site is almost entirely on private, patented land but it was sampled to the north on LCNF-administered land. Access is via an improved gravel road to the downstream sample site and then by 4-wheel drive to the upper site. The Iron Spring is in BDCC sec. 16, T14N, R8E.

2.7.2 Site History-Geologic Features

Schafer (1935) described the geology around the Haystack Creek Mine as a northeast-trending Carpenter Creek Porphyry dike that cuts across the north-south contact of the Snow Creek Neihart Porphyry and the “pre-Beltian” gneisses and schists. No other references to this mine were found in literature.

2.7.3 Environmental Condition

The Haystack Creek drainage has not had as much mine development as some of the other drainages in the Neihart mining district. Two adits are present–both are caved but one has an adit discharge. The adit on private land discharges a bright-orange flow with bright-green algae. The flow enters Haystack Creek. The dumps have sphalerite and pyrite on them.

2.7.3.1 Site Features-Sample Locations

The site was sampled on 05/26/98. The downstream sample (BHCS20M) was taken approximately 15 ft upstream from the culvert on Forest Road 3323. The upstream sample (BHCS10M) was taken on LCNF-administered land in a small grassy meadow approximately 500 ft up the road from the adit. The Haystack Iron Spring occurs approximately 2,000 ft north-northeast from the turnoff from Forest Road 3323. Sample BHFS10H was taken directly from the spring as it emerged from the ground. Site features and sample locations are shown in figure 9; photographs are shown in figures 9a and 9b.

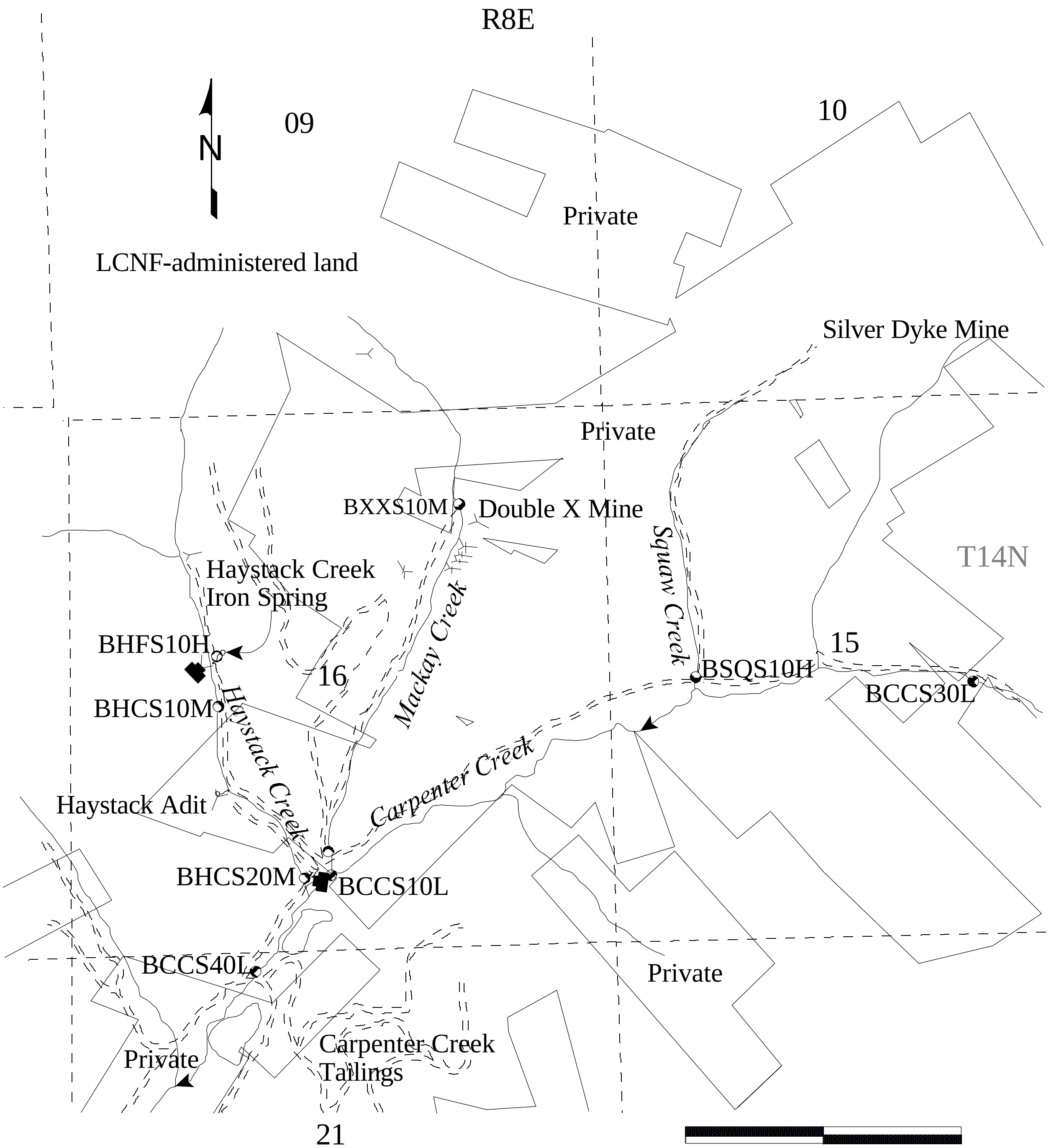


Figure 9. Schematic of sample sites on the upper part of Carpenter Creek and Haystack Creek, as taken from the Neihart 7.5-min. quadrangle.

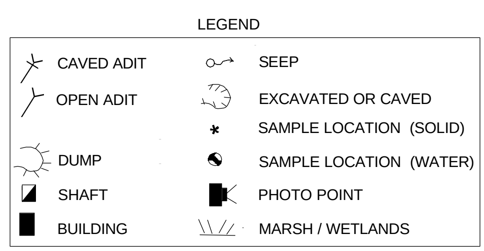


Figure 9a. The Haystack Creek Iron Spring discharged water (sample BHFS10H) that was brightly orange iron hydroxide stained but had abundant Equisetum growing in it.

Figure 9b. Haystack Creek looked clear and clean (sample BHCS20M) but slightly exceeded the secondary MCL, and aquatic and chronic life criteria for zinc.

2.7.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings are on private land.

2.7.3.3 Water

The water emerging from the Haystack Iron Spring is not as bad as it looks (table 11). The only exceedence was in zinc which exceeded the aquatic and chronic life criteria but did not exceed any MCL's. The pH was 6.86 and the SC was 903 µmhos. The flow was estimated at four gpm and it never reached the active drainage. The creek at its mouth also had a slight exceedence in zinc values but no water quality standards were exceeded in the upstream sample. The pH downstream and upstream were similar. The pH upstream was 6.88 and the SC was146 µmhos; the pH downstream was 6.78 and the SC was 139 µmhos. The TSS was higher than that of sample BHCS10M; it was 9.0 mg/l. The downstream sample on Haystack Creek measured 17.0 mg/l while the upstream sample measured <1.0.

Table 11. Water-quality exceedences at the Haystack Creek Mine and iron spring.

Sample Site	**Al**	**As**	**Ba**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Ag**	**Zn**	**Cl**	**F**	**NO_3**	**SO_4**	**Si**	**pH**
BHCS10M-upstream on Haystack Creek																			
BHFS10H-Haystack Creek Iron Spring													AC						
BHCS20M-downstream													AC						

Exceedence codes:

A-Aquatic Life Acute

C-Aquatic Life Chronic

Note: The analytical results are listed in Appendix IV.

2.7.3.4 Vegetation

The vegetation was not visibly affected on the banks of Haystack Creek. Lush grasses grew in the open meadow at the upstream sample site. Even at the iron spring, Equisetum grew in the water adjacent to the outflow.

2.7.3.5 Summary of Environmental Condition

The mines along Haystack Creek contribute metals to the creek, with zinc exceeding both aquatic and chronic water quality criteria. The Iron Spring may contribute a small amount to the total load but the water appears to never directly enter the creek on the surface.

2.7.4 Structures

No hazardous structures were noted on LCNF-administered land in this drainage.

2.7.5 Safety

No unsafe features were noted on LCNF-administered land. Safety concerns were not evaluated on private land. The adit on private land was collapsed.

2.8 Snow Creek and Big Seven Mine

2.8.1 Site location and Access

The Big Seven Group mines (including the Benton and Ripple) are located in secs. 28 and 29, T14N, R8E. The Snow Creek millsite lies in CADA sec. 21, T14N, R8E downhill from the Snow Creek road. The road up Snow Creek follows the stream and is a Forest Service access until the locked gate just past the switchback in sec. 22. The gate is approximately 1.6 miles from the turnoff on Forest Road 3323, and the road to the site passes through private land.

2.8.2 Site History-Geologic Features

The Big Seven was originally located in the 1880's and produced a large amount of silver and gold before 1898 (Schafer, 1935). Ore was mined out of four adits, and the total amount of workings were greater than 8,000 ft. Siliceous ore predominated in the deposit with some carbonates at the lower levels (Schafer, 1935). Ore minerals include pyrite, galena, sphalerite, proustite, and pearcite, with additional sulfides in small percentages (Schafer 1935). The map in Schafer’s report shows the Big Seven associated mainly with the Pinto diorite but the vein also cuts gneisses and Snow Creek quartz porphyry along a well defined fissure.

Robertson (1951) estimated production at 143,274 tons of ore mined from 1902 to 1943. Approximately 17,538 ounces of gold, 2,306,353 ounces of silver, 63,022 pounds of copper, and 523,369 pounds of lead were produced during this time. According to Robertson, a 100-ton bulk flotation mill was initially used to process the ore but was replaced by a 150-ton selective flotation plant.

2.8.3 Environmental Condition

The environmental condition of the Big Seven and associated mines was not directly addressed because it is on private land and is not accessible. The view from the valley below indicates it is a fairly large site and has unvegetated, yellow waste dumps. Runoff during storm events erodes the waste and tailings, as noted in a previous visit to the area.

2.8.3.1 Site Features-Sample Locations

The upstream sample (BSNS10L) was taken at the switchback in sec. 22, T14N, R8E just below the locked gate. The sample was taken approximately 100 ft upstream of the culvert. The downstream sample (BSNS20M) was taken upstream from the mill and tailings on Snow Creek. Pioneer Technical Services (1995) dropped the Snow Creek millsite from their list of priority sites because they found the site did not impact the creek. The sample taken by MBMG therefore was taken up stream from the tailings to assess the effects of the other mines upstream from the site. Site features and sample locations are shown in figure 10; photographs are shown in figures 10a and 10b.

2.8.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.8.3.3 Water

The sample taken upstream from the Snow Creek millsite area revealed exceedences in cadmium (chronic aquatic life criteria), manganese (secondary MCL) and zinc (acute and chronic aquatic life criteria) (table 12). The exceedences in this drainage are much lower than those at the Silver Dyke or at Rock Creek below, but zinc values were higher than those in Mackay or Haystack Creek. The pH in the creek was not significantly lower in the downstream sample in the field measurements but the lab pH decreased from 7.06 in the upstream sample to 6.80 in the downstream sample. The SC increased from approximately 50 µmhos upstream to about150 to 170 µmhos downstream. No increase in the TSS level was noted; both upstream and downstream measured <1.0 mg/l.

Table 12. Water-quality exceedences at the Snow Creek and below the Big Seven Mine.

Sample Site	**Al**	**As**	**Ba**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Ag**	**Zn**	**Cl**	**F**	**NO_3**	**SO_4**	**Si**	**pH**
BSNS10L-upstream on Snow Creek																			
BSNS20M-downstream on Snow Creek				C					S				AC						

Exceedence codes:
- S-Secondary MCL
- A-Aquatic Life Acute
- C-Aquatic Life Chronic

Note: The analytical results are listed in Appendix IV.

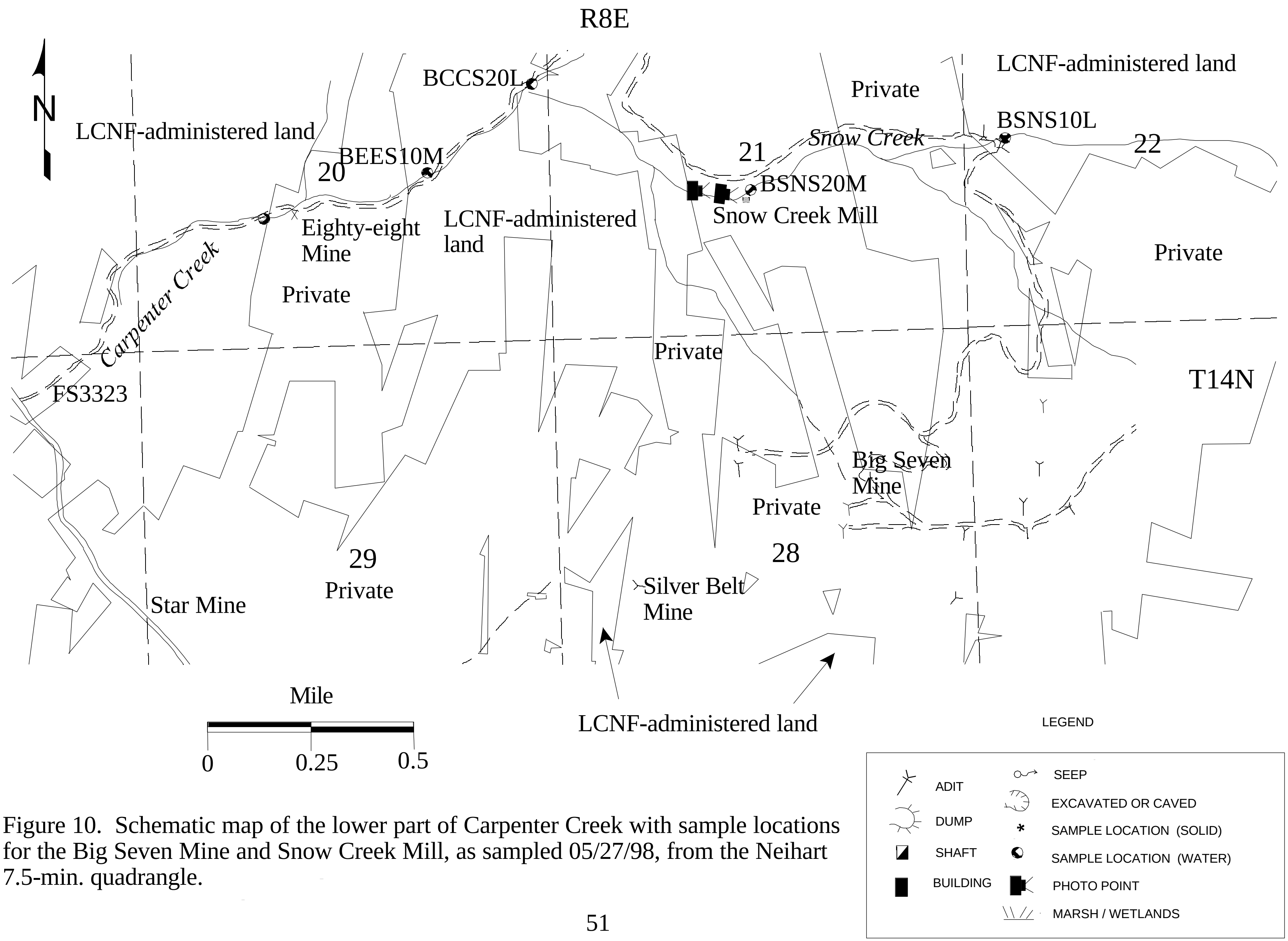


Figure 10. Schematic map of the lower part of Carpenter Creek with sample locations for the Big Seven Mine and Snow Creek Mill, as sampled 05/27/98, from the Neihart 7.5-min. quadrangle.

Figure 10a. Snow Creek was sampled upstream (BSNS20M) from the Snow Creek mill tailings. The bed of the creek was orange stained and had fine sediment which may be waste or tailings washed down from the Big Seven area.

Figure 10b. The Snow Creek millsite bears remnants of its past including a vat with crushed ore and a boiler.

2.8.3.4 Vegetation

The vegetation along the creek does not appear visibly affected by the mining along the creek. The waste dumps at the Big Seven could be seen in the distance and were completely unvegetated.

2.8.3.5 Summary of Environmental Condition

The mines upstream on Snow Creek contribute metals to the creek. Cadmium exceeds chronic aquatic life standards and zinc exceeds both aquatic and chronic water quality criteria. Manganese exceeds the secondary MCL.

2.8.4 Structures

The millsite on Snow Creek was not totally collapsed and could be considered hazardous. An outhouse perched on the banks of Snow Creek and a barn were still standing. Two or three other buildings were totally flattened. A wooden-stave tank or vat still contained crushed rock from the milling operations. Pioneer Technical Services (1995) sampled the contents. The Snow Creek Millsite (P.A. No. 07-505) received an AIMSS ranking of 284 (out of 331) with an AIMSS score of 0.02 and a safety score of 1.60. It was one of 55 sites dropped by the DSL-AMRB in their study because of a lack of significant environmental effects.

2.8.5 Safety

The structures mentioned above could all be considered dangerous. Safety concerns were not evaluated on private land.

2.9 Carpenter Creek Tailings

2.9.1 Site location and Access

The Carpenter Creek tailings are located 2.2 miles from the Highway 89 turnoff north-northeast on Forest Road 3323. They are very accessible and highly visible from the road. Two impoundments are present. The lower one, in CDDC sec. 21, T14N, R8E is entirely on private land, and the upper one, in BACB sec. 16 is on LCNF-administered land.

2.9.2 Site History-Geologic Features

Very little is known about the history of these tailings. No mill building was found nearby. Schafer (1935) shows the two tailings ponds on his Plate 2 but he does not indicate where the mill was located. The Silver Dyke Mine had a mill but the tailings are still present at the site. These impoundments could have been built to hold the excess tailings from the Silver Dyke and/or from the Big Seven area with the tailings trucked to them. Alternatively, they may have been the site of a custom mill for many of the small mines in the area. From the size of the impoundments, they represent a large amount of production.

2.9.3 Environmental Condition

This area is striking in the amount of tailings present. The impoundments are sparsely vegetated and runoff channels are prominent. Carpenter Creek runs adjacent to and, in places, through the tailings impoundment. No precipitation events were noted during this short visit, but it would be logical to assume that storm events play a large part in the continued erosion of the Carpenter Creek tailings.

2.9.3.1 Site Features-Sample Locations

Three samples were taken to help characterize the site. An upstream sample (BCCS10L) was taken at the upper end of the tailings. A second sample (BCCS40L) was taken at the lower end of the impoundment on LCNF-administered land but upstream from the private site. A third sample (BCCS20L) was taken on Carpenter Creek downstream from the private tailings but upstream from where Snow Creek joins Carpenter Creek. Site features and sample locations are shown in figure 11; panorama photographs are shown in figure 11a.

2.9.3.2 Soil

Soil samples were not taken because the tailings were in direct contact with the creek. Pioneer Technical Services analyzed the tailings in 1995. They found that the 111,000 cubic yards of tailings contained elevated levels of arsenic, cadmium, copper, lead, barium, cobalt, manganese and zinc.

2.9.3.3 Water

The water in Carpenter Creek did not appear exceedingly iron stained. No aquatic life was noted and very little plant life grew in the creek. The upstream sample reflected the influence of the mining farther up the drainage although the values had been diluted by the time the water got to the sample site. Immediately downstream of the upper tailings impoundment, cadmium had increased enough to exceed the chronic life standard, and manganese exceeded the secondary water quality standard (table 13). Zinc exceeded the acute and chronic criteria in the two upper samples. The third sample (BCCS20L) downstream from the second tailings impoundment had no exceedences. The pH in these samples did not show any discernable trend and the SC did not vary greatly. The TSS levels between the three samples did not show a marked increase. Further study would be needed to verify the suspected sediment load increase during storm events.

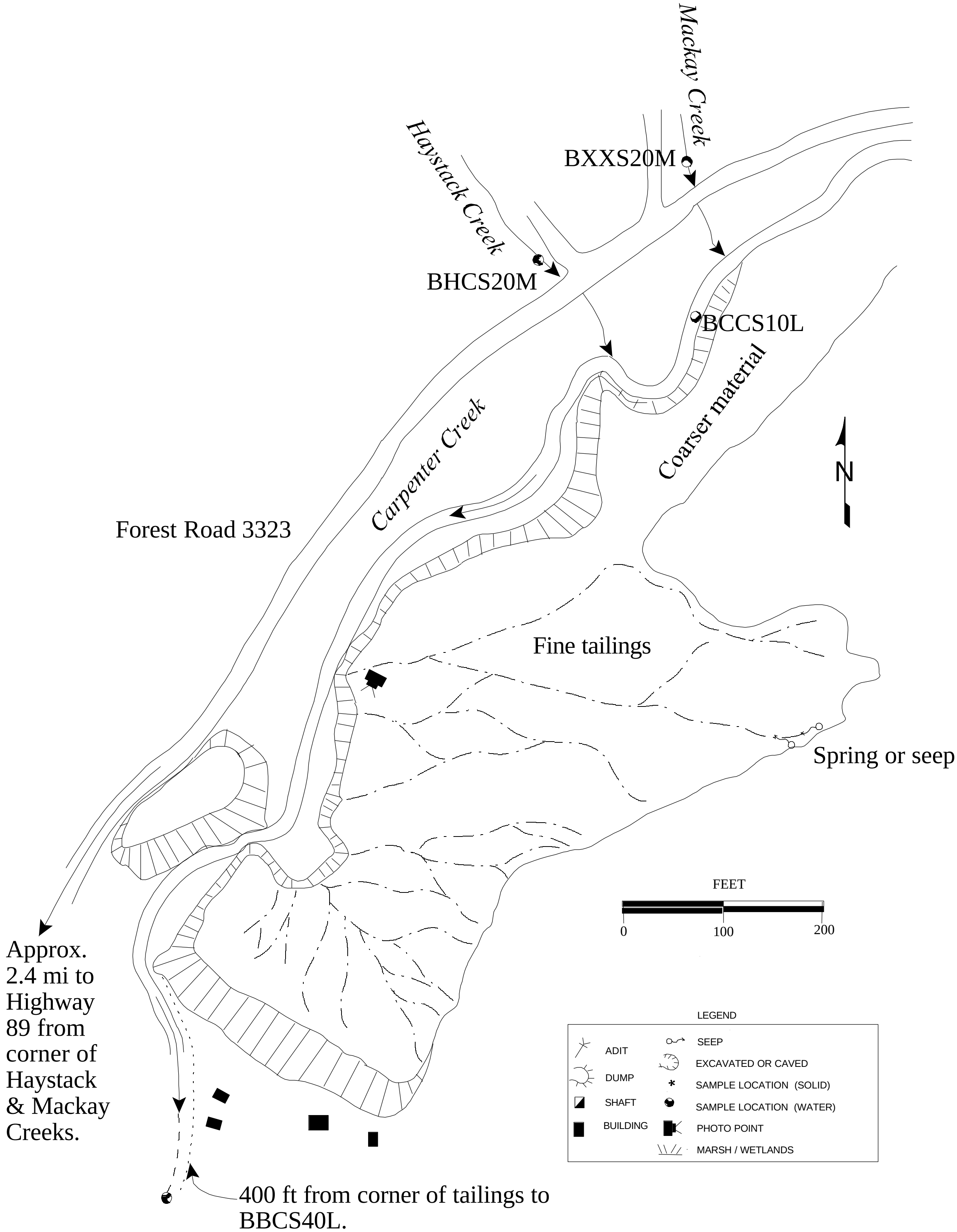


Figure 11. Rills and gullies mark intermittent erosional channels on the Carpenter Creek tailings, as mapped 5/27/98.

Figure 11a. Rills and gullies dissected the surface of the upper impoundment of the Carpenter Creek tailings reflecting the erosion of the tailings, as visited 05/27/98.

Table 13. Water-quality exceedences at the Carpenter Creek tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BCCS10L-upstream on Carpenter Creek						AC							AC						
BCCS40H-downstream on Carpenter Creek				C		AC			S				AC						S*
BCCS20L-downstream from 2nd tailings																			

Exceedence codes:

S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic
S*-Either the laboratory or the field measurement exceeded the standard, but not both.

Note: The analytical results are listed in Appendix IV.

2.9.3.4 Vegetation

The tailings are nearly unvegetated. A few trees, mainly spruce and a few willows, have established a foothold along Carpenter Creek. Interestingly, Equisetum (horsetails or scouring rush) grow abundantly at the toe of the tailings impoundment and on the surface of the tailings. This plant is known for its resilience to heavy metals. Equisetum was also noted at the Haystack Creek Iron Spring. Spruce and fir trees grew to the edge of the tailings impoundment and appeared to be healthy.

2.9.3.5 Summary of Environmental Condition

The tailings added cadmium and manganese to Carpenter Creek and there was a very slight increase in zinc values downstream.

2.9.4 Structures

Five cabins sit at the base of the upper tailings impoundment dam. Core from the Big Ben drilling project and a few drilling supplies are stored in two of them.

2.9.5 Safety

Some of the gullies are steep and could pose a threat if ATV riders were to get onto the tailings. The faces on the edges of the tailings are also steep. The buildings are all in fair to good shape but some of the stacks of core are not stable.

2.10 Eighty-Eight or “88" Mine

2.10.1 Site location and Access

The Eighty-Eight mine is in CADB sec. 20, T14N, R8E approximately one mile from the Highway 89 turnoff on Forest Road 3323. It is marked with a prospect symbol on the Neihart 7.5-min. topographic map. It is entirely on patented land but LCNF-administered land lies upstream and downstream. Access is via Forest Road 3323, an improved gravel road.

2.10.2 Site History-Geologic Features

Robertson (1951) briefly described this mine as consisting of an upper adit of unknown length and a 1,700 ft lower adit driven in diorite and gneiss. Mineralization, according to Robertson, included silver sulfides, galena, sphalerite, chalcopyrite, and cerussite in quartz and ankerite. He stated that only a small tonnage was mined and that the claim had not been worked since the 1890's.

2.10.3 Environmental Condition

The waste dump at the Eighty-Eight is being actively eroded by Carpenter Creek. The two adits were caved and did not discharge water.

2.10.3.1 Site Features-Sample Locations

Only one upstream (BEES10M) sample and one downstream (BEES20M) sample were taken because the mine site is entirely on private land. The mine has two caved adits and one waste dump in contact with Carpenter Creek. Site features and sample locations are shown in figure 12; photographs are shown in figures 12a and 12b.

2.10.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.10.3.3 Water

The pH and SC of the flow in Carpenter Creek both upstream and downstream were approximately the same. The analyses showed that the same exceedences in copper, manganese, and zinc also existed upstream and downstream. No effects resulting from the erosion of the waste dump at the Eighty-Eight were seen in the sampling. The analyses were essentially the same. The TSS levels were

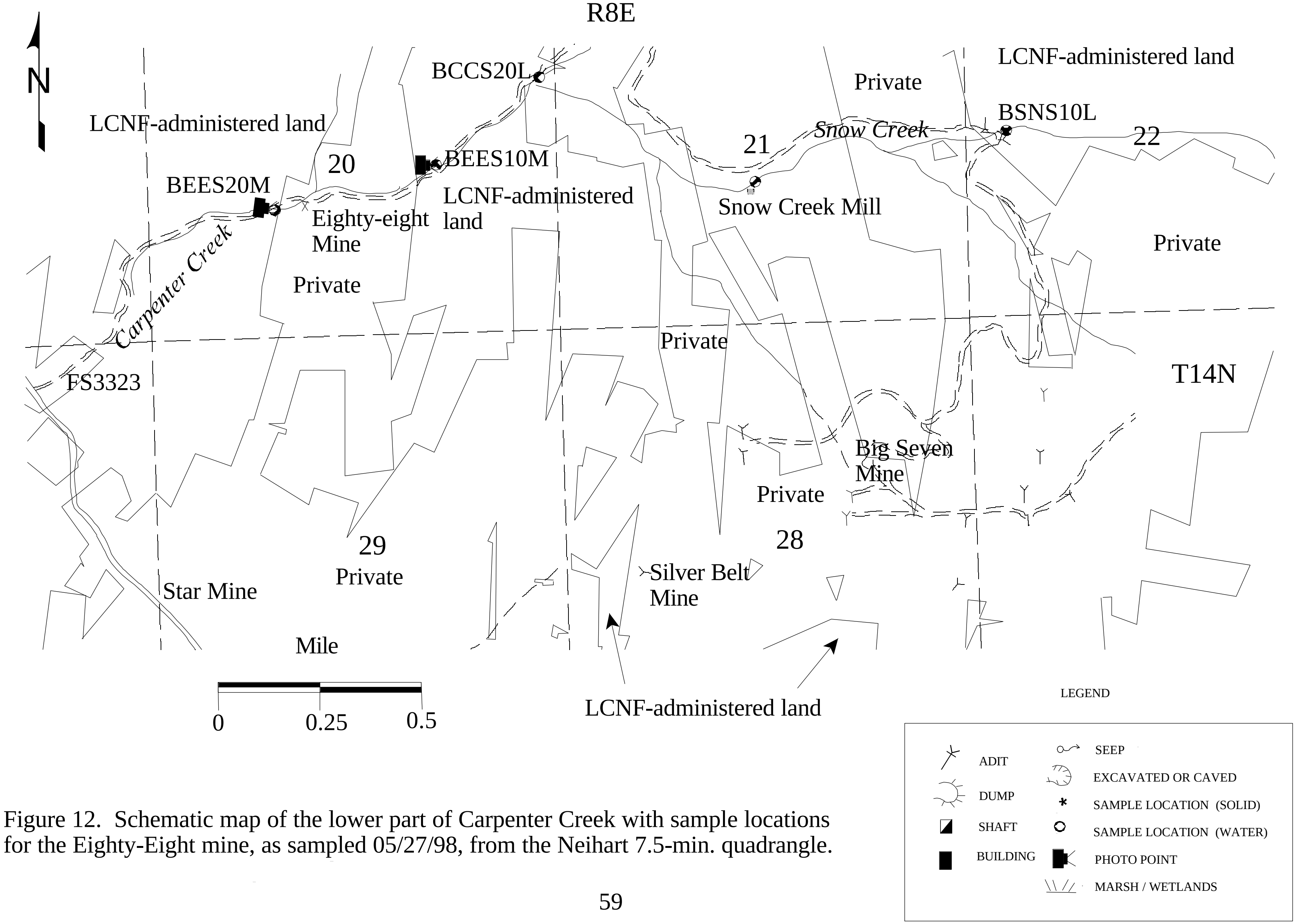


Figure 12. Schematic map of the lower part of Carpenter Creek with sample locations for the Eighty-Eight mine, as sampled 05/27/98, from the Neihart 7.5-min. quadrangle.

Figure 12a. Upstream of the Eighty-Eight Mine on Carpenter Creek showing sample site BEES10M.

Figure 12b. Downstream of the Eighty-Eight Mine on Carpenter Creek showing sample site BEES20M.

also the same (<1.0 mg/l).

Table 14. Water-quality exceedences at the Eighty-Eight Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
BEES10M-upstream						C			S				AC						
BEES20M-downstream						C			S				AC						

Exceedence codes:

S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic

Note: The analytical results are listed in Appendix IV.

2.10.3.4 Vegetation

No changes in the vegetation were noted. Willows and spruce and fir trees lined the banks of the creek.

2.10.3.5 Summary of Environmental Condition

Compared to the other mines in the Carpenter Creek drainage, this is a minor influence on the environmental condition of Carpenter Creek. Most of the degradation of the creek had already occurred upstream and the metals levels were similar upstream and downstream.

2.10.4 Structures

No structures were noted at this site. Most of the development on the site was on private land.

2.10.5 Safety

No safety concerns were noted at the Eighty-Eight Mine on LCNF-administered land.

2.11 Sites contributing to Belt Creek

2.11.1 Site location and Access

The town of Neihart is the center of the lower part of the Neihart mining district. Access is via Highway 89 and then by primitive roads. The sites discussed here are located on patented land and therefore were not sampled individually, but were assessed by sampling Belt Creek at public access sites. The mines found to potentially impact LCNF-administered land include: Ruth Mary and Fitzpatrick, Broadwater, Compromise, Queen of the Hills, Moulton, Rochester, Florence, Morning Star, Silver Belt, Lucky Strike, and the Neihart tailings. The Moulton, Rochester, Silver Belt and Dacotah mines are all on Rock Creek.

2.11.2 Site History-Geologic Features

The mines of Neihart were initially claimed in the 1880's and most were worked intermittently until the 1940s. The mines along Belt Creek were some of the earliest claims worked in the area, with the Queen of the Hills the first to be staked in Neihart. Many of the workings mined veins hosted by pre-Belt gneisses and schists or near contacts of these rocks with later intrusives (Robertson, 1951). Most of the mines exploited veins that were on the order of 37 ft wide. The area was initially known as a silver district, but gold, lead and zinc emerged as important commodities later. Ore minerals were primarily pyrite, galena and sphalerite and lesser amounts of chalcopyrite, polybasite, pyargyrite, pearceite and proustite (Robertson, 1951).

2.11.3 Environmental Condition

Several discharging adits were noted by Pioneer Technical Services (1995) including the Broadwater, Moulton (Molton), Queen of the Hills, Evening Star, Compromise, Silver Belt, Fairplay, and Dacotah. Streamside wastes and/or seeps were identified at the Hartley, Moulton, Compromise, Rochester, Silver Belt, and Dacotah. MBMG staff also identified potential environmental concerns at the Ruth Mary and Fitzpatrick (Stallabrass), Graham and Hollowbush, and the Neihart tailings. Waste piles, tailings, and mine buildings are evident from Highway 89.

2.11.3.1 Site Features-Sample Locations

All of the mines that have potential for impacting Belt Creek are private and so were not individually evaluated. Information was used from Pioneer Technical Services’ (1995) report and field inspection was made where access was available. An upstream sample (BBCS10M) was taken as a background level immediately upstream from the southernmost patented land. The next site available for testing was northwest of the town of Neihart where there is a small fraction of LCNF-administered land. Three samples were taken at this site: one upstream of Rock Creek on Belt Creek (BBCS20L), one on Rock Creek (BRCS10H), and one downstream of Rock Creek on Belt Creek (BBCS30M). The fourth sample on Belt Creek (BBCS40L) tested the effects of the Neihart tailings, Queen of the Hills and Florence mines. This sample was also considered the upstream sample for Belt Creek upstream of Carpenter Creek. BBCS50L was taken downstream of the confluence of Carpenter Creek and Belt Creek. Site features and sample locations are shown in figure 13; photographs are shown in figures 13a, 13b and 13c.

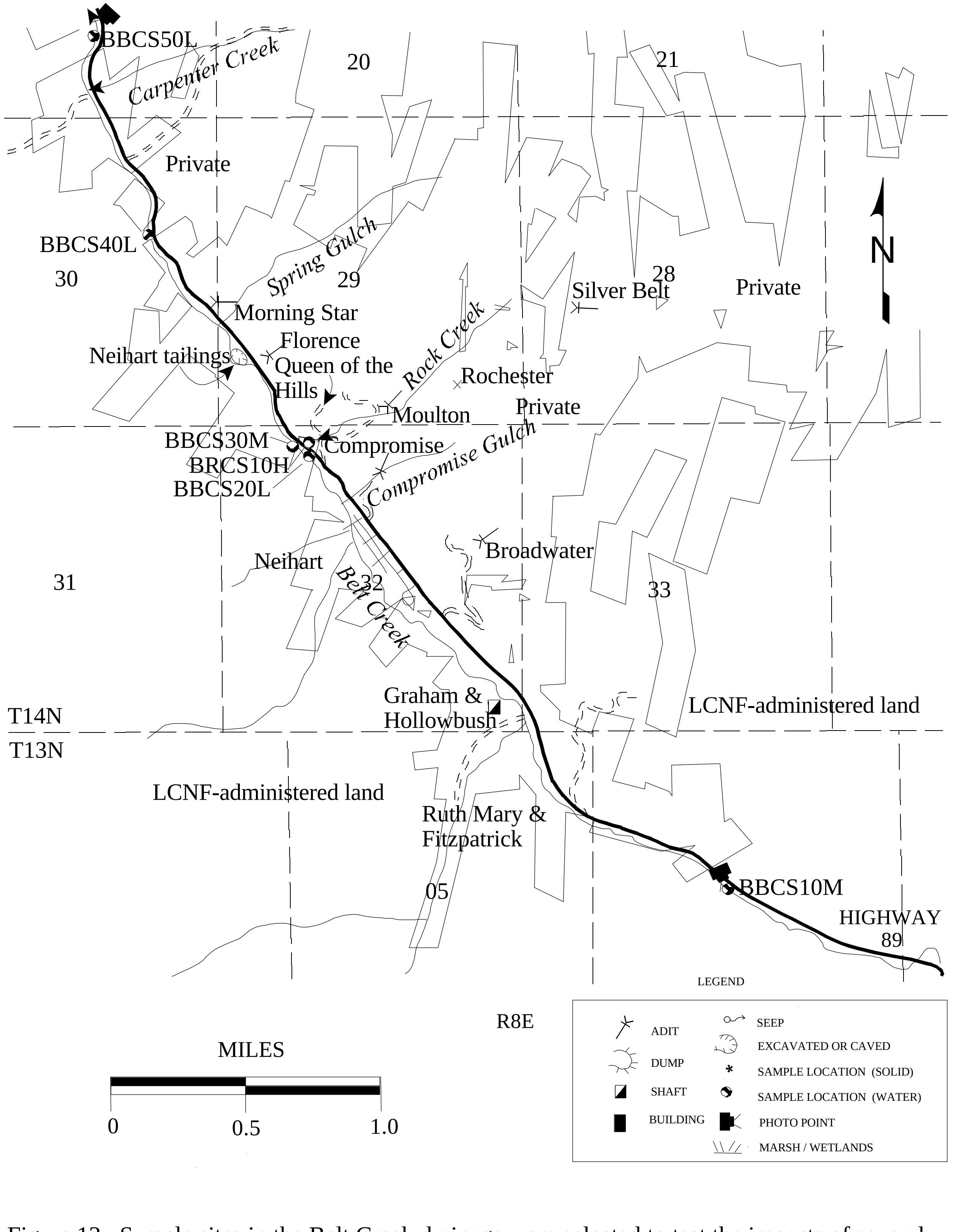


Figure 13. Sample sites in the Belt Creek drainage were selected to test the impacts of several mines with discharges, streamside waste, or other screening criteria on private land upstream. They were sampled on 05/28/98.

Figure 13a. The upstream sample (BBCS10M) was taken early in the morning upstream of all the mining activities in the valley.

Figure 13b. The final downstream sample (BBCS50L) was taken later in the day below all the mining activity in the Neihart mining district.

Figure 13c. Rock Creek (lower right) joins Belt Creek immediately downstream of the town of Neihart. A slight iron staining was noted at the confluence of Rock Creek and Belt Creek.

2.11.3.2 Soil

No soil samples were taken at this site because the waste dumps and tailings lie on private land.

2.11.3.3 Water

Rock Creek's water quality appeared to be most affected by mining and it, in turn, affected Belt Creek. The cumulative effects of mining left residual concentrations of cadmium and zinc in Belt Creek downstream from all mining activity (table 15). Rock Creek probably did account for some of the aluminum and manganese values that boosted the levels of aluminum and manganese in Belt Creek to exceed the respective secondary MCL's (appendix 3). The lead level exceeded the chronic aquatic life standard in Rock Creek but was diluted enough to be below detection limits in Belt Creek. The TSS levels increased very slightly and measured 4.0 mg/L in the final downstream sample—an increase from <1.0 mg/L upstream.

Table 15. Water-quality exceedences at the Neihart mining district on Belt Creek and Rock Creek.

Sample Site	**Al**	**As**	**Ba**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Ag**	**Zn**	**Cl**	**F**	**NO_3**	**SO_4**	**Si**	**pH**
BBCS10M-upstream of all mining activity																			
BBCS20L- downstream of the Compromise Group																			
BRCS10H-downstream on Rock Creek				PAC				C					SAC						
BBCS30M- downstream of Rock Creek				C					S				AC						
BBCS40L- downstream of Neihart tailings	S																		
BBCS50L- downstream of all mining activity	S												AC						

Exceedence codes:

- P-Primary MCL
- S-Secondary MCL
- A-Aquatic Life Acute
- C-Aquatic Life Chronic

Note: The analytical results are listed in Appendix IV.

2.11.3.4 Vegetation

No noticeable effects on vegetation were seen along Belt Creek. Even on Rock Creek, with its metal-laden water, grasses grew lushly along the banks.

2.11.3.5 Summary of Environmental Condition

The water in Rock Creek was the most impacted by mining in the Belt Creek drainage. It exceeded the primary MCL for cadmium, the secondary MCL for zinc, as well as the aquatic life standards for cadmium, lead, and zinc.

2.11.4 Structures

All structures associated with mining were located on private land. The Neihart Mill is the most noticeable along Highway 89.

2.11.5 Safety

Again, all structures and workings are on patented land and were not assessed as a part of this study.

2.12 Block 'P' Tailings

2.12.1 Site Location and Access

The Block 'P' tailings (DDBA sec. 13, T15N, R8E) are mostly on LCNF-administered land, but the mill site is on a private patented claim. Access to the site is 9.3 miles east on Forest Route 120 from Monarch. Continue straight ahead on Forest Route 6403 for 0.3 miles. The tailings are on the southeast side of the road opposite Galena Creek.

2.12.2 Site History-Geologic Features

Robertson and Roby (1951) state that the Barker mining district includes the area drained by the Dry Fork of Belt Creek and its tributaries, and the areas drained by the headwaters of Otter and Arrow Creek. Most of the mines and prospects in the Barker district are near the old towns of Barker and Hughesville. The Block 'P' Mine was the largest producer of the district. Buck Barker and Pat Hughes first discovered the silver-lead deposits in 1879. The claims at first were developed independently by various owners and lessees, with the ore shipped to Fort Benton. In 1910, a 75-ton gravity mill was built. In 1920, it was increased to 100 tons. A 400-ton selective flotation mill was built just south of Barker in 1927, possibly producing what this report is calling the Block 'P' tailings. Mining and milling continued until 1930 when operations ceased. Operations again resumed in 1941 continuing through 1943.

Geology at the mine reported by Robertson and Roby (1951) consisted mainly of sulfide veins in a mass or plug of syenite porphyry. The sulfide minerals are galena, sphalerite, marmatite, pyrite, tetrahedrite, and chalcopyrite. The gangue consists of quartz, calcite, barite, rhodochrosite, and altered syenite or granite porphyry.

2.12.3 Environmental Condition

The Block 'P' tailings consist of two barren impoundments, an upper and lower. The upper impoundment is dissected by a 1 ft–25 ft deep, erosional channel that flows into the lower impoundment. Some erosion has taken place at the base of the tailings, washing tailings onto private land. The site lacks any vegetation, the material is fine grained, and is susceptible to continued wind and rain erosion. Some work has been done to contain the tailings by utilizing a ditch above and below the impoundments. There is also a holding pond on private land below the washed out area. Several recent survey stakes were seen at the site.

2.12.3.1 Site Features-Sample Locations

Surface water samples were collected from Galena Creek. An upstream sample (GPTS20H) was collected approximately 80 ft upstream of the tailings, and a downstream sample (GPTS10H) was collected on LCNF-administered land upstream from where Galena Creek enters private property. A vertical profile sample (GPTT20H) and a surface sample (GPTT30H) were collected from the tailings dump. A soil sample (GPTD10H) was collected along Galena Creek. Site features and sample locations are shown in figures 14 and 15; photographs are shown in figures 15a and 15b.

2.12.3.2 Soil

Several concentrations of metals in the soil/tailings exceeded Clark Fork Superfund background levels and phytotoxic limits (table 14). The areas where the samples were collected are barren, lacking any vegetation, except along the stream channel were the soil-streambed sample (GPTD10H) was collected. Here the area is sparsely vegetated with willows, weeds, and grasses. Because the road is next to the stream channel, the soil sample is more representative of the streambed, which has also been impacted by mines and other workings further upstream from the site.

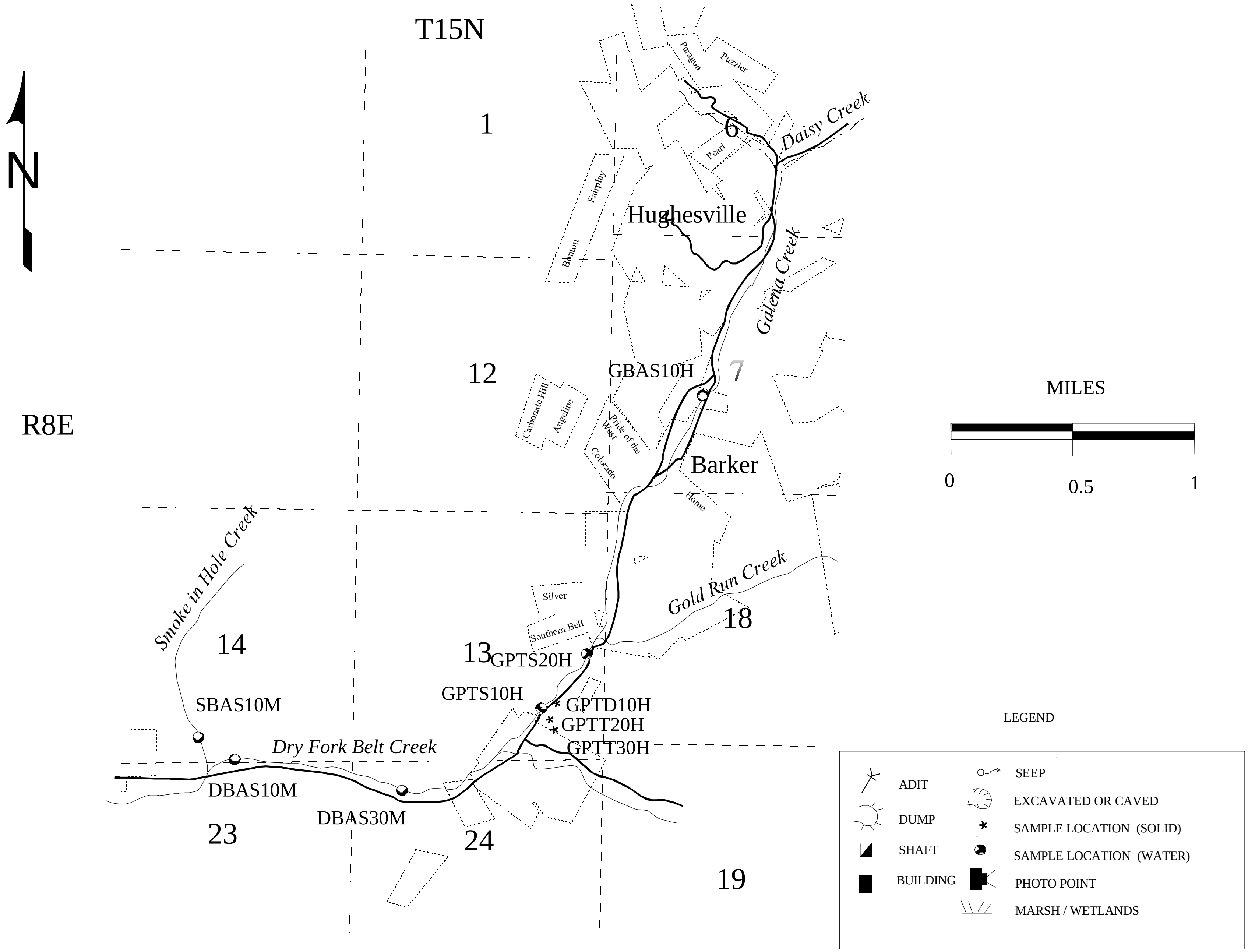


Figure 14. Schematic of the Hughesville/Barker mining districts showing sample locations, as sampled 05/19/98.

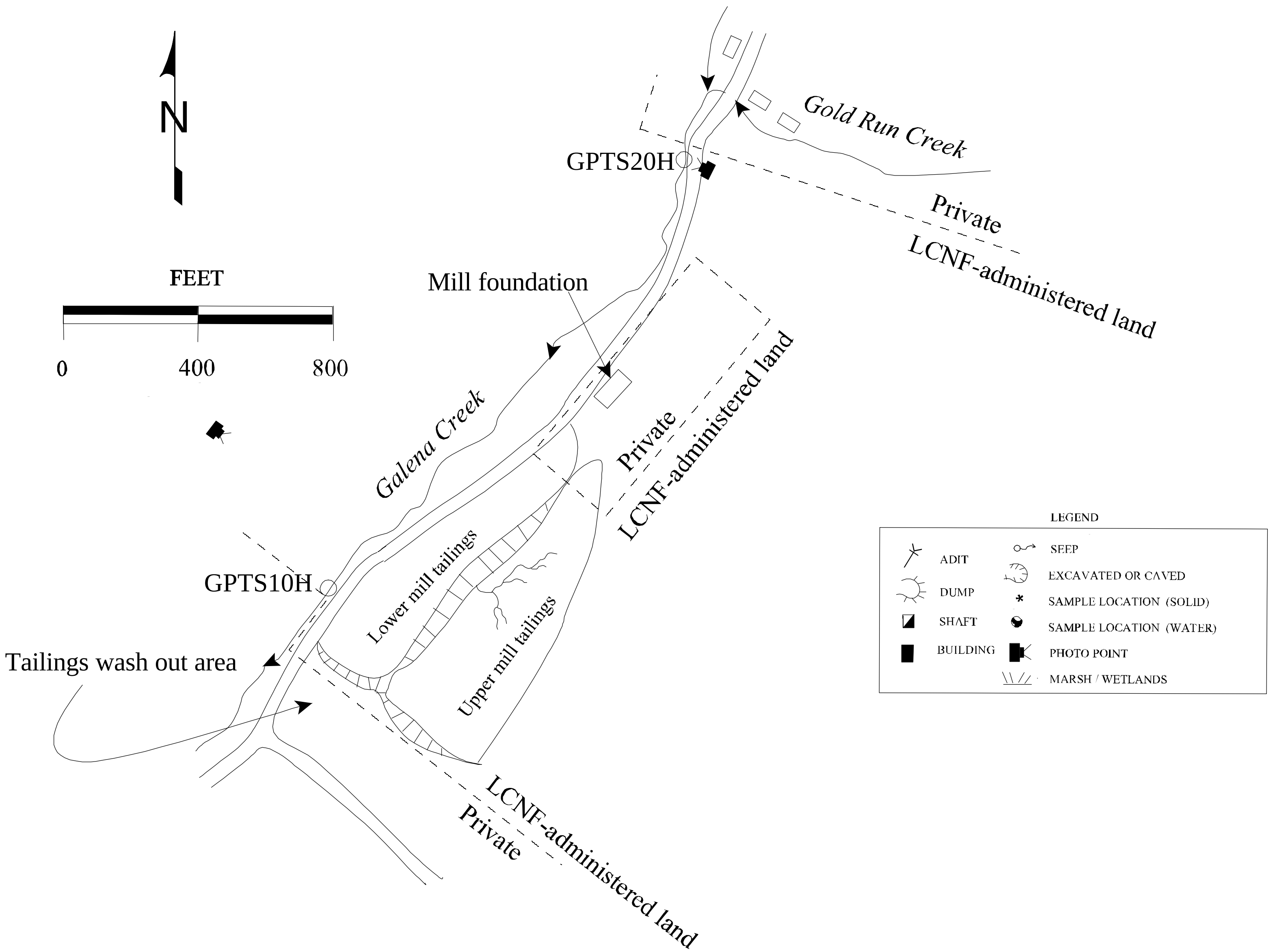


Figure 15. Brunton and tape map of the Block ‘P’ tailings, as mapped 5/19/98.

Figure 15a. The Block 'P' mill tailings upstream sample site (GPTS20H) on Galena Creek.

Figure 15b. The Block 'P' tailings are on private land.

Table 16. Soil sampling results at the Block 'P' tailings (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Vertical profile (GPTT20H)	191[1,2]	4.47[1]	48.4[1]	952[1]	48.2[1]
Lower impoundment (GPPT30H)	395[1,2]	4.22[1]	68.7[1]	1046[1,2]	224[1]
Soil-streambed profile (GPTD10H)	465[1,2]	4.63[1]	75.9[1]	611[1,2]	562[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

Numerous mine workings at the headwaters of Galena Creek have caused Galena Creek's streambed to be ironed stained for its entire length. Both the upstream and downstream samples exceeded MCL concentrations for cadmium as well as acute and chronic aquatic life levels for zinc (table 17). Concentrations in the downstream sample were slightly less or nearly the same as the upstream sample, indicating that other factors than the mill tailings have impacted Galena Creek. The field pH ranged from 6.75 upstream (5.45-lab) to 6.74 upstream of the Block 'P' (7.53-lab) to 6.51 (7.47-lab). Mining upstream (on private land) has already affected the water by the time it reaches the Block 'P' tailings.

The TSS levels were the highest on the upstream sample on Galena Creek (25 mg/l) whereas downstream samples measured only <1.0 mg/L to <.05 mg/L. The upstream sample was taken upstream from the confluence of Galena Creek with Gold Run Creek and the east branch of Dry Fork Belt Creek. This area would benefit from monitoring during storm events. During the time of this study, a spring storm in the higher elevations around Barker resulted in Dry Fork Belt Creek turning a milky yellowish color from runoff from the tailings and waste piles upstream.

Table 17. Water-quality exceedences at the Block 'P' tailings.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
GBAS10H-upstream				PAC		AC	SA		S				AC						S
GPTS20H-upstream				PAC									AC						
GPTS10H- downstream				PAC									AC						

Exceedence codes:

P-Primary MCL
S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic

Note: The analytical results are listed in Appendix IV.

2.12.3.5 Summary of Environmental Condition

Work to contain the mill tailings, with a cutoff ditch above and the road and bar ditch below the tailings, have greatly reduced any impact the tailings may have, isolating it from Galena Creek.

2.12.4 Structures

There are no structures at the site. Only the foundation of the mill building is left.

2.12.5 Safety

Easy access to roadside mill tailings on LCNF-administered land makes it a safety concern to visitors.

2.13 Lower mill tailings along Dry Fork Belt Creek

2.13.1 Site Location and Access

The Dry Fork Belt Creek mill tailings (ACAB sec. 23, T15N, R8E) are on LCNF-administered land approximately nine miles east of Highway 89 on Forest Route 120. The tailings can be seen on the north side of the road across from the Bender Creek trailhead. The gravel road is in good condition, accessible with 2-wheel drive vehicle.

2.13.2 Site History-Geologic Features

Pioneer Technical Services (1994) briefly mentioned the lower tailings, stating that there are approximately 10,000 cubic yards of material. No other references could be found for the lower mill tailings; Robertson and Roby (1951), Robertson (1951), and Spiroff (1954) do not mention the tailings.

2.13.3 Environmental Condition

Fine-grained mill tailings with no vegetation were found for over 1,000 ft at this site along both sides of Dry Fork Belt Creek in the flood plain. Pioneer Technical Services' report (1994) estimated 10,000 cubic yards of material.

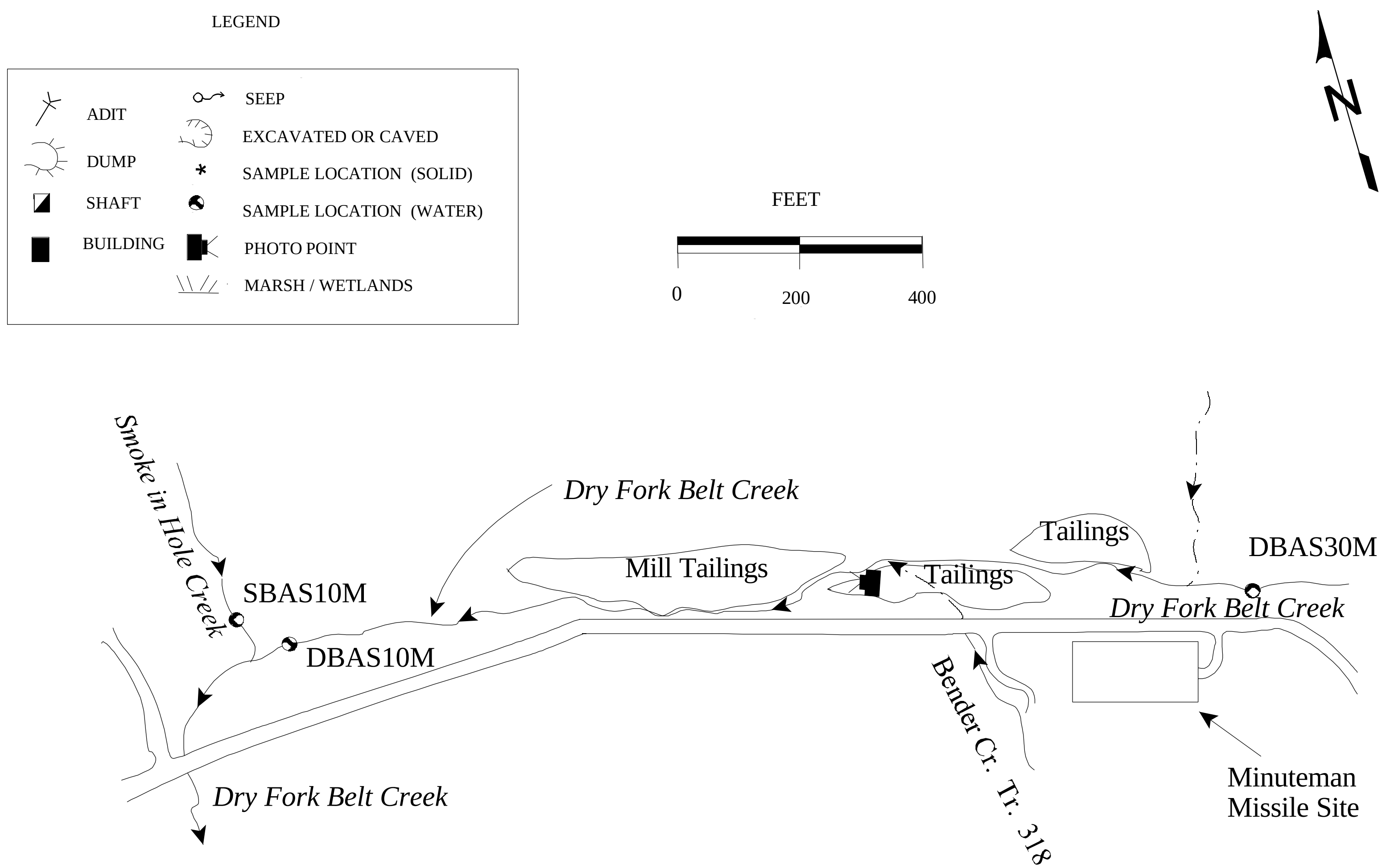


Figure 16. Dry Fork Belt Creek continues to erode the lower tailings in the Barker mining district, as mapped 05/20/98.

Figure 16a. The lower tailings on Dry Fork Belt Creek looking upstream.

Figure 16b. Lower tailings on Dry Fork Belt Creek looking downstream.

2.13.3.1 Site Features-Sample Locations

A surface water sample (DBAS30M) was collected upstream of the mill tailings and a downstream sample (DBAS10M) was collected from Smoke in Hole Creek before the confluence with Dry Fork Belt Creek. Additionally, a background water sample (SBAS10M) was collected on Smoke in Hole because the upstream sample on Dry Fork Belt Creek is most likely influenced by mines and the Block 'P' tailings farther upstream. Site features and sample locations are shown in figure 16; a photograph is shown in figures 16a and16b.

2.13.3.2 Soil

Soils adjacent to the disturbed area did not appear to be impacted; no soil samples were collected.

2.13.3.3 Water

The upstream and downstream samples both exceeded secondary MCLs for manganese, and acute and chronic aquatic life standards for zinc (table 18). Concentrations of metals in the two samples are nearly the same. The background sample from Smoke in Hole Creek (unaffected by mining) shows no exceedences. The background samples indicate that the natural pH is approximately 8.0 to 8.1. Dry Fork Belt Creek’s pH has increased again from upstream by the time it reaches the lower tailings. The lower tailings do not appear to have an effect on the pH of the water in the creek; it actually increased downstream. The SC also decreased downstream, possibly reflecting the role of dilution in the water quality of the area.

Table 18. Water-quality exceedences at the lower tailings along Dry Fork Belt Creek.

Sample Site	**Al**	**As**	**Ba**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Mn**	**Hg**	**Ni**	**Ag**	**Zn**	**Cl**	**F**	**NO_3**	**SO_4**	**Si**	**pH**
DBAS30M-upstream									S				AC						
DBAS10M-downsteam									S										
SBAS10M-background													AC						

Exceedence codes:
S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic
Note: The analytical results are listed in Appendix IV.

2.13.3.4 Vegetation

Undisturbed vegetation at the site consisted of weeds, grasses, and coniferous trees. The areas suspected of containing tailings along the stream had little or no vegetation. Vegetation along the edges of the mill tailings appeared healthy and unstressed.

2.13.3.5 Summary of Environmental Condition

Dry Fork Belt Creek is actively eroding away at the mill tailings in the flood plain. At the time the site was visited, a rain shower turned the stream from clear to turbid yellow.

2.13.4 Structures

There are no structures at this site.

2.13.5 Safety

A campsite is present immediately downstream of the mill tailings, but there was no indication of anyone disturbing or walking on the tailings.

Sites in the Musselshell River Drainage

2.14 Jumbo (Lucky Boy) / New Deal (Boss) and Kid's Dream Mines

2.14.1 Site Location and Access

These two mine sites are combined in the same write-up because of their small nature and because of their proximity–approximately two miles distance. They both occur in the Spring Creek drainage on the Russian Flat 7.5-min. quadrangle map. The Jumbo and New Deal site is easily accessible by Forest Road 6393, in BCDC sec. 12, T10N, R10E. The Kid's Dream site lies approximately ½-mile north of Forest Road 6393 on Forest Road 6332, in BDBC sec. 15, T10N, R10E. It is accessible in good weather by 2-wheel drive; in bad weather and from late-fall to spring, by 4-wheel drive vehicle.

2.14.2 Site History-Geologic Features

Two claims were originally located as the Lucky Boy and Boss according to Roby (1950). The names were later (1938) changed to the Jumbo and New Deal, respectively. Roby (1950) and Garverich (1995) show the New Deal Mine is located in the Precambrian Greyson shale and associated with Cambrian syenite dikes. These dikes strike northeast but the mineralized structure (a 1–7 ft wide quartz vein) strikes N65°–75°W as stated in Roby (1950). Garverich (1995) estimated that the total tons mined from all four mines in the area (Jumbo, New Deal, Lucky Boy and Clara Burton) was approximately 250 tons of ore. The ore minerals were described as chalcopyrite, with some bornite and possibly covellite (Roby, 1950). Roby stated that the shaft at the New Deal was 140 ft deep and was flooded to within 10 ft of the surface. The shaft has been filled in with waste rock and is no longer accessible.

2.14.3 Environmental Condition

These two sites were exceedingly small but were sampled for the sake of completeness. They had a very low probability of significant effects on LCNF-administered land. The New Deal had one small pool of water that had collected in a prospect pit and the Kid's Dream had some crushed rock that had been stored in three 55-gallon drums and one 20-gallon drum. One of the 55-gallon drums had been tipped over and the rock had spilled on the ground.

2.14.3.1 Site Features-Sample Locations

Water-quality samples were collected from a small pool of water that had collected in a prospect pit at the New Deal Mine (SNDS10M). The sample was collected on May 13,1998. Two of the open shafts were flooded but the water was inaccessible to sample because the water level was 10 ft. below ground level.

One composite sample was taken from the 55-gallon drums crushed rock (ore?) at the Kid's Dream prospect. Samples were collected on May 09, 1998. More samples were not collected because of the limited extent of the prospects. Site features and sample locations are shown in figure 17; photographs are shown in figures 17a and 17b.

2.14.3.2 Soil

One sample of the contents of drums located at the property was taken. The contents exceeded the phytotoxic limits for copper and zinc (table 19). No water pathway to an active drainage was present.

Table 19. Soil sampling results at the Kid's Dream Mine (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Ore sample (SKDD10H)	972[1,2]	4.47[1]	1259[1,2]	42.3[1]	1,133[1,2]

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

2.14.3.3 Water

The concentrations of analytes in the sample in the small pool (SNDS10M) did not exceed any water

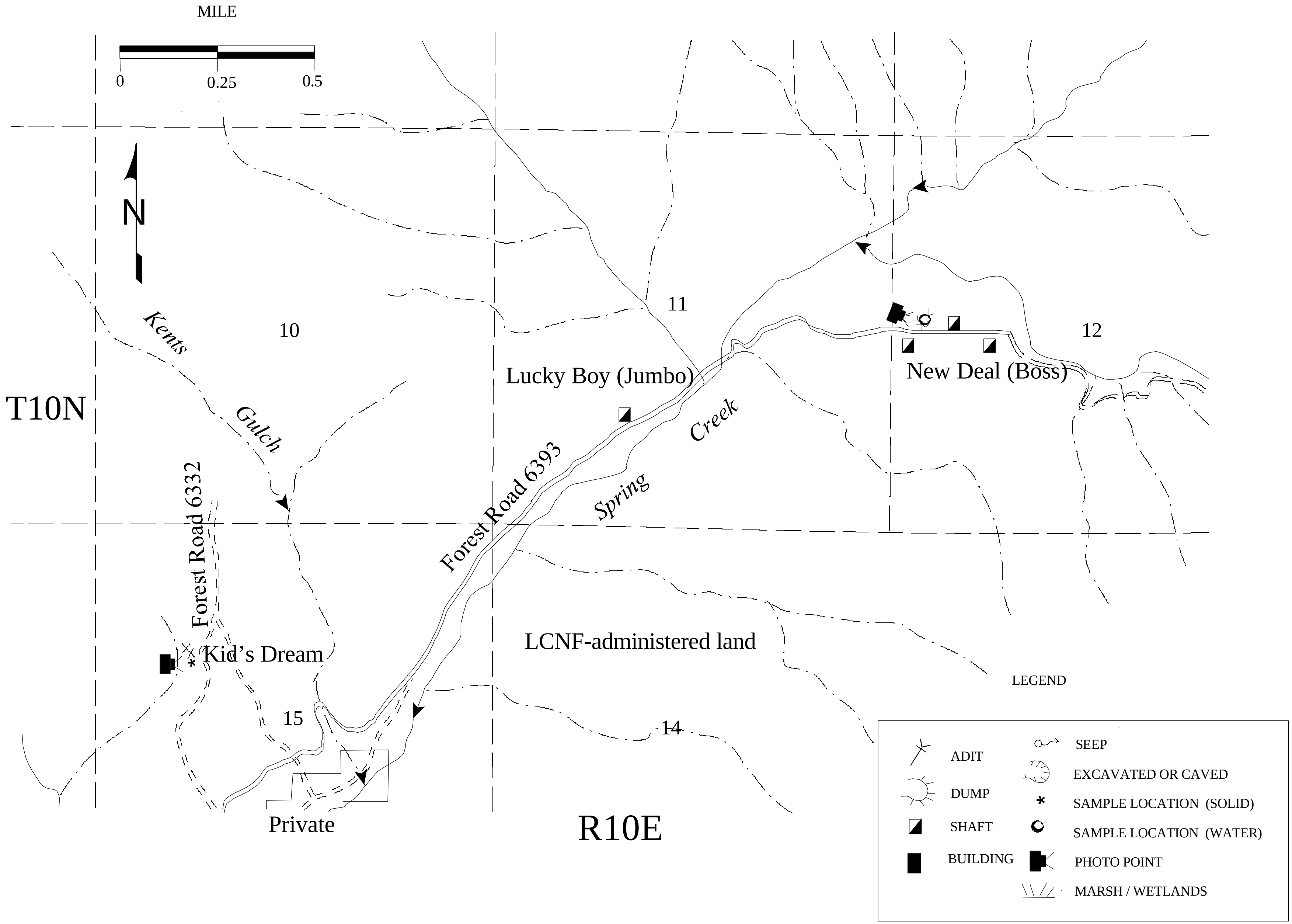


Figure 17. Schematic of the New Deal, Jumbo, and Lucky Boy mines on the Russian Flat 7.5-min. quadrangle, as mapped 05/09/98.

Figure 17a. A small prospect pit at the New Deal Mine filled with standing water.

Figure 17b. Several drums at the Kid's Dream were filled with what looked like ore. This stockpile was sampled to determine its content.

quality standards (table 20). The pool of water had abundant mosquito larvae in it. The pool may have been seasonal but there is a good chance that it represented ground water.

Table 20. Water-quality exceedences at the New Deal Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
SNDS10M-pool																			

Note: The analytical results are listed in appendix IV.

2.14.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted by the site.

2.14.3.5 Summary of Environmental Conditions

These two sites were sampled for the sake of completeness more than the possibility of environmental effects on LCNF-administered land. The drums at the Kid's Dream were not in contact with a water source. One was tipped over and the contents spilled out.

2.14.4 Structures

One log cabin in fair condition was located on the waste dump at the Jumbo; it may have been a mine hoist house. The Kid's Dream site had one log cabin in poor condition.

2.14.5 Safety

Two open and partially flooded shafts were located adjacent to the road that passed by the Jumbo mine. They were an obvious safety hazard; they had steep sides and the water levels were approximately 10–15 ft below ground level. Four wheeler tracks were visible all around the area.

2.15 Dr. Barnette's (Montana Copper) Mine

2.15.1 Site Location and Access

Access to this site is difficult in all but the best weather. The road from the bottom is locked and restricted by private landowners. An alternate route is via Forest Route 694 along Pasture Creek; this road is 4-wheel drive only as it curves to the northwest and drops into Cooper Creek. The site is entirely on LCNF-administered land on the Groveland 7.5-min. quadrangle in CAAB sec. 33, T9N, R10E.

2.15.2 Site History-Geologic Features

This has been known by at least two names: the Montana Copper and the Barnette (Roby, 1950) and is located in the Musselshell district. A Dr. Barnette originally owned the mine and possibly shipped 31 tons of ore in 1918. The ore reportedly averaged 15.34% copper. The next reported production was in 1948 when the mine produced some ore from a deepened winze on the property (Roby, 1950). Roby (1950) describes two adits on the property, the upper one with a stope to the surface and the other with a winze.

The mine is located in Belt shales and is associated with a quartz porphyry. The ore consists of chalcopyrite, silicates and carbonates in a 2–18 in. wide vein that trends N50°–60°W, 60°SW.

2.15.3 Environmental Condition

This is a small site with few impacts to the environment. The waste rock is in contact with the small flow in Cooper Creek. The small pond formed by the damming of the creek by the waste rock dump is also in contact with the waste rock.

2.15.3.1 Site Features-Sample Locations

Water-quality samples were collected from upstream (CDBS30H) and downstream (CDBS20H) of the site on LCNF-administered land. A sample of the water in the pond was also collected (CDBS10H). Samples were collected on May 21, 1998. Site features and sample locations are shown in figure 18; photographs are shown in figures 18a and 18b.

2.15.3.2 Soil

One waste sample was collected at Dr. Barnette’s. CBDD10H was a composite sample along the waste. It was composed of gray shale, silty soil, and quartz vein. The analytical results are shown in table 21.

Table 21. Soil sampling results at Dr. Barnette’s Mine (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Soils (CBDD10H)	6.56[1]	4.87[1]	9.14[1]	27[1,2]	43.3[1]

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

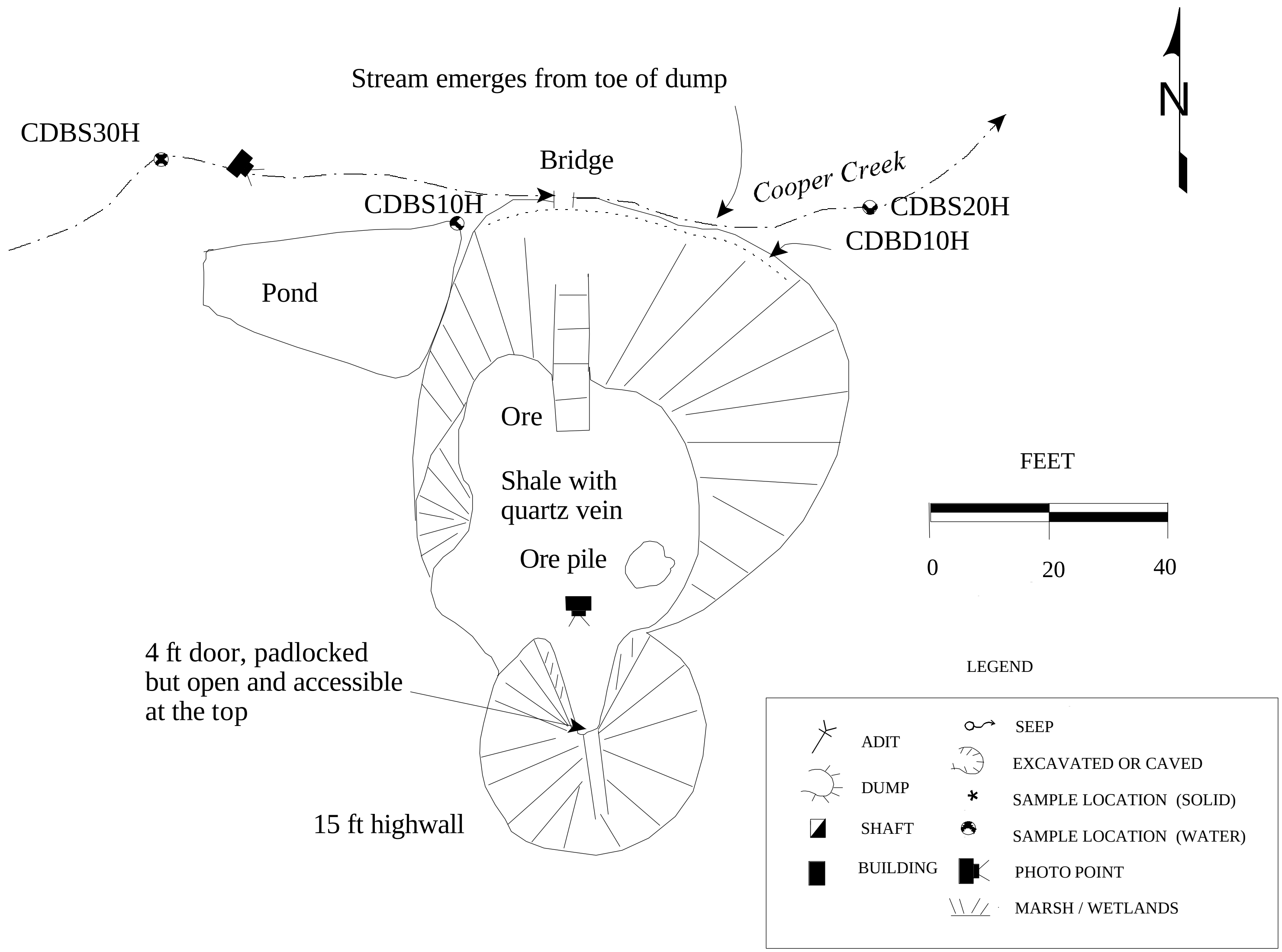


Figure 18. Dr. Barnette's mine was a small isolated working with one open adit and a waste dump that was in contact with Cooper Creek, as mapped 05/21/98.

Figure 18a. The adit at Dr. Barnette's Mine had a locked portal but it could be easily circumvented. Rock on the back of the mine had recently spalled off.

Figure 18b. The waste dump at Dr. Barnette's came into contact with Cooper Creek and blocked the drainage enough to form a small pond.

2.15.3.3 Water

The concentrations of analytes in the upstream sample, the pond or the downstream sample exceeded no water-quality standards (tables 2 and 22).

Table 22. Water-quality exceedences at Dr. Barnette's Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
CDBS30H-upstream																			
CDBS10H-pond																			
CDBS20H-downstream																			

Exceedence codes:

Note: The analytical results are listed in appendix IV.

2.15.3.4 Vegetation

The vegetation did not appear impacted by the mining activity. Although the waste dump was not well vegetated, small, 3- to 4-ft trees had started to grow on the flanks of the dump. Some grasses grew on top. The vegetation surrounding the mine workings did not appear stunted or dying.

2.15.3.5 Summary of Environmental Conditions

This is a very small site of very little consequence. The ore did not contain abundant sulfides and the waste dump was relatively small. A slight iron stain was noted downstream in the creek bed.

2.15.4 Structures

One totally collapsed log cabin is associated with the site.

2.15.5 Safety

The open adit has been secured rudimentarily with a wooden door but access could be gained either by crawling over the door or by prying off the lock. The second adit with the stope to the surface, as described in Roby (1950), could not be found even though the area uphill from the first adit was searched for the opening.

2.16 Belle of the Castle Mine and Copper Bowl / Copper Kettle Claims

2.16.1 Site Location and Access

The Belle of the Castle and other related mines were reached by an unimproved dirt road that follows Hensley Creek to the north-northwest. The small two-track road turns north from Forest Route 581 where it crosses Hensley Creek. The road can be either walked when it is impassable to vehicles, or driven after the snow melts in the summer. The mine is in sec. 2, T8N, R8E, in the Musselshell Ranger District at an elevation of approximately 6,920 ft.

2.16.2 Site History-Geologic Features

The Belle of the Castle was described by Roby (1950) as consisting of two adits and one shaft that explored the contact between the Belt shale and a quartz porphyry. Roby listed the ore mineral as primarily chalcopyrite and stated that production records were unavailable. Winters (1968) mapped the area and further described the mine. He stated that the ore minerals included chalcopyrite, chalcocite, and covellite (with oxides cuprite and tenorite). A shaft encountered a large magnetite, pyrite and chalcopyrite ore body. The deposit was associated with a shear zone that cut the Belt argillites and a dacite porphyry.

The Copper Bowl and Copper Kettle unpatented claims lie immediately to the north of the Belle of the Castles as shown on Winters' (1968) site map. The geology at the Copper Bowl and Copper Kettle is similar to that of the Belle of the Castle. The ore minerals are magnetite, pyrite, and chalcopyrite cemented in jasper. These claims produced 2,000 tons of iron ore in 1902 that was used as smelter flux. Winters (1968) also states that the property was worked in 1955 when a 36-ton sample was shipped to the East Helena smelter. Production in the intervening years is unknown.

2.16.3 Environmental Condition

The Belle of the Castle was one of the larger mines in the area and does affect the local hydrology. Waste was used as road fill and some waste is in contact with Hensley Creek, especially on the north fork of the stream. The adit discharged a small amount of water (<10 gpm). The water flowed out of the adit and infiltrated into the waste dump and then re-emerged from the toe of the waste dump where a second, cleaner-looking spring, also emerged. Hensley Creek had a slightly orange-stained bed downstream of the mining activity.

2.16.3.1 Site Features-Sample Locations

Water-quality samples were collected from two sites upstream (HBCS10L and HBCS20L) and two sites downstream (HBCS30L and HBCS40L) of the site on LCNF-administered land. The upstream samples were taken on both the north and main forks of Hensley Creek. One downstream sample was taken downstream of the Copper Kettle and Copper Bowl claims but upstream of the patented land. The other downstream sample was taken downstream of all mining activity at the Belle of the Castle and Copper Kettle. Samples were collected on May 26, 1998. More samples were not collected because of the private land position. Site features and sample locations are shown in figure 19; photographs are shown in figures 19a and 19b.

2.16.3.2 Soil

One waste sample was collected. HBCD10H was a composite sample along the waste being eroded by the small north fork of Hensley Creek. Copper levels were the only exceedence of phytotoxic limits (table 23). Pioneer Technical Services (1995) also sampled the waste rock at the site and found copper and lead levels to be at least three times background.

Table 23. Soil sampling results at the Belle of the Castle Mine (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Soils (HBCD10H)	7.4[1]	5.29[1]	356[1,2]	16.8[1]	35.3

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

2.16.3.3 Water

The concentrations of analytes in both upstream samples and the downstream samples did not exceed any water-quality standards (table 24). Levels of most metals were near detection limits. Previous water sampling by Pioneer Technical Services (1995) showed that the site may have exceedences at other times of the year. Copper levels increased from below detection limits in the upstream samples to 2.14 µg/L in the middle sample and increased again to 5.30 µg/L in the farthest downstream sample. These levels are well below the water-quality criteria.

Table 24. Water-quality exceedences at the Belle of the Castle Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
HBCS10L-upstream																			
HBCS20L-upstream																			
HBCS30L-downstream (middle)																			
HBCS40L-downstream of all																			

Note: The analytical results are listed in appendix IV.

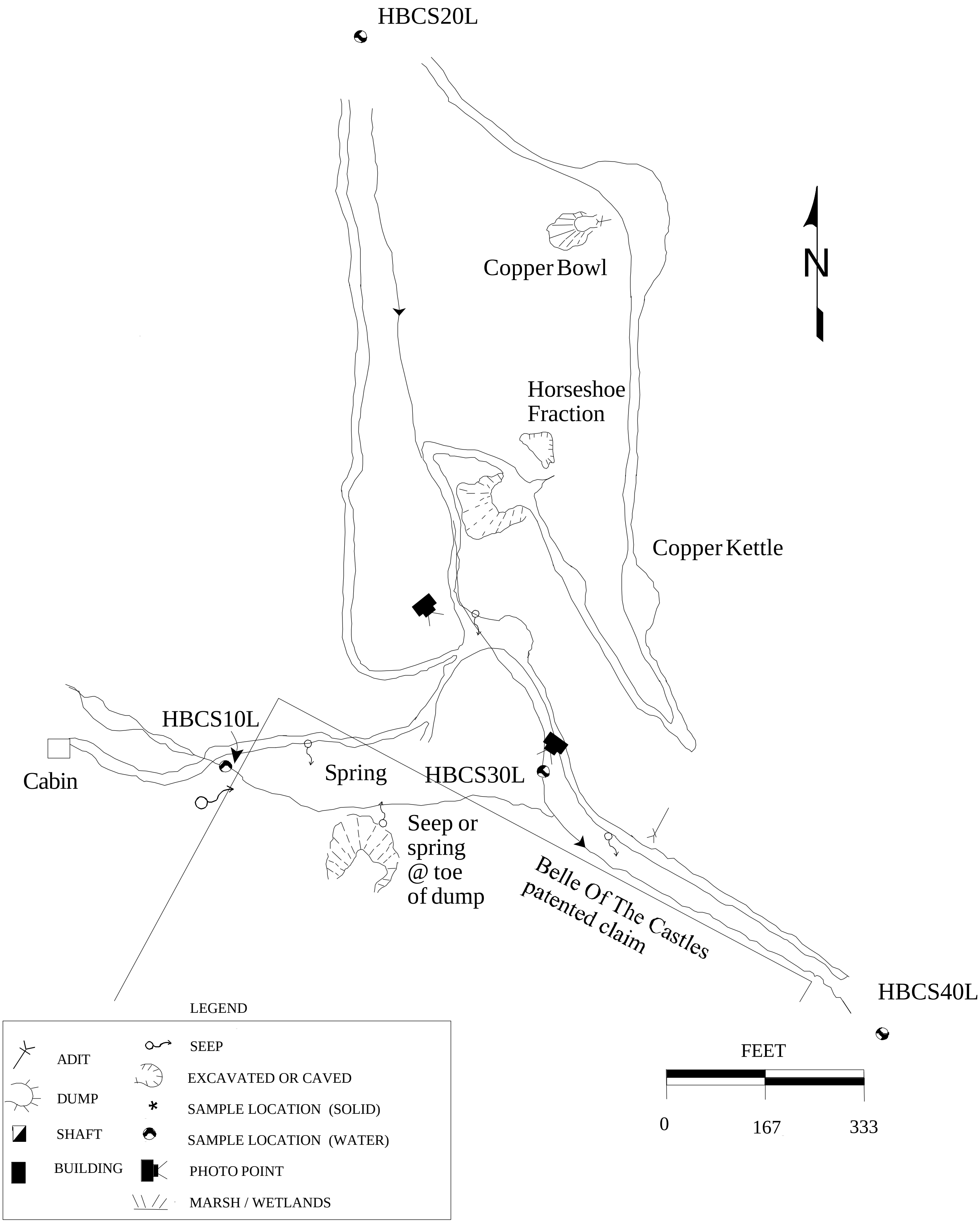


Figure 19. The Belle of the Castles and the other nearby mines are associated with several springs and seeps. They have several dumps that emit runoff into the creek. Original map is from Winters, 1968; this map made 05/26/98.

Figure 19a. Mine waste was used in building the road into the Belle of the Castle. The upper reaches of Hensley Creek and the "north fork" of the creek are in contact with the waste.

Figure 19b. Sample site HBCS30L was chosen to test the water quality of the site before it flowed onto patented land. The site is downstream from the Copper Kettle and Copper Bowl.

2.16.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted by the site. Grasses grew up to and in the water in the creeks. No dead or dying trees were noted. Physically, the vegetation near the upper workings at the Copper Kettle was impacted by the mine development. It was cut down during development and has not grown back because of the steep slope and continued erosion.

2.16.3.5 Summary of Environmental Conditions

Although Pioneer Technical Services (PTS) (1995) measured an observed release of copper to Hensley Creek and analyses showed levels above acute and chronic aquatic life criteria, this study did not find any exceedences. These dichotomies might be explained by the difference in the time of year that the samples were taken or by fluctuations in the amount of metals due to the temperature and/or pH of the water. In the adit discharge, PTS found exceedences in copper, iron, mercury and lead. MBMG did not sample the adit discharge because it was on private land.

2.16.4 Structures

A locked, metal-shingle-sided cabin was found on LCNF-administered land. It was in good condition and looked as if it had been recently occupied. A small, mine-storage shed on LCNF-administered land was located on the Copper Kettle claim. It was of board-and batten- construction with tar paper covering the outside, and was in good condition.

2.16.5 Safety

Pioneer Technical Services (1995) found one open adit that they considered potentially hazardous on patented land. No safety concerns were noted on LCNF-administered land.

2.17 Unnamed DCAA2,8N,8E Mine

2.17.1 Site Location and Access

The Unnamed DCAA2,8N,8E Mine is located on the northeast bank of Hensley Creek at DCAA sec. 2 , T8N, R8E and is accessed by following a road that begins where Forest Service road 581 crosses the creek. The site is on private land with LCNF-administered land both upstream and downstream.

2.17.2 Site History-Geologic Features

No historical information could be found for the site, but it is likely that it was developed near the turn of the century along with the Belle of the Castles Mine. The site was visited in June 1998 and a sketch map was prepared (figure 19). The site consists of a collapsed adit and a small streamside waste-rock dump containing minor sulfides. A small dam has been constructed across Hensley Creek on the upstream side of the dump.

2.17.3 Environmental Condition

Erosion of the dump by Hensley Creek was an obvious problem at this site.

2.17.3.1 Site Features-Sample Locations

Upstream (HPSS10L) and downstream (HNFS10L) water-quality samples were collected from Hensley Creek on June 23, 1998. No soil samples were collected because the dump is on private land. Sample locations are shown on figure 20; photographs of the site are shown in figures 20a and 20b.

2.17.3.2 Soil

No soil samples were collected at the site, but evidence of the dump slumping into the creek was visible from the road that passes by.

2.17.3.3 Water

On the day the site was sampled, Hensley Creek was flowing at approximately 8.2 cfs. The watercourse was not stained with precipitates, and there was no evidence of any other effects from mining. Aluminum and zinc concentrations downstream from the site were higher than upstream, but exceeded no water-quality standards (table 25).

Table 25. Water-quality exceedences at the Unnamed sec. 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
HPSS10L-upstream																			
HNFS40L-downstream of all																			

Note: The analytical results are listed in appendix IV.

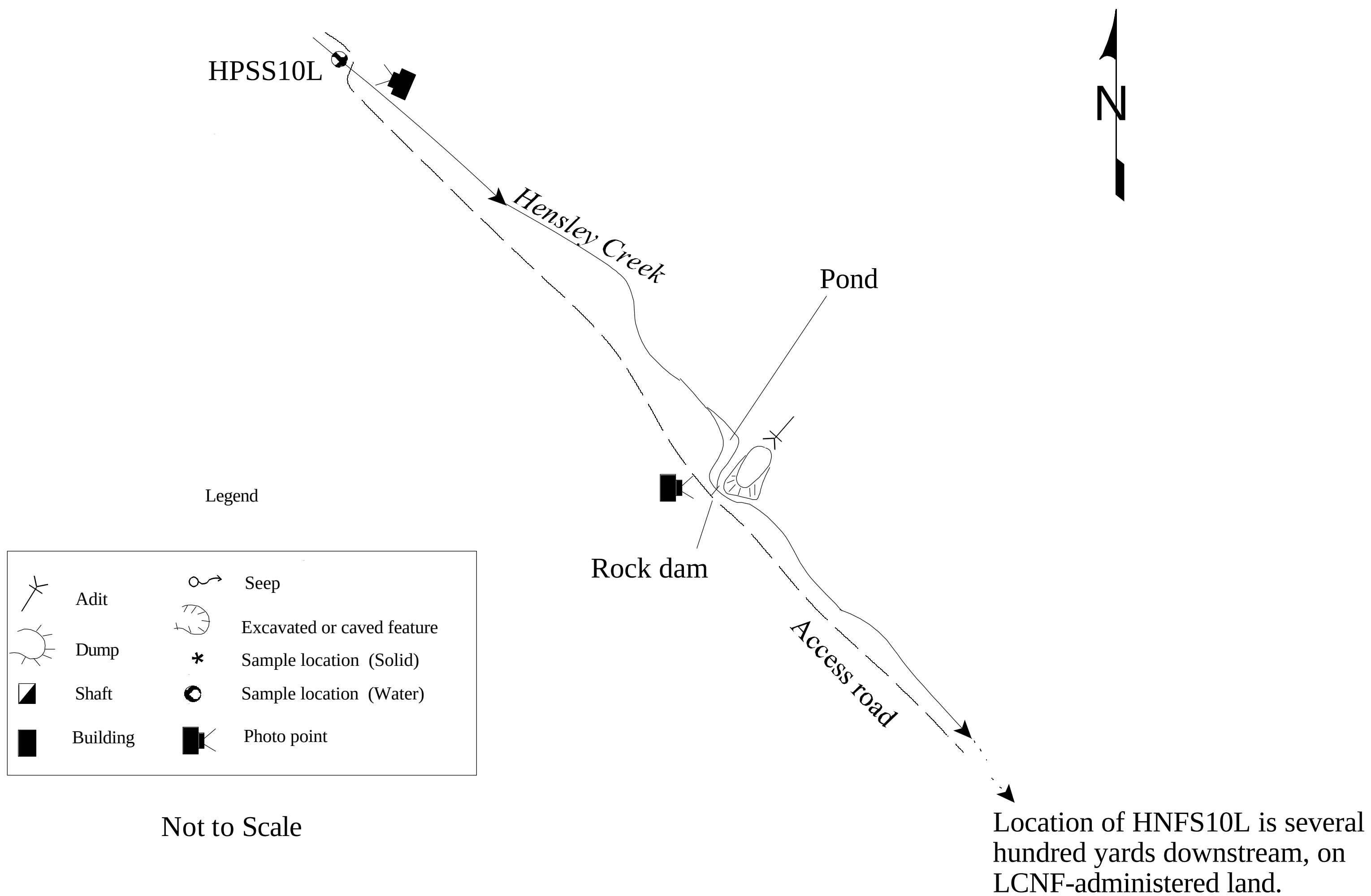


Figure 20. Sketch map of Unnamed DCAA section 2, T8N R8E mine, June 23, 1998. The waste dump is actively eroded by Hensley Creek.

Figure 20a. Hensley Creek eroded the toe of the mine's waste-rock dump when visited 06/23/98. The site was on private land but LCNF-administered land lay both upstream and downstream.

Figure 20b. Sample HPSS10L was collected from Hensley Creek, upstream of the site on LCNF-administered land. Both upstream and downstream, the creek appeared pristine.

2.17.3.4 Vegetation

The flood plain of Hensley Creek was densely vegetated with grasses and other small plants. Outside the flood plain, lodgepole pine and Douglas fir were abundant. The face of the waste-rock dump that borders the creek was unvegetated and was slumping.

2.17.3.5 Summary of Environmental Condition

Erosion of the waste-rock dump into Hensley Creek appeared to be a problem, but the metal concentrations in the waste are unknown because the site is on private land. Aluminum and zinc concentrations in the stream water increase downstream from the site, but it is unclear if this change in quality is attributable to the eroding mine waste.

2.17.4 Structures

No structures were observed at the site.

2.17.5 Safety

No safety problems were noted at the site.

2.18 Unnamed AABD sec. 11,T8N,R8E Mine

2.18.1 Site Location and Access

The Unnamed AABD sec.11,T8N,R8E Mine is located on the southwest bank of Hensley Creek at AABD sec. 11, T8N, R8E and is accessed by following a road that begins where Forest Service road 581 crosses the creek. The site is on LCNF-administered land.

2.18.2 Site History-Geologic Features

No historical information could be found for the site, but it is likely that it was developed near the turn of the century along with the Belle of the Castles Mine. The site was visited in June 1998 and a sketch map was prepared (figure 21). The site consists of a collapsed adit with a small discharge and a streamside waste-rock dump.

2.18.3 Environmental Condition

A small discharge (<1 gpm) flowed from the collapsed portal and then infiltrated the waste-rock dump. The dump was in contact with the creek but did not appear to contain significant sulfide mineralization.

2.18.3.1 Site Features-Sample Locations

Upstream (HNFS10L) and downstream (HNFS20L) water-quality samples were collected from Hensley Creek on June 23, 1998. The flow rate of the creek was approximately 8 cfs. A sample was also collected from the adit discharge (HNFS30L). Soil sample HNFD10L was collected at the base of the waste-rock dump where it comes into contact with the creek. Sample locations are shown on figure 21; a photograph of the site is shown in figure 21a.

2.18.3.2 Soil

Arsenic, cadmium, copper, and lead concentrations in the sampled waste rock and soil were above Clark Fork Superfund background levels but did not exceed phytotoxic levels (table 26). Therefore, material eroded from the dump into the creek probably does not contribute significantly to metal loading.

Table 26. Soil sampling results (mg/kg) for the Unnamed 08N08E11AABD Mine.

Sample Location	**As**	**Cd**	**Cu**	**Pb**	**Zn**
Streamside waste-rock dumps (HNFD10L)	17.0[1]	2.11[1]	17.9[1]	47.2[1]	44.3

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

2.18.3.3 Water

The adit discharge contained trace amounts of arsenic (1.03 µg/l), chromium (5.98 µg/l), and zinc (10.4 µg/L), but the concentrations were well below water-quality standards. Neither the adit discharge nor the waste-rock dump seemed to affect the water quality of Hensley Creek; all analytes' levels met water-quality standards (table 27).

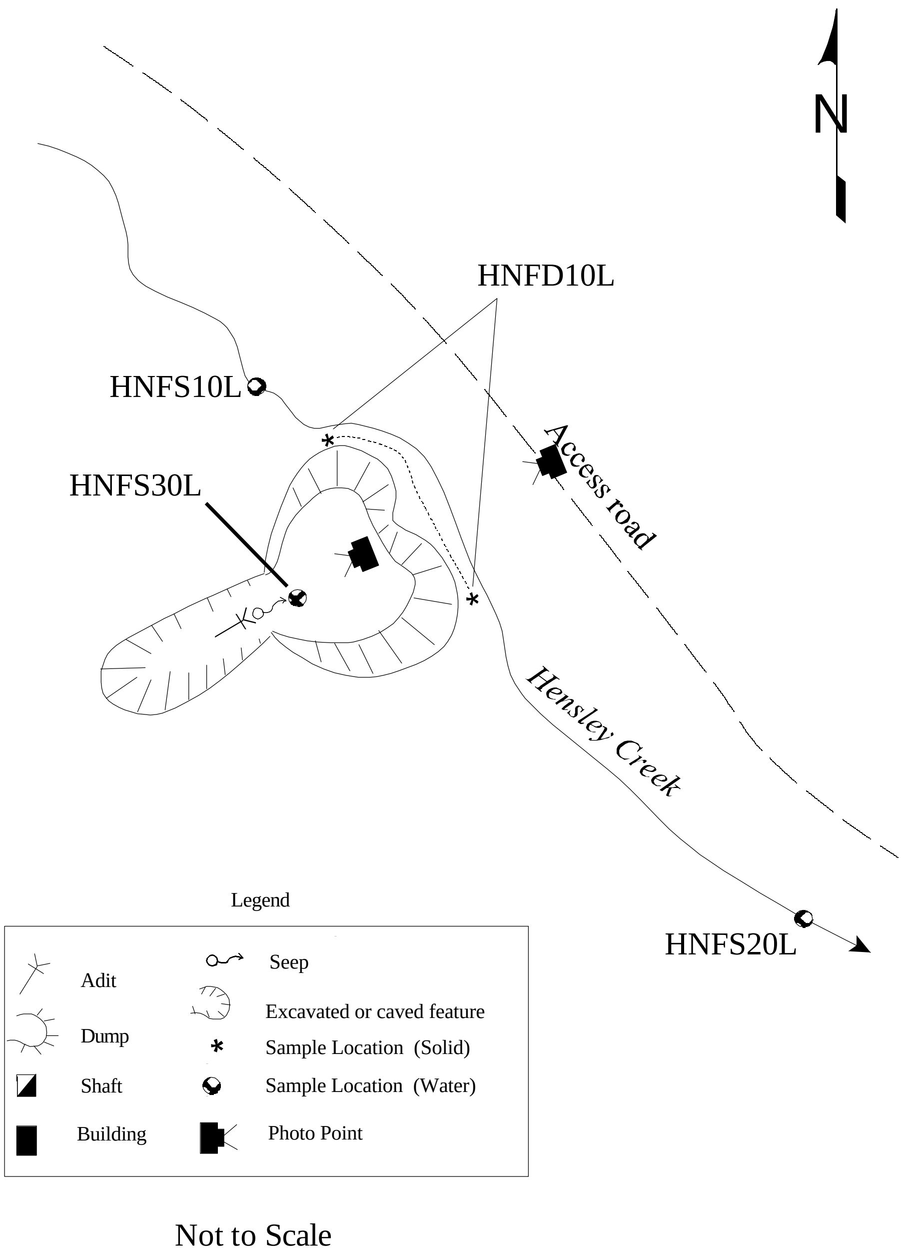


Figure 21. Sketch map of the unnamed AABD section 11, T8N, R8E mine, June 23, 1998. A small discharge flows from the collapsed adit portal.

Figure 21a. Moss, grass, and algae grew along the course of the small adit discharge. No evidence of metals precipitation was noted. Sample HNFS30L was taken here.

Figure 21b. The unnamed mine in sec. 11 had its waste dump in contact with Hensley Creek. The site was an unofficial, dispersed campsite.

Table 27. Water quality exceedences at the Unnamed Section 11 Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
HBCS10L-upstream																			
HBCS40L-downstream of all																			

Note: The analytical results are listed in appendix IV.

2.18.3.4 Vegetation

The flood plain of Hensley Creek was densely vegetated with grasses and other small plants. Outside the flood plain, lodgepole pine and Douglas fir were abundant. The waste-rock dump was moderately vegetated with grasses and small fir trees.

2.18.3.5 Summary of Environmental Condition

Erosion of the waste-rock dump into Hensley Creek may be a siltation problem but the material does not appear to contain high concentrations of metals. The adit discharge had trace amounts of arsenic, chromium, and zinc, but the concentrations were well below water quality standards and the discharge was very small. Overall, the environmental impact of the site on LCNF-administered land appeared minor.

2.18.4 Structures

No structures were observed at the site.

2.18.5 Safety

No safety problems were noted at the site.

2.19 Hamilton Mine

2.19.1 Site Location and Access

The Hamilton Mine is located in the Castle Mountain mining district. It can be accessed via an unimproved dirt road in the summer months, or by foot when the roads are impassable. It is located on both LCNF-administered land and patented claims, but the main development was on Forest Service land. The Great Eastern and Great Western patented claims lie to the southeast and the

Yellowstone Mine lies to the northeast. A map from Winters (1968) shows the location of the patented claims in the area. The mine can be found in sec. 11, T8N, R8E at an elevation of 6,680 ft on the Castle Town 7.5-min. quadrangle.

2.19.2 Site History-Geologic Features

No references were found for the Hamilton Mine, proper. The geographically closest mines described in literature are the Yellowstone Mine and the Great Eastern/Great Western mines. Most of the waste rock on the dump was a white marble, containing some banded gray limestone and intrusive rock on the dump closest to the adit (mined last?). Galena and cerussite was visible in some of the waste rock. The ore also appeared to be associated with jasper (some brecciated), much like that at the Yellowstone Mine. The jasper was a very fine grained rock with a conchoidal fracture. Locally, abundant yellowish brown limonite and manganese oxides coated fracture surfaces.

2.19.3 Environmental Condition

Although the Hamilton Mine had both an adit discharge and streamside waste, it did not appear to have a detrimental effect on the environment.

2.19.3.1 Site Features-Sample Locations

Water-quality samples were collected from each of the two creeks that join just upstream from the mine (HHAS30L and HHAS40L), and downstream (HHAS10L) of the site on LCNF-administered land. A sample of the adit discharge (HHAS20M) was also taken. One waste/soil sample was collected along the edge of the waste rock dump where it contacted the creek (HHAW10H). Samples were collected on May 06, 1998. Site features and sample location at the Hamilton are shown in figure 22; photographs are shown in figures 22a , 22b, and 22c.

2.19.3.2 Soil

One soil/waste sample was collected. HHAW10H was a composite sample along the waste and soil being eroded by Hamilton Creek. The sample was composited over fourteen 4-ft intervals (a total of 56 ft). It consisted of sandy soil, light orange to minor gray in color, containing fragments of limestone/marble, and with lesser amounts of jasperoid and limonite vein material.

Both lead and zinc exceeded the phytotoxic levels (table 28). The high levels may have been the result of the mixture of waste, ore and soils instead of soil only.

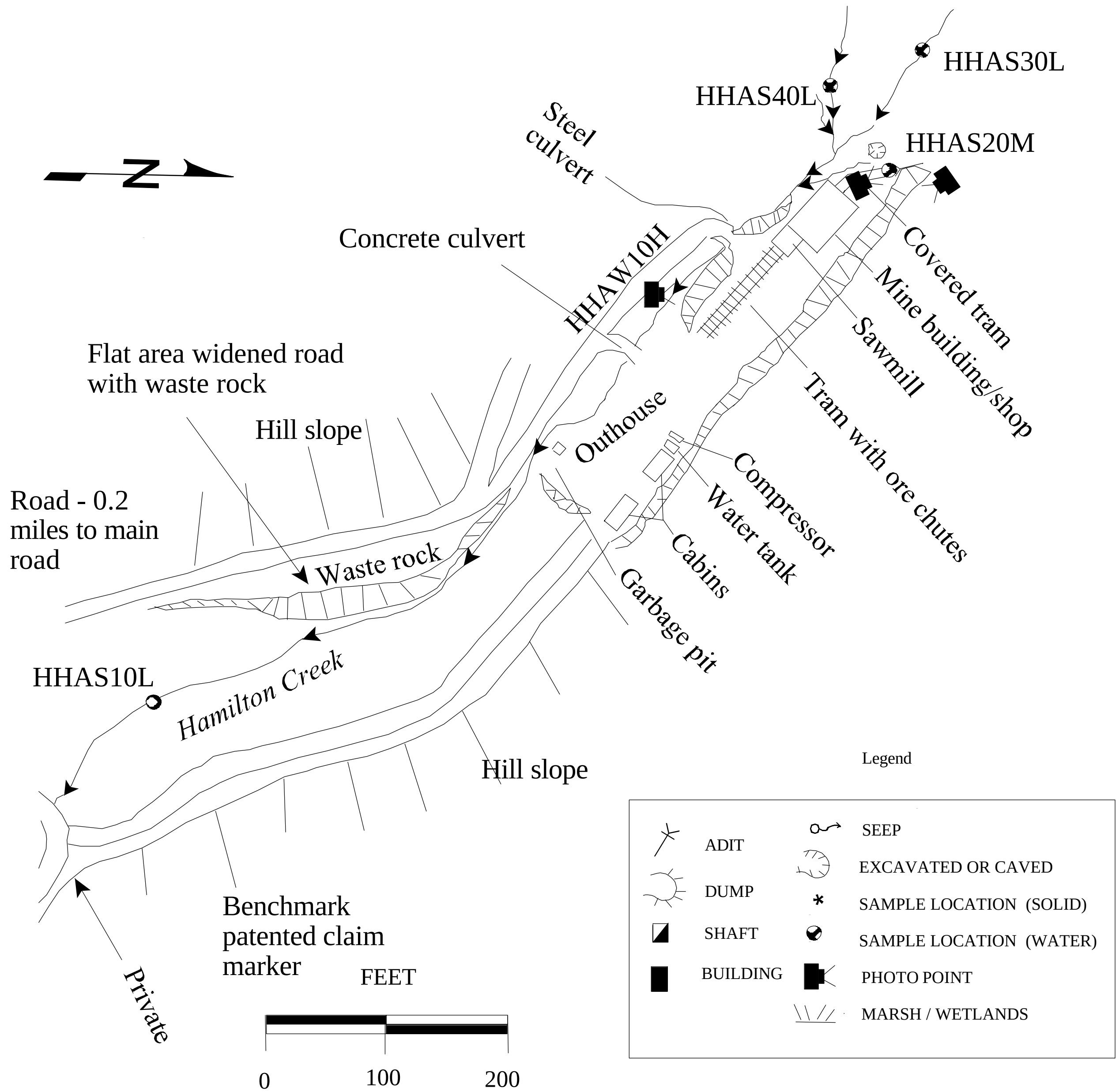


Figure 22. The Hamilton mine had both an adit discharge and a waste rock dump in contact with the creek, as mapped 05/06/98.

Figure 22a. The Hamilton Mine was a very complete mine site when visited on 05/06/98. Two cabins, the main mine building (shop and sawmill) and loading platform were all intact. The unique, covered tram had one wall that had collapsed but was otherwise in good condition. The adit was partially open but was secured by a locked gate.

Figure 22b. The waste rock dump contacted Hamilton Creek but the rock consisted primarily of limestone and marble. Waste sample HHAW10H was composited along 50 ft of the area in contact with the creek.

Figure 22c. The adit was open at least for 20 ft and was partially caved beyond that distance, on 05/06/98. The timbers were in good shape.

Table 28. Soil sampling results at the Hamilton Mine (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Soils (HHAD10H)	60.2[1]	4.5[1]	67.6[1]	826[1,2]	2,919[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 concentrations of analytes in the upstream samples (HHAS30L and HHAS40L) exceeded no water-quality standards (table 29). The adit discharge and downstream samples not only did not exceed any water quality standards but they also did not show any great increases in metals' levels. The adit discharge had very slight increases in metals (Ba, Cr, Ni, and Zn) content but they were not close to exceeding water-quality standards. The specific conductance also increased slightly in the adit discharge sample (from approximately 40 µmhos/cm to about 200 µmhos/cm) but this is not a significant increase. The pH values of all four samples were within acceptable limits and showed no great variation.

Table 29. Water-quality exceedences at the Hamilton Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
HHAS10L-upstream																			
HHAS20L-upstream																			
HHAS30M-adit discharge																			
HHAS40L-downstream																			

Note: The analytical results are listed in appendix IV.

2.19.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted. Some physical disturbances were noted. Vegetation had begun to regrow in the mined areas.

2.19.3.5 Summary of Environmental Conditions

The mining activity at and near the Hamilton Mine did not greatly impact the environment. The buffering capacity of the limestone and marble associated with the mine may have some effect.

2.19.4 Structures

Structures associated with the Hamilton Mine included a large sawmill/mine maintenance/ tramway building. A tramway/loading platform was connected with the main mine building. Two cabins were present when visited in 1998 as well as an outhouse along the creek.

2.19.5 Safety

The adit was physically open but was secured by a locked gate when visited in 1998. The walls of the covered tram were partially collapsed, probably due to snow loading. The main mine building was in good condition. A door led out to the uncovered portion of the tramway and loading platform, and the platform was possibly a hazard.

2.20 Powderly (Silver Spoon) Mine

2.20.1 Site Location and Access

The Powderly (Silver Spoon) Mine is located on the north bank of Robinson Creek in ADDD sec. 12 , T8N, R8E and is accessed by following a rough two-track road that begins where Forest Service road 581 crosses the creek. The site is on LCNF-administered land.

2.20.2 Site History-Geologic Features

The ore body at the Powderly Mine was discovered about 1887. Two veins occupy fractures that strike N55-59°W and dip 77-87°SW (Winters, 1968). Each is 2–3 ft wide, consisting chiefly of jasper containing large cubes of galena (Roby, 1950). Only the southernmost vein has been prospected. It was developed by a shaft and by an adit that intersects the vein between the 50- and 60-ft level. Only one stope, just west of the main shaft, was mined from this adit (Winters, 1968). In the early 1960's, the eastern end of the vein was stripped and a 16-ton sample was shipped. The metal content of the ore was low and showed that some upgrading would be required to produce a suitable product (Winters, 1968).

The site was visited in June 1998 and a map was prepared (figure 23). The main adit is partially collapsed at the portal but is still accessible. The shaft on the slope above the adit is open, but has a fence around it. The workings to the east were collapsed.

2.20.3 Environmental Condition

The site appears to have only a minor environmental impact. Two waste dumps in the flood plain of Robinson Creek are in direct contact with the creek. Less than 5% sulfides were noted on the waste dumps; primarily limestone and jasper are present.

2.20.3.1 Site Features-Sample Locations

Upstream (RPOS10L) and downstream (RPOS20L) water-quality samples were collected from Robinson Creek on June 23, 1998. Also, a composite soil sample (RPOD20L) was taken at the bases of the two dumps where they contact the creek. Another soil sample was taken earlier during the initial visit (RPOD10H) and was a composite along basically the same area. It was used as a duplicate, check sample. Sample locations are shown on figure 23; photographs of the site are shown in figures 23a and 23b.

2.20.3.2 Soil

The analysis of sample RPOD20L shows that the lead concentration in the soil/waste rock adjacent to the creek is well above the phytotoxic level of 1,000 mg/kg (table 30). The concentration of zinc also is elevated but is slightly below the phytotoxic level of 500 mg/kg. The second sample taken measured just above the phytotoxic limit.

Table 30. Soil sampling results (mg/kg) for the Powderly Mine.

Sample Location	As	Cd	Cu	Pb	Zn
Waste rock/soil-RPOD10H	15.7[1]	4.86[1]	65.3[1]	4.666[1,2]	572[1,2]
Streamside waste-rock dumps RPOD10L	14.8[1]	3.11[1]	31.9[1]	12,600[1,2]	420[1]

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

2.20.3.3 Water

On the day the site was sampled, Robinson Creek was flowing at approximately 6.5 cfs. The watercourse was not stained with precipitates, and there was no evidence of any other effects from mining (table31). Aluminum concentrations in the samples collected from the creek ranged from 43 to 46 µg/L, close to the secondary drinking water standard of 50 µg/L; however, the source of the aluminum does not appear to be the mine.

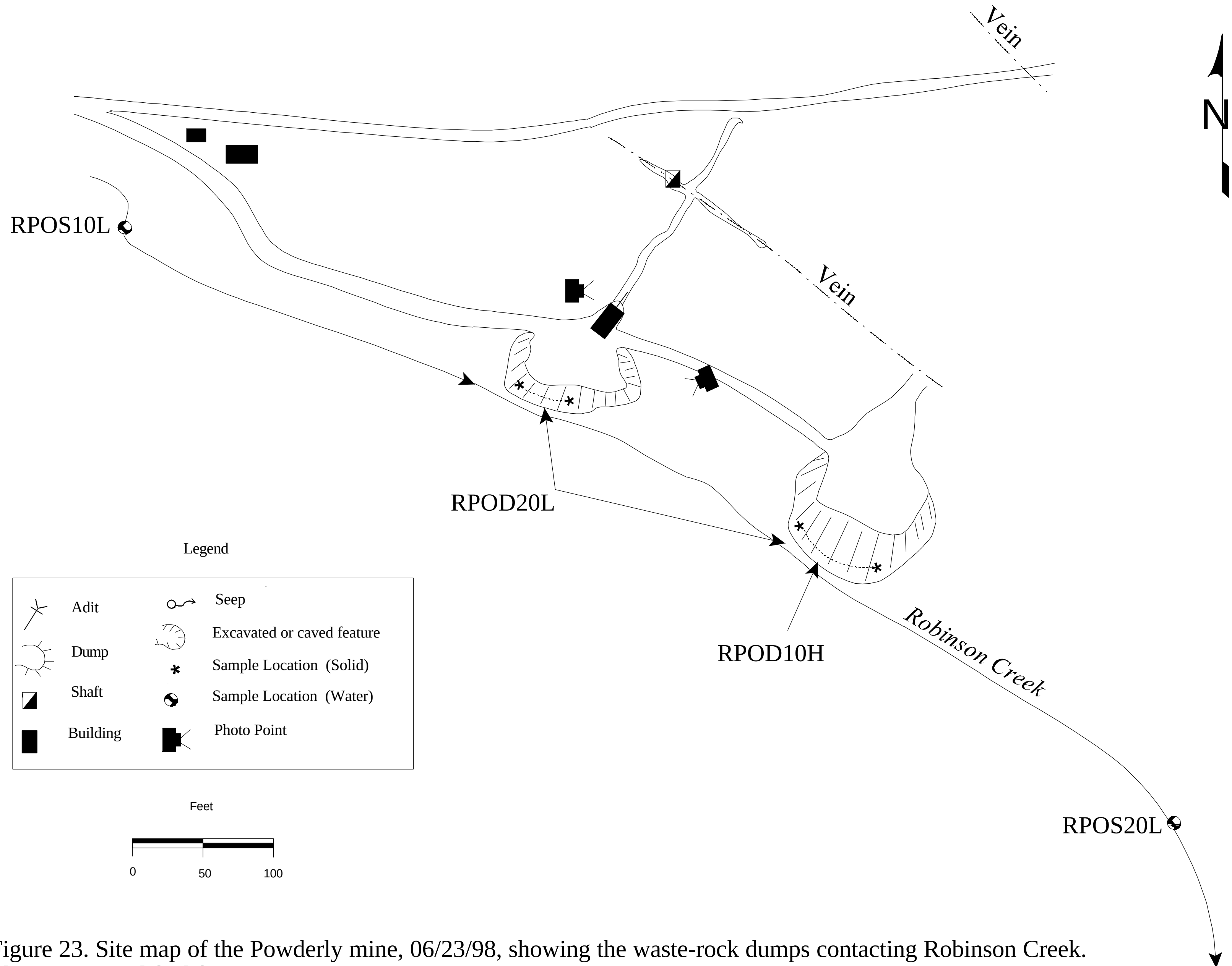


Figure 23. Site map of the Powderly mine, 06/23/98, showing the waste-rock dumps contacting Robinson Creek. The map is modified from Winters (1968).

Figure 23a. Robinson Creek flows adjacent to the Powderly Mine's waste-rock dumps.

Figure 23b. The portal of the main adit at the Powderly has partially collapsed but an open crawl space still exists.

Table 31. Water-quality exceedences at the Powderly Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
HBCS10L-upstream																			
HBCS40L-downstream of all																			

Note: The analytical results are listed in appendix IV.

2.20.3.4 Vegetation

Grasses grew along the flood plain of Robinson Creek. Outside the flood plain, lodgepole pine and Douglas fir were abundant. The waste-rock dumps were moderately vegetated with grasses, young fir trees, and some sage brush.

2.20.3.5 Summary of Environmental Condition

The waste rock and soil next to Robinson Creek contained elevated concentrations of lead and, to a lesser extent, zinc. During high water events, this material was eroded by the creek. Although the water samples from the creek did not contain high concentrations of dissolved metals, the sediment within the creek may still be contaminated and have an impact on aquatic life.

2.20.4 Structures

Two log cabins, a mine building, and an ore bin are located at the site. One cabin was in good condition and had a fence around it to exclude cattle; the second cabin was in fair condition and was sided with asphalt rolled paper. The mine building has collapsed.

2.20.5 Safety

The main adit was partially collapsed at the portal but is still accessible through a crawl space. The open shaft on the hillside above the adit has been fenced. The area is not highly visible but probably does have a few visitors each year.

2.21 Cumberland Mine

2.21.1 Site Location and Access

The Cumberland Mine (and smelter site) is easily visible from Forest Road 581. The mine is located west of the road and Castle Creek. It is accessed by an improved gravel road (Forest Road 581) from the small town of Lennep which is southwest of Martinsdale on Highway 294. The mine is approximately ½-mile northwest of the privately owned ghost town of Castle. The majority of land associated with the Cumberland has been patented but small fractions of LCNF-administered land surround the mine area. It is within the Castle Town 7.5-min. quadrangle (sec. 14, T8N, R8E) at elevations of 6,320–6,520 ft.

2.21.2 Site History-Geologic Features

The Cumberland Mine, in the Castle Mountain mining district, was the largest producer of lead ore in Montana in 1891 (Roby, 1950) and was the largest producer in the district, overall. It was discovered in 1884; mining began in 1888, but large-scale operations ceased in 1893. The area was explored and/or mined until at least the 1950's. Roby (1950) estimated that 18–20 million pounds of lead and approximately 615,000 ounces of silver came from the Cumberland. Production fell off further after 1932; the entire district produced a total of 242 tons of ore yielding 113,932 pounds of lead with 1,500 pounds of copper, 1,500 pounds of zinc, 2,122 ounces of silver, and 1.0 ounce of gold (Roby, 1950).

The ore came from the Madison limestone where it was intruded by igneous rocks or from fractures in the limestone (Roby, 1950). Ore minerals included argentiferous galena and cerussite, hosted by pyrite-bearing jasper (Roby, 1950).

2.21.3 Environmental Condition

Most of the potential environmental problems and physical disturbances are on patented land. The site was sampled because of the surrounding LCNF-administered land. Pioneer Technical Services (1995) sampled on the private land. They found “observed releases” of manganese and lead to the surface water and chronic fresh water aquatic life criteria for lead and mercury were exceeded in the downstream sample. The slag pile where the old smelter stood is not in direct contact with Castle Creek.

2.21.3.1 Site Features-Sample Locations

Water-quality samples were collected from two sites upstream (CCUS10M and CCUS20L) and one downstream (CCUS40L) of the site on LCNF-administered land. One spring to the west of the site was sampled (CCUS30L). Samples were collected on July 30, 1998. Additional samples were not collected because of the private land position. Site features and sample locations are shown in figure 24; a panorama photograph is shown in figure 24a.

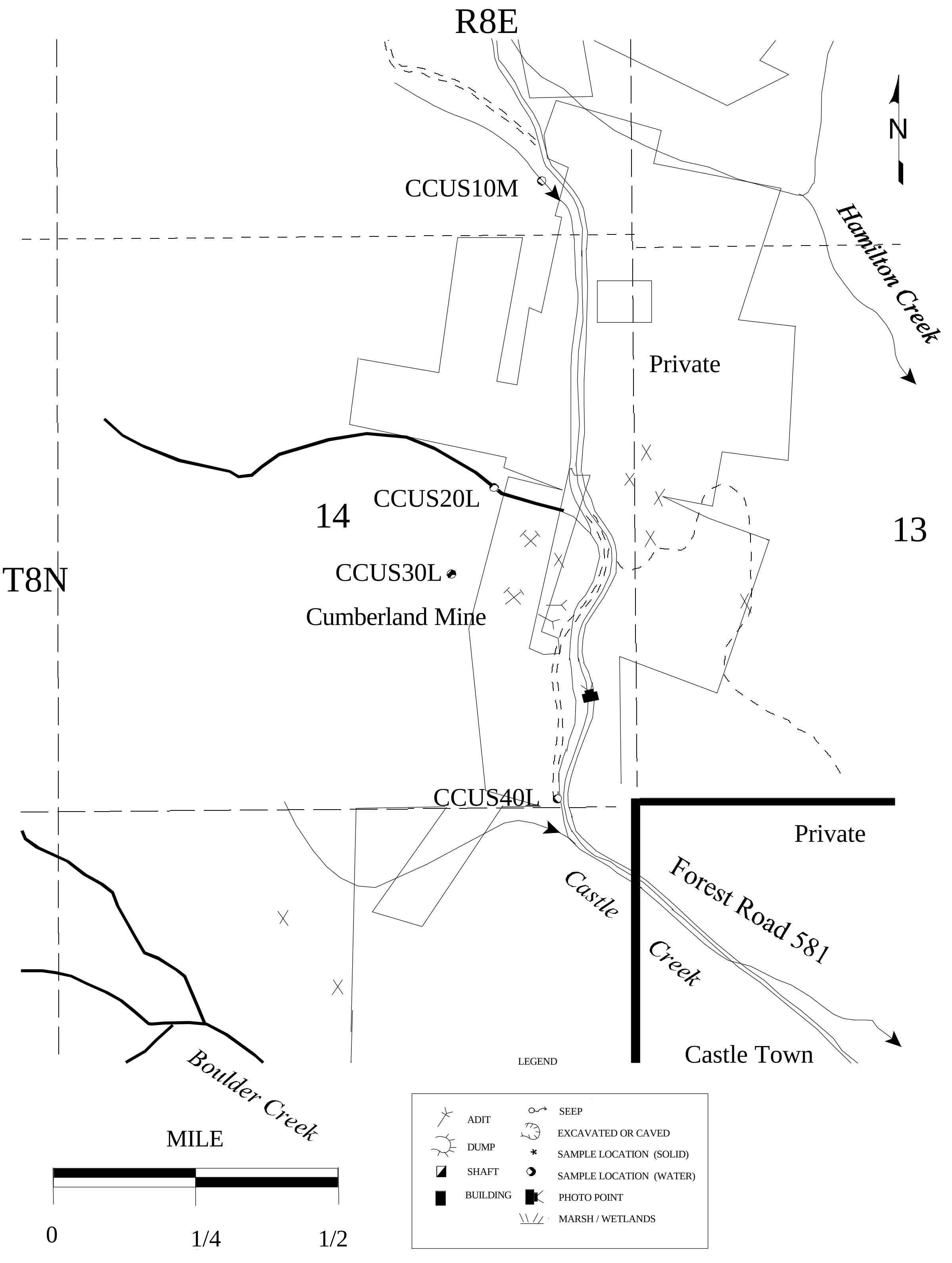


Figure 24. The Cumberland mine was on private land but was evaluated by sampling upstream and downstream on LCNF-administered land, on 05/12/98.

Figure 24a. The black slag on patented land did not directly contact Castle Creek, however, runoff from the slag and waste piles could possibly affect LCNF-administered land. The site is readily visible from Forest Road 581.

2.21.3.2 Soil

No soil samples were collected because all soil and waste were on patented land.

2.21.3.3 Water

The concentrations of analytes in none of the samples taken associated with the Cumberland exceeded any water quality standards (table 2 and table 32). Most of the metals' levels were at or near the detection limits for analyses. The specific conductance measured from 33 µmhos to 120 µmhos with the highest measurement for the upstream sample. The pH values of the samples ranged from 7.65 to 8.06.

Table 32. Water-quality exceedences at the Cumberland Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
Castle Creek-upstream																			
West trib to Castle Crk																			
Spring to west																			
Castle Creek-downst.																			

Exceedence codes:

Note: The analytical results are listed in appendix IV.

2.21.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted by the mining activity. Very little LCNF-administered land was associated with this site. Most of the patented claims in the area had been recently clearcut.

2.21.3.5 Summary of Environmental Conditions

LCNF-administered land is only slightly affected by the mining activity in the area. Most of the public land is upstream and to the west of this site.

2.21.4 Structures

All structures are on private property and were not evaluated or inventoried. The view from the road indicates at least one building remained standing.

2.21.5 Safety

The private portion of the site was not evaluated for safety by this study. Pioneer Technical Services (1995) did note two open shafts on the private portion of the property, one of which had a collapsed fence surrounding it. No other concerns were noted on LCNF-administered land.

Mines in the Judith River Drainage

2.22 Blue Dick Mill

2.22.1 Site Location and Access

The Blue Dick Mill is located on the Bandbox Mountain 7.5-min. quadrangle in AADC sec. 31 T14N R10E. The Blue Dick Mill processed ore from the Blue Dick Mine located up the slope from the mill. The site is within 500 ft of Forest Service Route 266 but is not visible from the road. A faint track leads up to the mine but it is overgrown and must be walked.

2.22.2 Site History-Geologic Features

The ore from the Blue Dick Mine was originally milled at an arrastra near Yogo when the mine was first worked in the 1890's. The mine is located on patented claims. Ore was mined from a contact zone between the Madison limestone and a syenite porphyry (Robertson and Roby, 1951). Ore minerals included magnetite, with lesser pyrite and chalcopyrite. The deposit was considered to be a copper-gold-iron type occurrence.

The Blue Dick Mill, a 50-ton per day gravity-flotation plant, was built in1943 (Robertson and Roby,1951). Initially, the mine and mill were connected by a surface tram but a road connecting the two was built after the tram did not work satisfactorily. Reportedly, 329 ounces of gold, 3,231 ounces of silver, and 23,667 pounds of copper was produced from 702 tons of ore and concentrate between the years of 1937 to 1946 (Robertson and Roby, 1951). This mill was described by Robertson and Roby (1951) as being “one-quarter of a mile southeast of the mine and about 500 ft lower in altitude.” It processed copper carbonate ore.

2.22.3 Environmental Condition

No large piles of tailings were noted at the site. The small intermittently flowing creek flowed clear and cold past the ruins of the mill. Several springs were found in the area but the water dissipated into the ground quickly, and the water never appeared to reach the active Elk Creek drainage at the surface.

2.22.3.1 Site Features-Sample Locations

Water-quality samples were collected from upstream (EBDS10H) and downstream (EBDS20H) of the site on LCNF-administered land. The flow rates at these locations were approximately 2 gpm and <1 gpm, respectively. Upstream, the unnamed tributary to Elk Creek had a pH of 8.5 and specific conductance was 274 µmhos/cm. Downstream, just before the water infiltrated into the ground, the pH was 7.42 and specific conductance was 273 µmhos/cm. Samples were collected on October 13, 1998. More samples were not collected because of the small nature of the site. Site features and sample locations are shown in figure 25; photographs are shown in figures 25a and 25b.

2.22.3.2 Soil

Two soil/waste samples were collected (table 33). EBDD10H was a composite sample along the waste and soil to the northeast of the small intermittent tributary along the waste dump. EBDT10H was taken of a very fine-grained, black solid material found in a small pile at the base of the waste dump. The patch was only 2–3 in. thick and has abundant shiny flecks that may have been sulfides. The analyses of the black solid showed a high copper content and may be a small patch of concentrate from the mill. It had 60 times the phytotoxic concentration level. The soils along the creek also had an elevated copper content; they had nine times the phytotoxic concentration.

Table 33. Soil sampling results at the Blue Dick Mill (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Soils/waste (EBDD10H)	12.6[1]	<9.6[(?)1]	907[1,2]	40.2[1]	76.3[1]
Black, undetermined solid (EBDT10H)	3.39	<4.4	6,230[1,2]	6.16[1]	75.6[1]

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).

(2) Exceeds phytotoxic levels (table 3).

2.23.3.3 Water

The concentrations of analytes in the upstream sample (EBDS10H) did not exceed any water quality standards (table 2 and 34). The analytical results were very similar both upstream and downstream. The only exceedence was that of the field pH measurement that was measured as 8.5; the lab pH was 7.42, however.

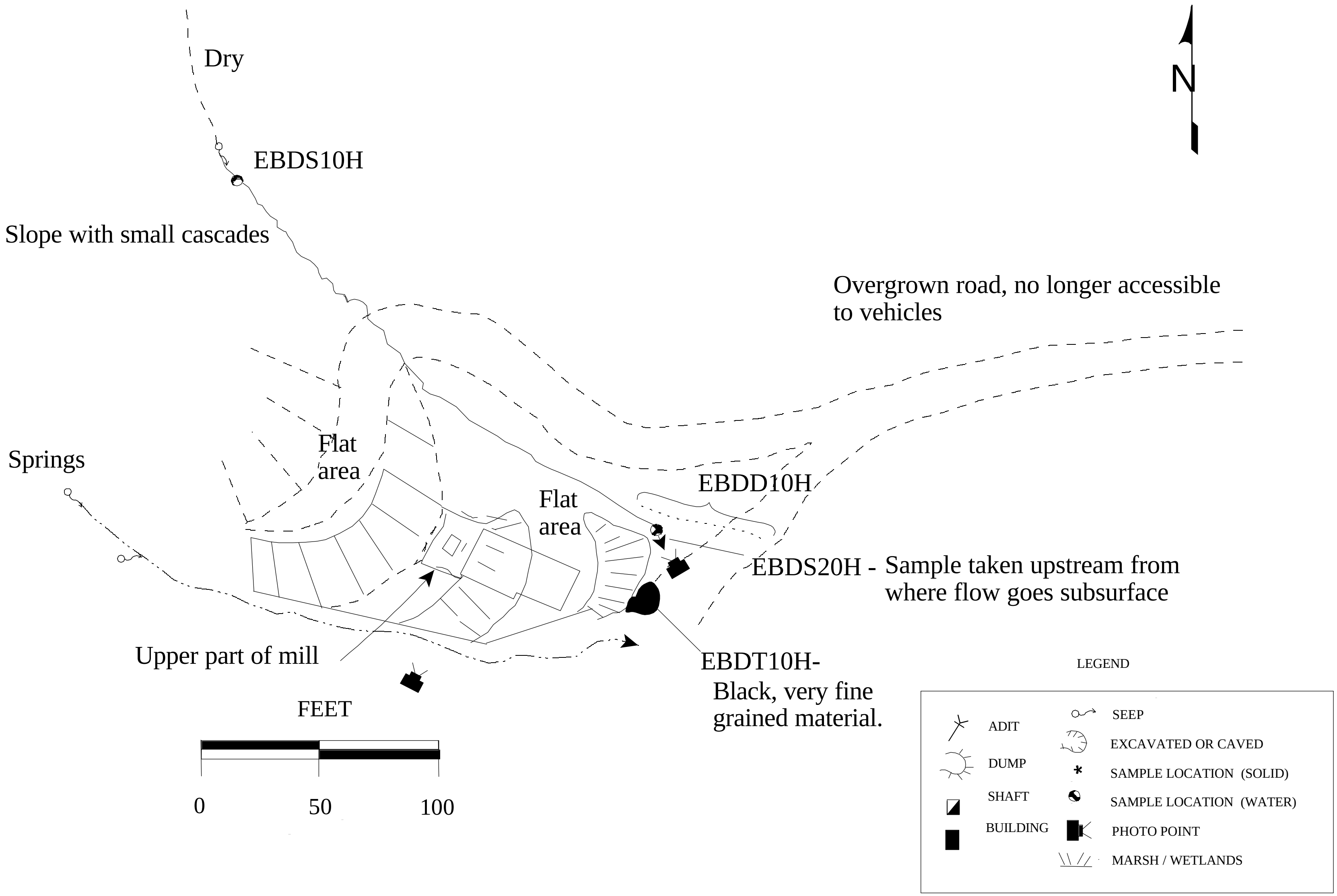


Figure 25. The Blue Dick mill laid in ruins in the small drainage formed by springs and ephemeral runoff. The drainage eventually joins Elk Creek but was not flowing at the surface when mapped on 10/13/98.

Figure 25a. Lumber, concrete foundations and some scattered junk mark the remains of the Blue Dick Mill. It lies in the drainage formed by springs in an unnamed tributary to Elk Creek.

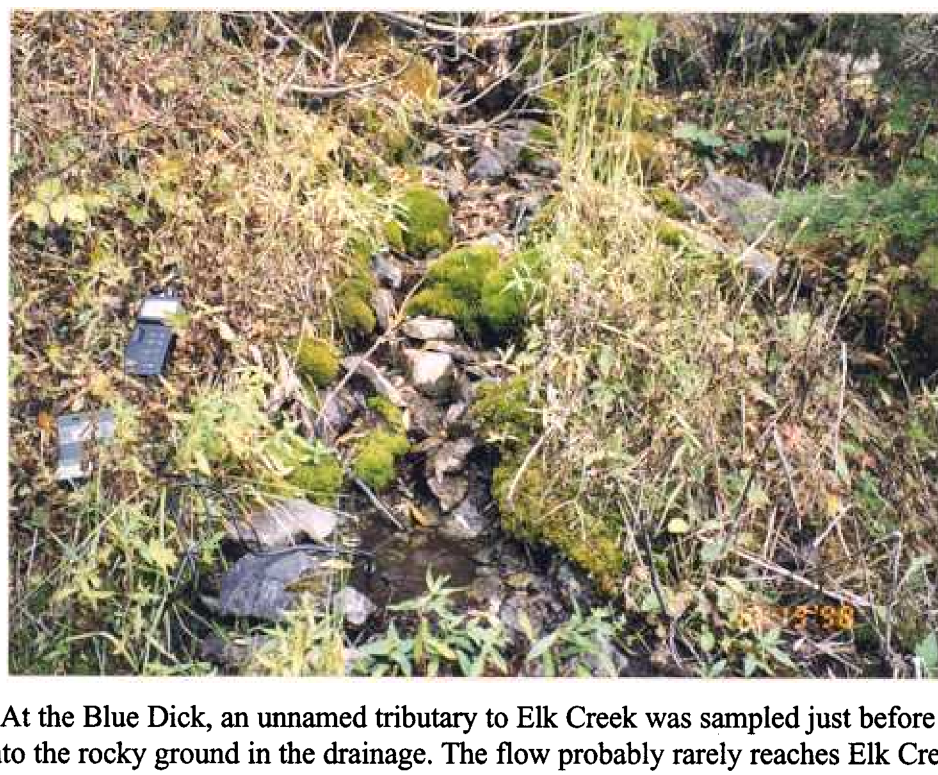


Figure 25b. At the Blue Dick, an unnamed tributary to Elk Creek was sampled just before it infiltrated into the rocky ground in the drainage. The flow probably rarely reaches Elk Creek.

Table 34. Water-quality exceedences at the Blue Dick Mill.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
EBDS10H-upstream																			
EBDS20H -downstream																			S*

(*) field pH exceeded the secondary MCL, but the lab pH did not.

Note: The analytical results are listed in appendix IV.

2.22.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted by the site. Small spruce and fir trees grew up to the edge of the mill site. Small trees have started to grow up through the ruins of the mill. Grasses grew along the creek banks and mosses grew on the rocks in the creek.

2.22.3.5 Summary of Environmental Conditions

The mill site posed no evident environmental problems. The metal junk and piles of boards were the only reminders of the site. The area disturbed by the milling operation is less than one acre. No tailings were identified except for the possible small pile of concentrate. Most of the waste at the site is a gray limestone. The waste occurs as large blocks.

2.22.4 Structures

The Blue Dick Mill has totally collapsed and a large haphazard pile of boards remains. The concrete foundations that supported the engines remain. No walls remain standing. The tram that once connected the mill with the Blue Dick Mine is not longer discernible.

2.22.5 Safety

The site is entirely on LCNF-administered land. The topography is steep and the area of the collapsed mill may pose a slight threat to safety. The site is not visible from the main road but is probably visited by a few hunters and hikers each year.

2.23 Ben Franklin Mine

2.23.1 Site Location and Access

The Ben Franklin Mine is located on the Yogo Peak 7.5-min. quadrangle in sec. 36, T14N, R9E.

Forest Route 266 leads up Yogo Gulch and then to Elk Saddle. Forest Route 251 then heads west toward Yogo Peak and a small two-track road turns south (Forest Route 6526). This road becomes progressively less passable and turns east to the small mine on the Lead Gulch drainage. It is accessible by 4-wheel drive vehicle (with difficulty) or by walking the old road from the surface trench. It appeared that the area had been recently explored and the road had been cleared but is very steep.

The ownership of the land was uncertain. The location of the patented claims plotted on the ridge, but no workings were noted where they were drawn on the topographic map. A surface trench and a recent surface excavation to the east of the trench were found where a prospect symbol is located in the SW¼ sec. 36 on the topographic map. The adit and waste dump were found by walking east and then north down the steep road from the surface excavation. The adit was estimated to be at 7,560 ft elevation and the trench was at 7,910 ft elevation. This difference would fit the description of the workings that were found in literature.

2.23.2 Site History-Geologic Features

This mine was termed the Ben Franklin although the identification was based on Robertson and Roby (1951) who described the group of claims roughly in this area. There are three patented claims (Sarsfield, Sheridan and Ben Franklin) that plot on the Yogo Peak 7.5-min. quadrangle to the north of this area. The patented claims were owned at one time by Charles and Mildred Goyins of Stanford, and Gordon and Edna Trimmer of Lewistown (1975). An assay of a sample taken in the 1940's by the U.S. Bureau of Mines was reported as 0.99% copper, 0.01% tungsten trioxide, 0.035 opt gold, and 0.25 opt silver (Robertson and Roby, 1951).

The mine was located at the contact of the Madison limestone and a granite intrusive. An unpublished letter from Mr. Chas. Goyins stated that the 452 ft adit was driven entirely in granite. The shaft was 65 ft deep and was caved in 1975.

2.23.3 Environmental Condition

This is a fairly small site with a stream (Lead Gulch) in contact with the waste dump for approximately 95 ft. No sulfides were noted in the waste rock but the stream was moderately to highly iron stained. The total area of disturbance was less than two acres.

2.23.3.1 Site Features-Sample Locations

Water-quality samples were collected from upstream (LBFS20L) and downstream (LBFS10L) of the site on LCNF-administered land. The flow rates at both these locations were 15 gpm. Samples were collected on October 15, 1998. One soil/waste sample was taken along the edge of the waste dump where it contacted Lead Creek. A composite was taken every two paces for 20 intervals representing approximately 50 ft. Site features and sample locations are shown in figure 26; photographs are shown in figure 26a and 26b.

2.23.3.2 Soil

One waste/soil sample was collected. LBFD10H was a composite sample along the waste being eroded by Lead Gulch (table 35).

Table 35. Soil sampling results at the Ben Franklin Mine (mg/kg).

Sample Location	As	Cd	Cu	Pb	Zn
Soils (LBFD10H)	11.2[1]	<5.6[1]	1,410[1,2]	17.4[1]	89.4[1]

(1) Exceeds one or more Clark Fork Superfund background levels (table 3).
(2) Exceeds phytotoxic levels (table 3).

2.23.3.3 Water

The concentrations of analytes in neither the upstream sample (LBFS20L) nor the downstream sample exceeded any water-quality standards (table 2). Most of the analytes were near detection limits and were well below the water-quality limits. The field pH in the upstream sample was 7.37 and in the downstream sample was 7.85. The specific conductance in the upstream sample, as measured in the field, was 45 µmhos and downstream was 50µmhos.

Table 36. Water-quality exceedences at the Ben Franklin Mine.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
LBFS20L-upstream																			
LBFS10L-downstream																			

Exceedence codes:

Note: The analytical results are listed in appendix IV.

2.23.3.4 Vegetation

Vegetation on LCNF-administered land does not appear to be impacted by the mining activity. The site was visited in late-fall and a recent snow had covered much of the vegetation. Mosses and small aquatic plants grew in the stream and along the banks. No dead or dying trees were noted.

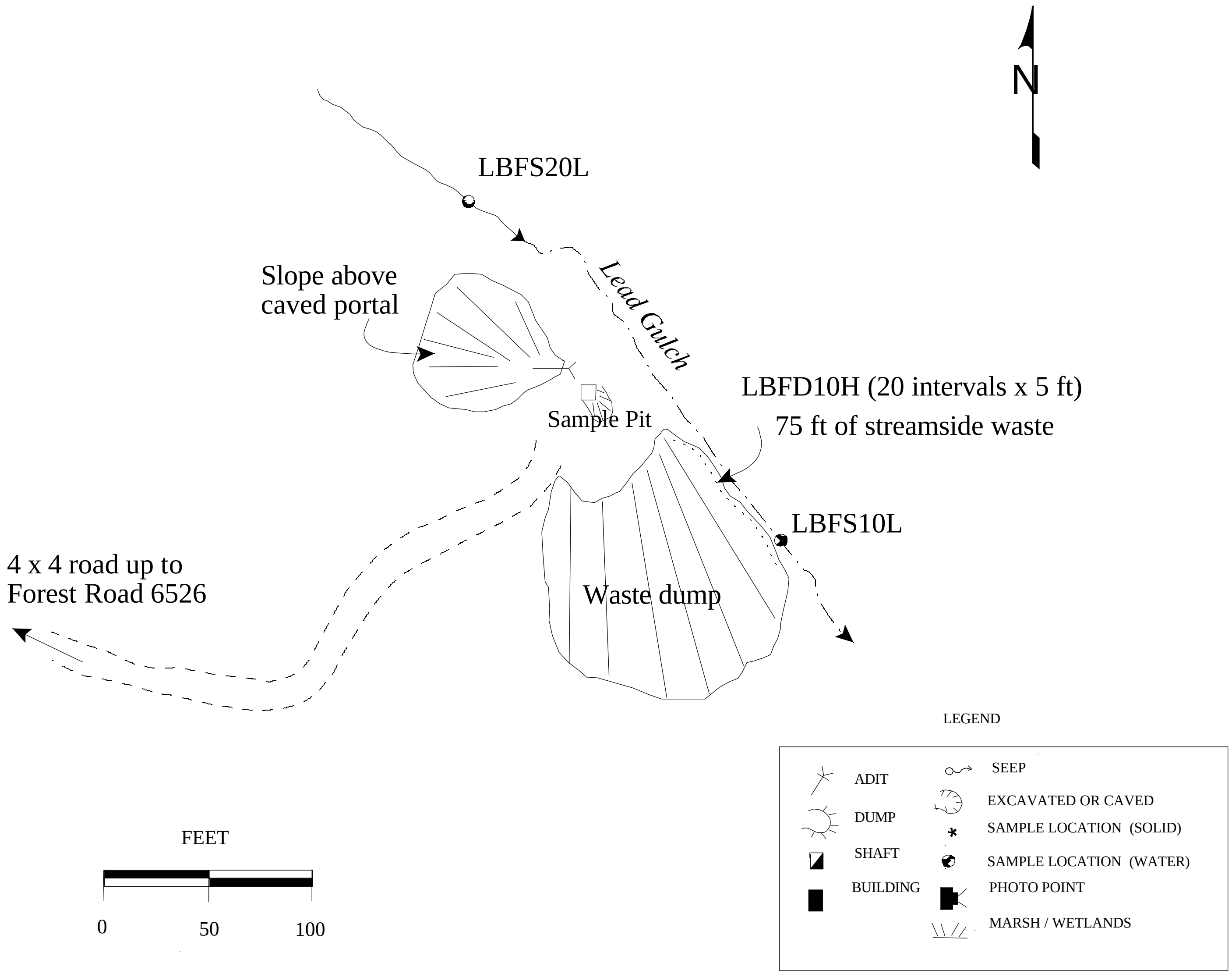


Figure 26. The Ben Franklin Mine was tucked away along Lead Gulch; the creek appeared to have been re-routed during the mining operations, as mapped 10/15/98.

Figure 26a. The Ben Franklin Mine appeared as if recent exploration had been attempted. A small pit (5 ft by 8 ft) had been dug on top of the waste dump.

Figure 26b. At the Ben Franklin, small conifer trees grew on the waste dump (left) and Lead Gulch was in contact with the waste dump for approximately 95 ft.

2.23.3.5 Summary of Environmental Conditions

This is a small property. No significant change in water quality was noted downstream from the mine.

2.23.4 Structures

No structures were noted at the site. There was no evidence that any structures ever existed at the site.

2.23.5 Safety

The 5 ft deep and 8 ft diameter pit was a potential safety concern. It appeared to be a recent test pit for exploration. The site was remote, but the possibility exists that a vehicle could back into the pit.

2.24 Summary of the Belt Creek, Musselshell, Judith and Smith River Drainage

Most of the mine and mill sites exhibiting a potential to cause environmental problems on LCNF-administered land are in the Neihart and Barker/Hughesville mining districts which drain into Belt Creek and the Dry Fork Belt Creek and are associated with the veins in the pre-Belt Pinto diorite, Snow Creek porphyry and other intrusives. One hundred and one sites were located in the Dry Fork Belt Creek and Belt Creek drainages; 74 were on private land and 27 are on a mixture of public/private or all public land. Of the 21 sites that have a potential to adversely affect soil or water quality on LCNF-administered land in this area, 19 are on private land and only 3 are on mixed private/public or all public land. Many of the sites in the Neihart and Barker/Hughesville districts were discharging water to nearby streams (faults are associated with many of the mines); several had waste material in contact with the stream. The relative severity of the impacts to LCNF-administered land in this area was generally localized.

Repeated visits to some sites exemplify the need for multiple sampling events. For example, some mine sites had small discharges when Pioneer Technical Services studied them but had none when MBMG visited them.

An accurate assessment of the cumulative impact of mining in this area on the drainage would require extensive sampling on private land. Only three samples were taken on the Dry Fork of Belt Creek. No upstream sample could be taken because all land upstream was private and the upper reaches of the drainage were dry. One small LCNF-administered land fraction provided access for sampling on Galena Creek. The analyses showed that the water at this sample site was already impacted. Sampling on private land also would be necessary to determine the impact of the mining upstream. The Neihart area was also sampled at public access sites and mines were assessed as a group with relative results for an area. Table 17 lists the mines considered in this report. The exceedence of one or more MCLs is noted for each site as well as the analyses for each sample.

Other drainages in the Musselshell, Judith and Smith rivers' watersheds also have clusters of mines and mills, but overall the impacts are local. The Castle Mountain mining district and Yogo mining district have had long histories of mining. Mines in these areas tend to be small and local in their effects.

Table 37. Summary of water-quality exceedences in the Belt Creek, Musselshell, and Judith river drainages.

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
Silver Dyke Mine	SAC			PAC		SAC		PAC	S				SAC				P		S
Double X Mine	S					AC			S				AC						S
Haystack Iron spring							SA		S				AC		S				
Haystack Creek Mine													AC						
Big Seven Mine				C					S				AC						
Carpenter Creek tails	S			C		AC			S				AC						S
Eighty-eight Mine						C			S				AC						
Compromise Claim																			
Moulton	S			PAC				C					SAC						
Neihart Tailings	S			C					S				AC						
Lucky Strike				PAC		AC	SA		S				SAC						S
Block 'P' Tailings				PAC					S				AC						
Dry Fork-lower tails									S				AC						
Dr. Barnette's copper																			
Belle of the Castle																			
Powderly																			

Sample Site	Al	As	Ba	Cd	Cr	Cu	Fe	Pb	Mn	Hg	Ni	Ag	Zn	Cl	F	NO_3	SO_4	Si	pH
Unnamed sec. 2																			
Unnamed sec. 11																			
Hamilton Mine																			
Cumberland Mine																			
New Deal & Kids Dream																			
Blue Dick Mill																			S
Ben Franklin, etc.																			

Exceedence codes:

P-Primary MCL
S-Secondary MCL
A-Aquatic Life Acute
C-Aquatic Life Chronic

Note: The analytical results are listed in appendix IV.

References

Alden, W.C., 1953, Physiography and glacial geology of western Montana and adjacent areas: U.S. Geological Survey Professional Paper 231, 200 p., plus plates.

Anonymous, [n.d.]., Mineral properties files: Montana Bureau of Mines and Geology, Montana Tech of The University of Montana.

Armstrong, R.L., Harakal, J.E., and Hollister, V.F., 1982, Eocene mineralization at Mount Tolman (Keller), Washington, and Silver Dyke, Montana: Isochron/West, No. 33, p. 9.

Ayres, H.B, 1899, Lewis and Clarke Forest Reserve, Montana: U.S. Geological Survey Twenty-first Annual Report Part 5, 80 p.

Baker, D.W., and Berg, R.B., technical editors, 1991, Guidebook of the central Montana alkalic province. Geology, ore deposits and origin: Montana Bureau of Mines and Geology Special Publication 100, 201 p.

Bergantino, R.N., 1978, Average annual temperatures–Montana, unpublished map. Montana Bureau of Mines and Geology, Butte.

Blumer, J.W., 1971, Geology of the Deadman Canyon-Copperopolis area, Meagher County, Montana: Montana College of Mineral Science and Technology, Butte, unpublished M.S. thesis, 68 p., 3 plates.

Bondurant, K.T., and Lawson, D.C., 1969, Directory of mining enterprises, 1968: Montana Bureau of Mines and Geology Bulletin 72, 64 p., plus plate.

Clabaugh, S.E., 1952, Corundum deposits of Montana: U.S. Geological Survey Bulletin 983, 100 p., 6 plates.

Crowley, F.A., 1961, Directory of known mining enterprises, 1960: Montana Bureau of Mines and Geology Bulletin 20, 67 p., plus plate.

Crowley, F.A., 1962, Directory of known mining enterprises, 1961: Montana Bureau of Mines and Geology Bulletin 25, 75 p.

Dahl, G.G. Jr., 1969, General geology of the area drained by the North Fork of the Smith River; Meagher County, Montana: Montana College of Mineral Science and Technology, Butte, unpublished M.S. thesis, 58 p., 2 plates.

Dahy, J.P., 1988, The geology and igneous rocks of the Yogo sapphire mine and the surrounding area, Little Belt Mountains, Judith Basin County, Montana: Montana College of Mineral Science and Technology, Butte, unpublished M.S. thesis, 92 p., 4 plates.

DeMunck, V.C., 1956, Iron deposits in Montana: Montana Bureau of Mines and Geology Information Circular 13, 55 p.

Earhart, R.L., Grimes, D.J., Leinz, R.W., and Marks, L.Y., 1977, Mineral resources of the proposed additions to the Scapegoat Wilderness, Powell and Lewis and Clark counties, Montana: U.S. Geological Survey Bulletin 1430, 62 p.

Earhart, R.L., Grimes, D.J., Leinz, R.W., Marks, L.Y., and Peterson, D.L., 1975, Mineral resources of the proposed additions to the Scapegoat Wilderness, Powell, and Lewis and Clark counties, Montana: U.S. Geological Survey Open-file Report 76-438, 106 p., plus plates. Scale 1:48,000.

Earhart, R.L., Mudge, M.R., Whipple, J.W., and Connor, J.J., 1981, Mineral resources of the Choteau 1° x 2° quadrangle, Montana. U.S. Geological Survey Miscellaneous Field Studies Map MF-858A. Scale 1:250,000 with text.

Garverich, M.R., 1995, Geology of the Spring Creek area, Meagher County, Montana: Montana Tech of The University of Montana, Butte, unpublished M.S. thesis, 67 p.

Geach, R.D., 1964, Directory of mining enterprises for 1963: Montana Bureau of Mines and Geology Bulletin 38, 71 p.

Geach, R.D., 1965, Directory of mining enterprises for 1964: Montana Bureau of Mines and Geology Bulletin 46, 81 p.

Geach, R.D., 1966, Directory of mining enterprises for 1965: Montana Bureau of Mines and Geology Bulletin 49, 87 p.

Geach, R.D., and Chelini, J.M., 1963, Directory of known mining enterprises, 1962: Montana Bureau of Mines and Geology Bulletin 33, 84 p., plus plate.

Gilbert, F.C., 1935, Directory of Montana mining properties: Montana Bureau of Mines and Geology Memoir 15, 100 p.

Godlewski, D.W., and Zieg, G.A., 1984, Stratigraphy and depositional setting of the Precambrian Newland Limestone in The Belt: Abstracts with summaries, Belt Symposium II, 1983, S. Warren Hobbs (ed.): Montana Bureau of Mines and Geology Special Publication 90, p. 2-4.

Groff, S.L., 1965, Reconnaissance ground-water and geological studies, western Meagher County, Montana: Montana Bureau of Mines and Geology Special Publication 35, 23 p., 1 plate.

Hansen, M., 1971, Directory of mining enterprises, 1970: Montana Bureau of Mines and Geology Bulletin 82, 59 p., plus plate.

Hargrave, P.A., Bowler, T.P., Lonn, J.D., Madison, J.P., Metesh, J.J., and Wintergerst, Robert, 1998, Abandoned-inactive mines of the Blackfoot and Little Blackfoot River drainages. Helena National Forest. Volume II: Montana Bureau of Mines and Geology Open-file Report 368, 182 p.

Hem, J.D., 1985, Study and interpretation of the chemical characteristics of natural waters: USGS Water-supply Paper 2254: 3rd Edition, 263 p., plus plates.

Hill, J.M., 1912, The mining districts of the western United States (with a geologic introduction by Waldemar Lindgren). U.S. Geological Survey Bulletin 507, p.181–198, 1 plate.

Koschmann, A.H., and Bergendahl, M.H., 1968, Principal gold-producing districts of the United States: U.S. Geological Survey Professional Paper 610, p.142–171.

Krohn, D.H., and Weist, M.M., 1977, Principal information on Montana mines: Montana Bureau of Mines and Geology Special Publication 75, 151 p.

Lawson, D.C., 1975, Directory of mining enterprises for 1974: Montana Bureau of Mines and Geology Bulletin 95, 66 p., plus plate.

Lawson, D.C., 1976, Directory of mining enterprises for 1975: Montana Bureau of Mines and Geology Bulletin 100, 63 p., plus plate.

Lawson, D.C., 1978, Directory of mining enterprises for 1977: Montana Bureau of Mines and Geology Bulletin 107, 59 p.

Lawson, D.C., 1979, Directory of mining enterprises for 1978: Montana Bureau of Mines and Geology Bulletin 109, 55 p., plus plate.

Lawson, D.C., 1980, Directory of mining enterprises for 1979: Montana Bureau of Mines and Geology Bulletin 111, 52 p.

Lawson, D.C., 1984, Directory of Montana mining enterprises for 1983: Montana Bureau of Mines and Geology Bulletin 121, 57 p.

Lindsay, W.L., 1979, Chemical equilibria in soils. New York, N.Y.: John Wiley & Sons. 449 p.

Lyden, C.J., 1948, The gold placers of Montana: Montana Bureau of Mines and Geology Memoir 26, 152 p.

Lyden, C.J., 1987, The gold placers of Montana: Montana Bureau of Mines and Geology Reprint 6, 120 p.

Madison, J.P., Lonn, J.D., Marvin, R.K., Metesh, J.J., and Wintergerst, Robert, 1998, Abandoned-inactive mines program. Deerlodge National Forest. Volume IV. Upper Clark Fork River drainage: Montana Bureau of Mines and Geology Open-file Report 346, 156 p.

Maest, A.S., and Metesh, J.J., 1994, Butte ground water injury assessment report–Clark Fork River basin NPL sites, Montana: Montana Department of Health and Environmental Sciences, December 1994, 120 p.

Marvin, R.K., Metesh, J.J., Lonn, J.D., Madison, J.P., and Wintergerst, Robert, 1995, Abandoned-inactive mines program. Deerlodge National Forest. Volume III. Flint Creek and Rock Creek drainages. Final report to U.S. Department of Agriculture, USFS, Butte: Montana Bureau of Mines and Geology, 174 p.

Marvin, R.K., Metesh, J.J., Hargrave, P.A., Lonn, J.D., Watson, J.E., Bowler, T.P., and Madison, J.P., 1998, Abandoned-inactive mines of the Beaverhead National Forest: Montana Bureau of Mines and Geology Open-file Report 348, 513 p.

McClernan, H.G., 1980, Metallogenic map of the White Sulphur Springs quadrangle, central Montana: Montana Bureau of Mines and Geology Geologic Map 7, 31 p., 2 sheets.

McClernan, H.G., 1975, Preliminary bibliography and index of the metallic mineral resources of Montana through 1969: Montana Bureau of Mines and Geology Special Publication 70, 91 p.

McClernan, H.G., 1967, Geology of the Sheep Creek area, Meagher County, Montana. Butte: Montana College of Mineral Science and Technology, unpublished M.S. thesis, 51 p., 3 plates.

McCulloch, R.B., 1993, Montana mining directory: Montana Bureau of Mines and Geology Bulletin 131, 76 p.

Metesh, J.J., 1993, Unpublished report for Darrel McNenny, U.S. Forest Service, Missoula, Montana, April 1993, 10 p.

Metesh, J.J., 1992, Quality assurance project plan for mine site preliminary assessments– Deerlodge National Forest, May 1992: Montana Bureau of Mines and Geology Open-file Report 259, 36 p., plus appendix.

Metesh, J.J., Lonn, J.D., and Hall, J.G., 1994, GIS Analysis: Geology-land type associations, Basin and Cataract Creek drainages: Final Report to U.S. Department of Agriculture, Forest Service, March 1994, 14 p.

Metesh, J.J., Lonn, J.D., Marvin, R.K., Hargrave, P.A., and Madison, J.P, 1998, Abandoned-inactive mines. Helena National Forest. Upper Missouri River drainage: Montana Bureau of Mines and Geology Open-file Report 352, 195 p.

Metesh, J.J., Lonn, J.D., Marvin, R.K., Madison, J.P., and Wintergerst, Robert, 1995, Abandoned-inactive mines. Deerlodge National Forest. Volume V. Jefferson River drainage: Montana Bureau of Mines and Geology Open-file Report 347, 132 p.

Metesh, J.J., Lonn, J.L., Duaime, T.E., and Wintergerst, Robert,1994, Abandoned-inactive mines program report. Deerlodge National Forest. Volume I. Basin Creek drainage: Montana Bureau of Mines and Geology Open-file Report 321, 131 p.

Metesh, J.J., Lonn, J.L., Duaime, T.E., Marvin, R.K., and Wintergerst, Robert, 1995, Abandoned-inactive mines in the Deerlodge National Forest. Volume II. Cataract Creek Drainage. Open-file Report 344. Butte: Montana Bureau of Mines and Geology. 163 p.

Mudge, M.R., Earhart, R.L., Watts, K.C. Jr., Tuchek, E.T., Rice, W.L., and Peterson, D.L., 1975, Mineral resources of the Scapegoat Wilderness, Powell, and Lewis and Clark counties, Montana: U.S. Geological Survey Bulletin 1385-B, 82 p.

Mudge, M.R., Erickson, R.L., and Kleinkopf, M.D., 1968, Reconnaissance geology, geophysics and geochemistry of the southeastern part of the Lewis and Clark Range, Montana. U.S. Geological Survey Bulletin 1252-E, 35 p.

Pardee, J.T. and Schrader, F.C., 1933, Metalliferous deposits of the greater Helena mining region, Montana: U.S. Geological Survey Bulletin 842, 318 p.

Pioneer Technical Services, Inc. (with assistance by: Thomas, Dean and Hoskins, Inc.), 1994, Abandoned hardrock mine priority sites, summary report (for Montana Department of State Lands Abandoned Mines and Reclamation Bureau), March 1994, p.5:138,139, 248, 249.

Pioneer Technical Services, Inc., 1995, Abandoned hardrock mine priority sites, summary report for Montana Department of State Lands Abandoned Mines and Reclamation Bureau, April 1995, 588 p.

Robertson, A.F., 1951, Mines and mineral deposits (except fuels) Cascade County, Mont.: U.S. Bureau of Mines Information Circular 7589, 81 p.

Robertson, A.F., and Roby, R.N., 1951, Mines and mineral deposits (except fuels) Judith Basin County, Mont.: U.S. Bureau of Mines Information Circular 7602, 51 p.

Roby, R.N., 1950, Mines and mineral deposits (except fuels) Meagher County, Mont.: U.S. Bureau of Mines Information Circular 7540, 43 p.

Sahinen, U.M., 1935, Mining districts of Montana: Montana School of Mines, Butte, unpublished M.S. thesis, 109 p.

Schafer, P.A., 1935, Geology and ore deposits of the Neihart mining district Cascade County, Montana: Montana Bureau of Mines and Geology Memoir 13, 62 p., 1 plate.

Schmidt, R.G. and Strong, C.P. Jr., 1972, Geologic map of the Roberts Mountain quadrangle, Lewis and Clark County, Montana. U.S. Geologic Quadrangle Map GQ-977. Scale 1:24,000.

Shields, R.R., White, M.K., Ladd, P.B., and Chambers, C.L.,1997, Water resources of Montana, Water Year 1996: USGS-WDR-MT-96-1, 458 p.

Spiroff, Kiril, 1934, Geological observations of the Block P mine Hughesville, Montana: Michigan College of Mining and Technology, Houghton, unpublished M.S. thesis. 22 p., 3 plates.

Stout, K.C., and Ackerman, W., 1958, Directory of known mining enterprises, 1957: Montana Bureau of Mines and Geology Information Circular 20, 59 p.

Stumm, W., and Morgan J.J., 1981, Aquatic chemistry: an introduction emphasizing chemical equilibria in natural waters: New York, N.Y., John Wiley & Sons. 780 p.

Trauerman, C.J., 1940, Directory of mining properties: Montana Bureau of Mines and Geology Memoir 20. 135 p.

Trauerman, C.J., and Reyner, M.L., 1950, Directory of Montana mining properties, 1949: Montana Bureau of Mines and Geology Memoir 31, 125 p., plus plates.

Trexler, B.D. Jr., Ralston, D.A., Reece, D.A., and Williams, R.E., 1975, Sources and causes of acid mine drainage: Idaho Bureau of Mines and Geology Pamphlet 165, 129 p.

U.S. Geological Survey and U.S. Bureau of Mines, 1978, Mineral resources of the Bob Marshall Wilderness and study areas, Lewis and Clark, Teton, Pondera, Flathead, Lake, Missoula, and Powell counties, Montana: U.S. Geological Survey Open-file Report 78-295, 187 p., 5 plates.

Walker, D.D., 1963, Tungsten resources of western Montana; miscellaneous deposits. U.S. Bureau of Mines Report of Investigations 6334, 60 p.

Walker, G.E., 1991, Geology of the Barker mining district, Judith Basin and Cascade counties, Montana *in* Guidebook of the Central Montana Alkalic Province: D.W. Baker and R.B. Berg, eds., Montana Bureau of Mines and Geology Special Publication 100, p. 29-37.

Weed, W.H., 1900, Geology of the Little Belt Mountains, Montana, with notes on the mineral deposits of the Neihart, Yogo, and other districts: U.S. Geological Survey, 20th Annual Report, parts 1 and 2, p. 257–461.

Weed, W.H., and Pirsson, L.V., 1896, Geology of the Castle Mountain mining district, Montana. U.S. Geological Survey Bulletin 139, 164 p.

Winters, A.S., 1968, Geology and ore deposits of the Castle Mountain mining district, Meagher County, Montana: Montana Bureau of Mines and Geology Bulletin 64, 64 p., 4 plates.

Witkind, I.J., 1973, Igneous rocks and related mineral deposits of the Barker quadrangle, Little Belt Mountains, Montana. U.S. Geological Survey Professional Paper 752, 55 p.

Woodward, L.A., 1991, Metallic mineralization in the Yogo and Running Wolf mining districts, Little Belt Mountains, Montana *in* Guidebook of the Central Montana Alkalic Province. D.W. Baker and R.B. Berg, eds.: Montana Bureau of Mines and Geology Special Publication 100, p. 19-27.

Young, F.M., Crowley, F.A., and Sahinen, U.M., 1962, Marketing problems of small business enterprises engaged in lead and zinc mining: Montana Bureau of Mines and Geology Bulletin 30, 58 p.

Zoldok, S.W., Biggs, Paul, and Norberg, J.R., 1972, Mineral resources of the Musselshell and Judith Basin divisions. U.S. Bureau of Mines Preliminary Report 190, 54 p.

Appendix I

USFS-MBMG Field Form

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 Meridan ____________________

Township ____________ Range ____________ Section ______ ¼______ ¼______ ¼______

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 *(If yes, take picture of site)*, Film number(s) __________

If yes, provide name of person who visited site and date of visit

Name: ________________________________ Date: ____________

If no, 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 panoromic 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 inake ________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 specfic 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 intermittant 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 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=Seasonsal 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 specfic 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 specfic 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 (*Initials*)				
Sample Type				
Waste Type				
Feature Number				
Sample Latitude				
Sample Longitude				
Photo Number				

Comments: (*When commenting on a specfic 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 (*Initials*)				
Sample Type				
Sample Latitude				
Sample Longitude				
Likely Source of Contamination				
Feature Number				
Indicators of Contamination				
Photo Number				

Comments: (*When commenting on a specfic 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 specfic 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 fearue 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 _____0-¼ miles _____¼-½ miles _____½-1 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 _____0-¼ miles _____¼-½ miles _____½-1 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

List of Sites in the Lewis and Clark National Forest

ID	NAME	T	R	Sec	TRACT	l_24k	OWNER
MR008498	ADIT IN SEC 25/9N/8E	09N	08E	25	DCBD	FOURMILE SPRING	NF
JB008506	ADIT IN SEC 29/14N/10E	14N	10E	29	CCCB	BANDBOX MOUNTAIN	NF
MR000253	ALABAMA-CLEVELAND MINE	08N	07E	3	BCAD	MANGER PARK	PRV
CC002447	ALBRIGHT DEPOSIT	16N	06E	22		RICEVILLE	MIX
CC002933	ALBRIGHT GROUP /LAST CHANCE, VALLEY	15N	06E	13		THUNDER MOUNTAIN	MIX
MR003142	ALICE MINE	09N	08E	36	DCAC	CASTLE TOWN	PRV
MR003727	AMERICAN	08N	08E	22	DDAD	CASTLE TOWN	NF
JB005297	AMERICAN - KUNISAKI YOGO SAPPHIRE	13N	11E	21	CBCB	INDIAN HILL	PRV
MR008478	ANNIE MAUDE	09N	08E	36	DCAA	CASTLE TOWN	PRV
MR003702	ANTELOPE	08N	08E	2	DDDB	CASTLE TOWN	NF
LC007362	BABE PROSPECT	18N	09W	13		JAKIE CREEK	NF
JB005307	BELL MINES	15N	09E	18		BARKER	PRV
MR000355	BELLE-OF-THE-CASTLE	08N	08E	2	CAAD	CASTLE TOWN	MIX
CC002897	BENTON MINE / REBELLION /SPOKANE	14N	08E	27	BCAD	NEIHART	PRV
JB005117	BESSIE / SEIDEN	14N	10E	16		BANDBOX MOUNTAIN	MIX
MR003082	BIESEL MINE	10N	09E	29		CHECKERBOARD	PRV
CC002891	BIG BEN DEPOSITS	14N	08E	21	ABDB	NEIHART	NF
CC002885	BIG SEVEN	14N	08E	28	ADAA	NEIHART	PRV
TE001004	BIGGS CREEK PROSPECTS	24N	09W	6		OUR LAKE	NF
CC002729	BLACK DIAMOND	14N	08E	22	CCAC	NEIHART	PRV
CC002879	BLACKBIRD / BLACK BIRD / MAUD S.	14N	08E	28	CCAC	NEIHART	PRV
MR003547	BLACKHAWK-ALICE PROPERTY	09N	08E	36	DDAC	CASTLE TOWN	PRV
JB004817	BLACKTAIL HILLS	15N	10E	12		WOLF BUTTE	MIX
CC002123	BLIZZARD	14N	08E	28		NEIHART	
JB005047	BLOCK P MINE / GREY EAGLE	15N	09E	6	DCCD	BARKER	PRV
CC008375	BLOCK 'P' TAILINGS	15N	08E	13		BARKER	MIX
JB008505	BLUE DICK MILL	14N	10E	31	AADC	BANDBOX MOUNTAIN	NF
JB005077	BLUE DICK MINE	14N	10E	30	ABDB	BANDBOX MOUNTAIN	NF
CC002237	BOSS MINE	14N	08E	29		NEIHART	
CC002591	BOSS MINE / ATLANTUS	14N	08E	28		NEIHART	
CC002249	BROADWATER = LIBERTY?	14N	08E	33	ADAA	NEIHART	PRV
MR003412	BROADWAY	08N	08E	14	ADBA	CASTLE TOWN	PRV
CC002585	BROKEN HILL	14N	08E	33		NEIHART	
CC002693	BULL OF THE WOODS MINE	14N	08E	33	BCBB	NEIHART	PRV
LC004259	BURRELL AND EVANS	19N	07W	29		STEAMBOAT MOUNTAI	NF
JB005107	CALIFORNIA (HARRIET)	14N	10E	30	ADDD	YOGO PEAK	NF
MR003522	CALIFORNIA / CALIFORNIA-HENDRICKS	08N	08E	1	CDDA	CASTLE TOWN	PRV
MR003467	CALUMET-JAMISON AND HECLA	10N	09E	28		CHECKERBOARD	PRV
CC008407	CARPENTER CREEK TAILINGS	14N	08E	21	BAAB	NEIHART	MIX
JB005132	CARTER	15N	09E	6		BARKER	PRV
MR003562	CASTLE LEAD	08N	08E	11		CASTLE TOWN	
CC002573	CHAMPION "B"	14N	08E	29	ADDD	NEIHART	PRV
LC004514	CHIEF OF THE MTNS. PATENTED CLAIM	21N	10W	1		PATRICKS BASIN	PRV
JB005127	CHRISTOPHER COLUMBUS	14N	10E	20		BANDBOX MOUNTAIN	PRV
LC001825	CINNAMON LODE	18N	09W	14	DB	JAKIE CREEK	NF
MR000343	CLARA BARTON / CLARA BURTON	10N	10E	22	BCDA	MOUNT HOWE	NF
MR008490	CLEOPATRA / FORGET-ME-NOT	08N	08E	12	BCAC	CASTLE TOWN	NF
CC002567	COMPROMISE CLAIM	14N	08E	32	ABCB	NEIHART	PRV
CC002561	CONCENTRATED AND MONARCH	14N	08E	29	CBDD	NEIHART	PRV
MR008475	COOK'S FLAT MANGANESE	10N	10E	16	DDDA	MOUNT HOWE	MIX
CC002135	COPES / AJAX 1 & 2/ LEADVILLE 1 & 2	14N	06E	9		BLANKENBAKER FLATS	MIX

ID	NAME	T	R	Sec	TRACT	I_24k	OWNER
MR000367	COPPER DUKE	10N	09E	29		FOURMILE SPRING	PRV
MR003567	COPPER STATE MINE	11N	08E	15	CDBB	VOLCANO BUTTE	PRV
MR000361	COPPEROPOLIS	10N	09E	29		CHECKERBOARD	PRV
CC002537	CORNUCOPIA MINE	14N	08E	22	DCCD	NEIHART	PRV
CC002531	COWBOY/ISABELLE	14N	08E	17	DDCC	NEIHART	MIX
CC002525	CUMBERLAND	14N	08E	29	DCCB	NEIHART	PRV
MR003572	CUMBERLAND MINE	08N	08E	14	DABB	CASTLE TOWN	MIX
CC002837	DACOTAH MINE	14N	08E	28	BCDC	NEIHART	PRV
JB008435	DANNY T	15N	09E	7	ACBC	BARKER	PRV
CC002483	DAWN AND FOSTER	14N	08E	16	AABB	NEIHART	PRV
JB005347	DELLA AND QUAKER CITY	14N	10E	30	DACC	BANDBOX MOUNTAIN	NF
JB004772	DEWEY / IRON KING / IRON CLAD	15N	10E	32		WOLF BUTTE	NF
LC001837	DEXTER LODE	20N	10W	16		WOOD LAKE	NF
JB005137	DOCKTER KALLOCH	15N	09E	7		BARKER	PRV
CC002795	DOUBLE X (XX)	14N	08E	16	AACC	NEIHART	PRV
CC008508	DRY FORK BELT CREEK LOWER TAILINGS	15N	08E	23	ACAB	BARKER	NF
MR003392	DUCOLIN-POTTER PROSPECT / DUCOLON	14N	04E	26		BALD HILLS	NF
JB008432	EDWARDS	15N	09E	7	BABC	BARKER	PRV
CC002513	EIGHTY EIGHT / 88 / EIGHTY-EIGHT	14N	08E	20	CADB	NEIHART	PRV
CC008414	EMMA	14N	08E	15	BBDC	NEIHART	PRV
JB008488	ENGLISH SAPPHIRE MINE	13N	11E	22	ACBA	WOODHURST MOUNTA	PRV
CC002555	EQUATOR MINE	14N	08E	29	CDAB	NEIHART	PRV
MR003752	ETTA CLAIM	08N	08E	14	ACAB	CASTLE TOWN	PRV
MR003577	EXCELSIOR	14N	06E	6		MONUMENT PEAK	
CC002903	FAIRPLAY & BON TON	15N	08E	1	DDCA	BARKER	PRV
CC002543	FAIRPLAY MINE	14N	08E	28	CBAA	NEIHART	PRV
MR003757	FELIX CEXENT / FELIX CREXENT	09N	08E	36	ADCC	CASTLE TOWN	NF
CC002699	FLORENCE MINE	14N	08E	29	CCAA	NEIHART	PRV
JB005357	FOREST	15N	09E	18		BARKER	PRV
CC002501	FRISCO	14N	08E	29	BCDB	NEIHART	PRV
JB004697	GALENA	14N	10E	31		YOGO PEAK	
CC002495	GALT-QUEEN	14N	08E	29	CDCC	NEIHART	PRV
CC002129	GAVANDER / GOLD BUG	14N	06E	6		BLANKENBAKER FLATS	PRV
JB012345	Gibson Peak Trail Prospects	14N	10E	3		Wolf Butte	NF
LC004509	GOAT RIDGE PROSPECT	24N	11W	3		THREE SISTERS	NF
JB005082	GOLDBUG / WEATHERWAX	14N	10E	29		BANDBOX MOUNTAIN	NF
MR003742	GOLDEN EAGLE	08N	08E	2	ACAD	CASTLE TOWN	PRV
CC002873	GRAHAM & HOLLOWBUSH / S & R	14N	08E	32	DDDB	NEIHART	PRV
MR003487	GRASSHOPPER	09N	08E	19	BBDB	PINCHOUT CREEK	PRV
MR003437	GREAT EASTERN & GREAT WESTERN	08N	08E	11	DABA	CASTLE TOWN	PRV
MR008477	HAMILTON MINE	08N	08E	11	ACAC	CASTLE TOWN	
CC002255	HARNER & DAVIS PROSPECT	14N	08E	33		NEIHART	
CC002867	HARTLEY	14N	08E	32	AABA	NEIHART	PRV
CC002855	HATCHET	14N	08E	20	DBDB	NEIHART	PRV
CC008507	HAYSTACK CREEK MINE	14N	08E	16		NEIHART	PRV
CC008497	HAYSTACK IRON SPRING	14N	08E	16	BDCA	NEIHART	NF
CC002603	HEGENER GROUP / VILIPA	14N	08E	16	ACDC	NEIHART	PRV
JB004652	HELL CREEK CLAIMS	13N	09E	18		YOGO PEAK	NF
CC002597	HIDDEN TREASURE	14N	08E	32	AADC	NEIHART	MIX
MR003407	HIDDEN TREASURE CLAIM	08N	08E	12	BBAD	CASTLE TOWN	PRV
MR003557	HOMESTAKE MINE	08N	08E	12	ACCC	CASTLE TOWN	PRV

ID	NAME	T	R	Sec	TRACT	l_24k	OWNER
CC002195	HOOVER CREEK QUARRY	15N	08E	31		MONARCH	NF
CC002909	HURRICANE AND TORNADO / EDNA	15N	06E	13		THUNDER MOUNTAIN	MIX
CC002861	INGERSOLL	14N	08E	29	DACA	NEIHART	PRV
MR003492	IRON CHIEF	08N	08E	1	CDAB	CASTLE TOWN	PRV
MR003537	IRON CLIFF	12N	06E	34		STRAWBERRY BUTTE	MIX
MR008376	IRON MINES PARK	14N	06E	24		BUBBLING SPRINGS	NF
MR002519	IRON MOUNTAIN	14N	06E	13		BUBBLING SPRINGS	NF
JB004672	IRON ORE DEPOSITS NEAR YOGO PEAK	14N	10E	30		BANDBOX MOUNTAIN	NF
JB003344	Iron Prospects-Sec. 36	15N	10E	36		Wolf Butte	NF
JB003343	Iron Prospects-Sec. 6	14N	11E	6		Wolf Butte	NF
JB004627	IROQUOIS PROSPECT	15N	11E	32		CAYUSE BASIN	MIX
CC002921	IXL / I.X.L. / EUREKA	14N	08E	29	AABD	NEIHART	PRV
JB005252	J.W. SISSON GYPSUM DEPOSIT	16N	10E	21	CBBC	WOLF BUTTE NW	PRV
LC001735	JESSIE PROSPECT	18N	09W	4	A	SCAPEGOAT MOUNTAI	NF
LC001891	JEWEL MOUNTAIN MINING CO. / JEWELL	18N	09W	28	A	SCAPEGOAT MOUNTAI	NF
CC002111	JOHANNESBURG	14N	07E	12	DDAD	BELT PARK BUTTE	PRV
MR003552	JUDGE MINE	09N	08E	36	DAAB	CASTLE TOWN	PRV
MR003582	JUMBO MINE	08N	08E	14	ADDA	CASTLE TOWN	PRV
MR008476	KID'S DREAM PROSPECT	10N	10E	15	BCAA	RUSSIAN FLAT	NF
JB004637	KING CREEK MINES	14N	11E	27		WOODHURST MOUNTA	MIX
MR003427	KING GROUP	14N	04E	26		BALD HILLS	MIX
JB004632	KOLAR BENTONITE	14N	11E	27		WOODHURST MOUNTAIN	
MR003712	LEGAL TENDER	09N	08E	36	ACCA	CASTLE TOWN	PRV
CC002117	LEROY (SEE ALSO JOHANNESBURG)	14N	07E	12	DDAD	BELT PARK BUTTE	PRV
CC008527	LEXINGTON #2	14N	08E	22	CBBA	NEIHART	NF
CC002717	LEXINGTON / UNION/ MOUNTAIN VIEW	14N	08E	28	ACDB	NEIHART	PRV
JB005062	LIBERTY MINE / OWNER FAITH MINING	15N	09E	7		BARKER	PRV
MR003102	LITTLE BELT MINE	10N	10E	32	AACC	MOUNT HOWE	NF
CC008494	LIZZIE	14N	08E	29	DABA	NEIHART	PRV
CC002927	LONDON	14N	08E	29	CBBB	NEIHART	PRV
JB004717	LONE STAR	13N	09E	32		SAND POINT	
MR008474	LUCKY BOY	10N	10E	11	CACD	RUSSIAN FLAT	NF
MR003432	LUCKY DOLLAR MINE / SILVER SPOON	08N	08E	12	ADDD	CASTLE TOWN	NF
CC002849	LUCKY STRIKE / COMMONWEALTH /	14N	08E	28	BDAC	NEIHART	PRV
CC008496	LUCY CREEK	14N	08E	17	DDDA	NEIHART	PRV
MR003107	LYNN MINE / HIGH TARIFF	11N	07E	10	ACAD	CHARCOAL GULCH	MIX
LC004214	MAGMA	18N	06W	30		BEAN LAKE	MIX
JB005367	MAGNOLIA & ST. LOUIS	15N	09E	7	DBDC	BARKER	PRV
MR003502	MANGER MANGANESE	14N	03E	9		MANGER PARK	PRV
JB008428	MARCELLINE	15N	09E	7	BDBA	BARKER	
JB005372	MAY & EDNA	15N	09E	6		BARKER	PRV
MR003112	MAYBE MINE	11N	08E	22	ABAB	VOLCANO BUTTE	PRV
MR003717	MERRIMAC / MERRIMAC #1	08N	08E	14	ABDA	CASTLE TOWN	PRV
JB005287	MIDDLE FORK / DRY FORK BELT CREEK	14N	09E	6		BARKER/MIXES BALDY	MIX
MR003732	MILWAUKEE MINE	08N	08E	2	DABB	CASTLE TOWN	NF
CC002939	MINUTE MAN - LAST HOPE - WESTGARD	14N	08E	15	CCBA	NEIHART	MIX
CC002843	MOGUL LODE MINE	14N	08E	32	CACD	NEIHART	PRV
MR000331	MONTANA COPPER / BARNETTE	09N	10E	33	CAAB	GROVELAND	NF
MR003442	MONTCANA GROUP	08N	08E	2		CASTLE TOWN	MIX
CC002723	MORNING STAR MINE	14N	08E	29	CBBC	NEIHART	PRV
CC002681	MOULTON / MOLTON GROUP/COMPROMISE	14N	08E	29	DBCA	NEIHART	PRV

ID	NAME	T	R	Sec	TRACT	I_24k	OWNER
CC002951	MOUNTAIN CHIEF	14N	08E	20	CDDC	NEIHART	PRV
JB005377	MOUNTAINSIDE AND LAST CHANCE	14N	10E	16		BANDBOX MOUNTAIN	PRV
JB008430	NE SE S7 (LUCKY STRIKE)	15N	09E	7	CAAD	BARKER	PRV
CC008410	NEIHART TAILINGS	14N	08E	29	CCB	NEIHART	PRV
CC002957	NEVADA	14N	08E	29	CADD	NEIHART	PRV
CC002963	NEW ALICIA & NEW RODWELL CLAIMS	14N	08E	10		NEIHART	
JB005092	NEW DEAL	14N	10E	30		BANDBOX MOUNTAIN	MIX
MR000337	NEW DEAL & JUMBO MINES / BOSS	10N	10E	12	BCDC	RUSSIAN FLAT	NF
JB004642	NEW MINE SAPPHIRE SYNDICATE MINE	13N	11E	23		WOODHURST MOUNTA	PRV
MR008503	NF SITE ON HENSLEY CREEK	08N	08E	11	AABD	CASTLE TOWN	NF
CC002969	NILSON	14N	06E	10		THUNDER MOUNTAIN	PRV
MR008528	NORTH PACIFIC	10N	09E	29	ADCC	CHECKERBOARD	PRV
JB004712	OLE GRENDAL ET	13N	09E	32		SAND POINT	
MR008504	OPEN CUT SEC 33/9N/10E	09N	10E	33	ACAB	MOUNT HOWE	NF
JB005382	OSCAR HELSING	14N	10E	16		BANDBOX MOUNTAIN	NF
JB004722	OUR ONLY CHANCE	12N	09E	4		SAND POINT	NF
JB004702	OVERLOOK CLAIM	14N	10E	32	CBCB	BANDBOX MOUNTAIN	NF
CC002915	PALMETTO NO. 2	15N	06E	34		THUNDER MOUNTAIN	MIX
JB005387	PARAGON	15N	09E	6		BARKER	PRV
MR003532	PARNELL-BOARD-OF-TRADE	14N	06E	31		MONUMENT PEAK	
CC002813	PEABODY	14N	08E	29		NEIHART	
JB005392	PIERCE-HIGBEE / DRY WOLF	14N	10E	18		YOGO PEAK	PRV
JB005292	PIG EYE BASIN GYPSUM	14N	11E	34		WOODHURST MOUNTA	PRV
MR003122	PLACER CREEK	14N	06E	17		BUBBLING SPRINGS	NF
MR003117	PLACER CREEK DEPOSIT	14N	06E	8		BUBBLING SPRINGS	NF
CC002705	PONDEROSA MINE	14N	08E	15		NEIHART	
MR003762	POWDERLY (SILVER DOLLAR)	08N	08E	12	ADDD	CASTLE TOWN	NF
MR003737	PRINCESS	08N	08E	28	AAC	CASTLE TOWN	PRV
CC008486	PROSPECT - SEC 23	16N	06E	23	DADD	RICEVILLE	NF
MR008485	PROSPECTS IN SEC 05	14N	05E	5	ACDB	BLANKENBAKER FLATS	NF
MR008481	PROSPECTS IN SEC 36/9N/8E	09N	08E	36	AACC	FOURMILE SPRING	NF
JB008483	PROSPECTS IN SEC 6	13N	11E	6	DACB	WOODHURST MOUNTA	NF
MR008493	PROSPECTS IN SEC 6/8N/9E	08N	09E	6	ABBB	CASTLE TOWN	MIX
MR008501	PROSPECTS NE OF HIDDEN TREASURE	08N	08E	1	CDCC	CASTLE TOWN	NF
MR008500	PROSPECTS SEC 02/8N/8E	08N	08E	2	BBDC	CASTLE TOWN	NF
JB005402	QUEEN ESTHER	15N	09E	6		BARKER	PRV
CC002819	QUEEN OF THE HILLS	14N	08E	29	CDCA	NEIHART	PRV
MR003722	QUEEN-HENSLEY GROUP / COPPER BOWL /	08N	08E	2	ACCC	CASTLE TOWN	NF
LC001747	READY MONEY MINE	18N	08W	3		STEAMBOAT MOUNTAI	PRV
MR003512	RINGLING MINE / WILLOW CREEK IRON	09N	07E	26		PINCHOUT CREEK	
CC002807	RIPPLE	14N	08E	27	CBBB	NEIHART	PRV
CC002801	ROCHESTER AND UNITY	14N	08E	29	DDBD	NEIHART	PRV
LC001603	ROOSEVELT CLAIM	18N	09W	3		JAKIE CREEK	NF
JB004687	RUBY / SNOWBALL / YELLOWBELL	14N	09E	36		YOGO PEAK	MIX
JB005442	RUNNING WOLF IRON DEPOSITS	14N	11E	7		BANDBOX MOUNTAIN	
CC002297	RUTH MARY AND FITZPATRICK	13N	08E	4	ACAA	NEIHART	PRV
JB005257	SAGE CREEK IRON DEPOSIT	14N	11E	22		WOODHURST MOUNTA	PRV
CC002777	SAVAGE	14N	08E	15	BACC	NEIHART	PRV
MR008461	SEC 11 PROSPECTS	11N	07E	11	DBCB	CHARCOAL GULCH	NF
MR008479	SEC 12 PROSPECTS	11N	07E	12	CDBB	CHARCOAL GULCH	NF
JB005072	SETTER MINE / HANS SETTER	14N	10E	21		BANDBOX MOUNTAIN	NF

ID	NAME	T	R	Sec	TRACT	l_24k	OWNER
MR008484	SHAFT - SEC 18	11N	08E	18	ABCC	CHARCOAL GULCH	NF
MR008480	SHAFT IN SEC 07/9N/9E	09N	09E	7	DBCD	FOURMILE SPRING	NF
MR008491	SHAFT IN SEC 11/8N/8E	08N	08E	11	ABBC	CASTLE TOWN	NF
MR008492	SHAFT SEC 02/8N/8E	08N	08E	2	CACC	CASTLE TOWN	NF
MR008499	SHAFT SEC 35/9N/8E	09N	08E	35	CCCB	CASTLE TOWN	NF
MR003037	SHEEP CREEK DEPOSIT	12N	06E	11		STRAWBERRY BUTTE	MIX
CC002765	SHERMAN	14N	08E	15	CBAB	NEIHART	PRV
CC002753	SILVER BELL	15N	08E	13	ADAA	BARKER	PRV
CC002741	SILVER BELT	14N	08E	28	CBAD	NEIHART	PRV
CC008412	SILVER DYKE MILL	14N	08E	15	BACC	NEIHART	PRV
CC002711	SILVER DYKE MINE	14N	08E	10	CDDB	NEIHART	PRV
CC008411	SILVER DYKE TAILINGS	14N	08E	15	BDCD	NEIHART	PRV
JB005407	SILVER GULCH	15N	09E	6		BARKER	PRV
CC002453	SILVER HORN	14N	10E	28		NEIHART	PRV
MR003542	SILVER SPOON (SEE POWDERLY)	08N	08E	12	ADDD	CASTLE TOWN	NF
MR003417	SILVER STAR	08N	08E	12	DABC	CASTLE TOWN	PRV
JB005412	SIR WALTER SCOTT & MYSTERY	14N	10E	10		BANDBOX MOUNTAIN	PRV
MR003697	SKIDOO	08N	08E	11		CASTLE TOWN	U
JB004802	SKUNK CREEK DEPOSIT	14N	10E	29		BANDBOX MOUNTAIN	NF
CC008495	SNOW CREEK MILL	14N	08E	21	CADA	NEIHART	NF
MR003402	SOLID SILVER	08N	08E	12	BBCD	CASTLE TOWN	PRV
JB004762	SOUTH FORK PLACER	11N	11E	5		DAISY PEAK	NF
CC002735	SPOTTED HORSE	14N	08E	27	CADB	NEIHART	NF
MR002977	SPRING CREEK	09N	10E	10		MOUNT HOWE	MIX
CC002471	SUNSHINE MINE	15N	08E	16		BARKER	MIX
JB005417	SWEEPSTAKES	12N	09E	23	DDDA	SAND POINT	NF
JB005247	T.C. POWER	14N	10E	32		BANDBOX MOUNTAIN	
CC002579	THORSON HOOVER CREEK	14N	08E	11		NEIHART	NF
JB005422	TIGER MOULTON AND T.W. / HARRISON	15N	09E	5		MIXES BALDY	
JB005427	TOP HAND	15N	09E	6		BARKER	PRV
MR000349	TOP LODE / TIP TOP / COPPER TOP	08N	08E	2		CASTLE TOWN	MIX
MR003517	TWENTIETH CENTURY CLAIM	14N	07E	19		BUBBLING SPRINGS	PRV
MR008502	UNNAMED 08N08E02DCAA	08N	08E	2	DDCB	CASTLE TOWN	PRV
MR008512	UNNAMED 09N08E19BDDC PROSPECT	09N	08E	19	BDDC	PINCHOUT CREEK	PRV
MR008511	UNNAMED 09N08E20BDCA PROSPECT	09N	08E	20	BDCA	FOURMILE SPRING	NF
MR008510	UNNAMED 09N08E20DAAA PROSPECT	09N	08E	20	DAAA	FOURMILE SPRING	NF
JB005342	UNNAMED GYPSUM	15N	10E	25		WOLF BUTTE	PRV
JB004752	UNNAMED GYPSUM OCCURRENCE	16N	08E	20		LIMESTONE BUTTE	PRV
MR003747	UNNAMED PUMICE	09N	08E	16		FOURMILE SPRING	MIX
CC002183	UNNAMED QUARRY	13N	08E	10	AACB	NEIHART	NF
CC002231	UNNAMED QUARRY	15N	07E	24		MONARCH	NF
MR008526	UNNAMED SEC 27 PROSPECT	08N	08E	27	ABCC	CASTLE TOWN	NF
MR003482	VANDOR / RUBY ADIT	08N	08E	2	ACDD	CASTLE TOWN	NF
CC002507	VENUS	14N	08E	21		NEIHART	
MR003447	VOSS MINE	08N	08E	2		CASTLE TOWN	MIX
JB005112	WEATHERWAX AND KING CLAIMS	13N	09E	31		SAND POINT	PRV
CC002747	WHIPPOORWILL MINE / BLOTTER CLAIM	14N	08E	16	AAAC	NEIHART	MIX
MR008482	WHITETAIL ADIT	10N	10E	16	DDAA	MOUNT HOWE	NF
MR003137	WHITTAKER 1901 CLAIM	14N	07E	19		BUBBLING SPRINGS	PRV
JB005267	WHITTAKER RIDGE	14N	10E	2		WOLF BUTTE	MIX
JB005262	WILLOW CREEK DEPOSIT	14N	11E	7		WOODHURST MTN	PRV

ID	NAME	T	R	Sec	TRACT	I_24k	OWNER
JB004807	WOLF BUTTE DEPOSIT	16N	10E	21		WOLF BUTTE NW	PRV
JB005432	WOODHURST & MORTSON	14N	10E	15		BANDBOX MOUNTAIN	PRV
JB008431	WRIGHT LODE	15N	09E	6	CCDA	BARKER	PRV
JB005437	YANKEE GIRL	14N	10E	14		BANDBOX MOUNTAIN	
MR003587	YELLOWSTONE MINE	08N	08E	11	ABDD	CASTLE TOWN	PRV
MR003387	YELLOWSTONE MINE	08N	08E	18		MANGER PARK	NF
JB004787	YOGO CREEK PLACER	13N	10E	4		BANDBOX MOUNTAIN	MIX

Appendix III
Description of Mines and Mill Sites
Lewis and Clark National Forest

JEFFERSON DIVISION

Adit in sec. 29 T14N, R10E
JB008506

This site was inspected on 5-22-98, this inspection revealed one caved adit and one waste dump near the adit.

Alabama-Cleveland
MR000253

The Alabama-Cleveland was screened out by the MBMG because it is on private land. References on the site include Roby (1948), Roby (1950), and Groff (1965).

According to Roby (1950), the mine produced manganese ore consisting of pyrolusite and psilomelane. Workings consisted of two adits, one that was 170 ft long on the Alabama claim and another 200 ft long on the Cleveland claim. The Cleveland adit is caved and inaccessible; the condition of the Alabama adit is unknown.

Limestone and shale striking northwest and dipping 45°SW are exposed in the vicinity of the mine workings. The rocks are probably members of the Belt Series (Roby, 1950).
Location: BCAD sec. 3, T8N, R7E.

Albright Group
CC002933

The Albright Group was screened out because it is on private land. It consist of 8 claims located in sec. 13, T15N, R6W. According to DeMunck (1956), the deposits occur in limestone along the contact with the Thunder Mountain granite porphyry forming lenses up to 46 ft in width. The ore is made up of limonite, hematite, and magnetite with minor amounts of gold and sulfide minerals.

American Mine
MR003727

According to Winters (1968), the American is on Alabaugh Creek one mile west of Castle Town. Workings consisted of three small adits that yielded several tons of high-grade silver ore. The MBMG located the remains of a log cabin on Alabaugh Creek (SE¼ of sec. 22), but did not locate any significant workings. Small prospects are widely scattered on the mountainside north of the creek.
Approximate Location: DDA sec. 22, T8N, R8E.

American Yogo Sapphire Mine
JB005297

This site was screened out due to no references in the MILS data base and the fact that it is mostly on private land located in sec. 21, T13N, R11E.

Benton Mine/Big Snowy/Spokane/Rebellion
CC002897

There were no mill tailings present at the site. An estimated volume of 64,920 cubic yards or waste rock with elevated levels of silver, mercury, arsenic, barium, cadmium, copper, lead, manganese, and zinc were present. According to Pioneer Technical Services (1995), three discharging adits were observed. The MCL for cadmium was exceeded, and the EPA action level for lead was exceeded in two discharging adits. The three discharging adits merged to form the headwaters of Snow Creek. Snow Creek exceeded the MCL for cadmium. There were several collapsing structures at the site. The silver, lead, and zinc mine is located 2 miles east of Neihart (Robertson, 1951). The group includes 15 patented claims.

Bessie
JB005117

The Bessie was inspected by MGMB personnel; no hazards, shaft, or adits were observed (10-14-98). The reference for this site is USBM Information Circular 7602. The location of this site is sec. 16, T14N, R10E.

Blackbird
CC002879

The Blackbird Mine is located three quarters of a mile east of Neihart and one quarter of a mile north of the Broadwater Mine. There were no tailings at the site and there was about 1,800 cubic yards of uncovered waste rock. There was an adit that held water but the water was not discharging. The pH of the water was 6.51. Samples showed that levels of cadmium and antimony exceeded MCL standards. There was no surface water on the site.

According to Robertson (1951), the Blackbird Mine was a silver, lead, and zinc mine. The first development consisted of one shallow shaft and some open pits, and later, an adit was driven that was about 185 ft long. Drifts were driven from the adits to follow the veins.

Black Diamond
CC002729

The location of the Black Diamond Mine is sec. 22, T14N, R10E. There was a mill building on the site, but there were no tailings. There was some evidence of discharge, but there was no hazardous waste present. There were also no open adits or shafts, highwalls, or hazardous structures. According to Robertson (1951) the Black Diamond Mine was a lead, silver, and zinc mine. The mine includes five patented claims about 2 miles up Snow Creek from its junction with Carpenter Creek. Development work includes 1,100 ft of adits, and a 50 ton gravity mill was constructed.

Blacktail Hills
JB004817

This site was screened out because its location was inaccurate (+/- 1 km), the commodity was listed as stone/limestone so it is unlikely to impact Federal lands. There were no references for this deposit listed in the MILS database.

Blizzard

CC002123

The Blizzard Mine is located between the Pennsylvania claim and the Spotted claim. The site was screened out because of the inability to locate the mine. Robertson (1951) states that the mine was a silver and lead mine. It is presumably located between Snow Creek and Belt Creek on the top of the ridge.

Big Seven

CC002885

The Big Seven site is located about two miles northeast of Neihart (Robertson, 1951). This was a gold, silver, lead, and zinc mine. According to Pioneer Technical Services (1995), the mill tailings were impounded in a pond and two piles. The volume of the tailings was estimated to be 2,580 cubic yards. The volume of the waste rock was estimated to be 25,800 cubic yards. Sediments released were mercury and manganese and there was zinc and manganese in the water. Cadmium levels exceeded the drinking water standards. One adit was discharging at a significant flow and had iron staining 1,000 ft downstream. The water had a pH of 6.63 and exceeded drinking water standards for cadmium and nickel. There were several buildings that were in fair condition, and there were two open adits.

Robertson states that the Big Seven Mine was developed by four main adits, the three upper adits were driven along the vein and the lower adit was driven as a crosscut. The lower adit was about 800 ft long and then it was driven as a drift for about 2,900 ft. This vein is about seven ft wide and is nearly vertical. The ore minerals in the uppers parts of the mine were silver sulfides and the lower parts were mainly lead and zinc. There were two ore shoots that were about 600 ft long.

Blue Dick

JB005077

The Blue Dick was inspected on 5-22-98, one caved adit was found, as well as ore bins and recent drill roads. The approximate location of this site was sec. 30, T14N, R10E. The references listed for this site include: DeMunck,1965, MBMG Information Circular 13; Goodspeed,1945, USGS Professional Paper; Weed,1898, 20th Annual Report; Robertson and Roby, USBM Information Circular 7602, p. 32.

Boss

CC002591

The Boss Mine was screened out because of the inability to locate it. According to Young, Crowley, and Sahinen (1962) the mine is located in sec. 28, T14N, R8E. The minerals related to the site include galena, sphalerite, chalcopyrite, pyrargyrite, polybasite, barite, rhodochrosite, quartz, ankerite, siderite, and cerussite.

Broadwater Mine

CC002249

The Broadwater Mine is located southeast of Neihart (Schafer, 1935). This site is on private land. There were no mill tailings. There was approximately 41,200 cubic yards of waste rock. There was one discharging adit, and the discharge seeped into the dump. The MCLs for cadmium and zinc were exceeded in the discharge. The potential safety hazards included an open adit with an unsecured fence around it and two wooden loadout structures that were collapsing.

According to Schafer (1935), the mine was developed by three adits and a shaft. Many winzes, raises and sublevels were also driven.

Broken Hill

CC002585

The Broken Hill Mine was not found although the area was visited. It was a dry hillside. According to Robertson (1951), the Broken Hill Mine is located east of the Broadwater Mine on the west slope of Neihart Baldy Mountain. Production from 1906 until 1921 was recorded to have been 769 tons of ore. From the 769 tons, 0.57 ounces of gold, 42,778 ounces of silver and 72,454 pounds of lead were recovered. The underground workings cannot be accessed.

Bull of the Woods

CC002693

The Bull of the Woods claim is located in sec. 33 near the top of the Neihart Baldy Mountain and a half of mile east of Neihart (Robertson, 1951). This site is part of the Broadwater claim. It was a sliver and lead mine (Lawson, 1974). According to Robertson (1951), early miners mined some high grade silver ore from a fissure vein containing quartzite. The general area was visited 05/18/00 but this site was private and so was not inventoried.

California (Harriet)

JB005107

This site was visited by MBMG personnel on 5-22-98. It was noted that there is a collapsed adit immediately adjacent to the road and a fenced shaft with the fence falling in on the other side of the road. The location of the California is sec. 30, T14N, R10E. The reference for this site is USBM, 1952, Information Circular 7602 p. 54.

Calumet Mine

MR003467

The Calumet Mine is in the Copperopolis district in Grayson shale; it is also known as the Calumet-Jamison and Hecla. Ore and gangue minerals include calcite, quartz, jasper, hematite, pyrite, chalcopyrite, and bornite.

This site was screened out because it was only briefly mentioned in Roby (1950) as having produced copper from veins in Belt shales. No more specific location was noted. It plots on private land from the location provided by the MILS database.

Castle Lead

MR003562

A lead-zinc prospect that the MBMG was unable to locate based on the available information.
Approximate Location: T08N R08E

Champion “B”
CC002573

The Champion "B" Mine is located one mile northeast of Neihart in sec. 29 (Robertson, 1951). There is no a mill or tailings present. There are no signs of erosion, and there were no discharging adits. No hazardous structures or materials are located at the site. Robertson (1951) states that the location of the mine is between the Lizzie claim and the Dacotah claim. There are two parallel veins. A winze was sunk on one vein that was three ft wide. The veins are mainly honeycombed quartz that contains galena, sphalerite, and pyrite.

Christopher Columbus
JB005127

The Christopher Columbus was screened out because it is on private land located in sec. 20, T14N, R10E. According to Robertson and Roby (1951), the deposits occur along a minette dike cutting through limestone near a syenite porphyry. They mentioned three shafts and an adit– all inaccessible in 1948.

Clara Burton/ Clara Barton
MR000343

The reference for this site is USBM, 1950, Information Circular 7540, p. 30. The location of this site was sec. 22, T10N, R10E. It was visited by an MBMG geologist on 05/13/98. There was one partially open shaft noted with a wooden headframe above it. The open shaft was obscured by collapsed boards. The large, dry waste dump was composed of match-stick sized shale fragments with minor calcite/quartz/chalcopyrite/copper oxide veins. The site was accessible by ATV’s and to hikers. The depth to which the shaft is accessible and open was undetermined because the headframe and timbering above it obscured the opening.

Compromise
CC002567

The Compromise claim is located in sec. 32, T14N, R8E and is on private land. This site was not visited because there was no public access. According to Pioneer Technical Services (1995), there were no mill tailings at the site. The waste rock was estimated to be 600 cubic yards. There was a discharging shaft and two discharging adits. The MCLs were exceeded for cadmium and nickel at the discharging shaft, but the MCLs for the discharging adits were not exceeded. The shaft is a hazardous structure but it was fenced. There is also a headframe and two highwalls that are 15 to 30 ft in height. A cabin is located at the south end of the site, and the site is near the town of Neihart.

According to Robertson (1951), the Compromise claim is part of the Moulton Group. An adit was driven 400 ft on the main vein, and later a 150 foot shaft was sunk and a drift was driven for several hundred ft. The vein is from three to four ft in width.

Concentrated and Monarch
CC002561

The Concentrated and Monarch site is part of the Florence Group. The site is located in the Neihart mining district in sec. 29. It is on private land and there is no mill site or tailings on the site. There were no discharging adits. No hazardous structures or materials as well as no open adits or pits are present at the site. According to Robertson (1951), the site is located between the Florence and the British Lions claims. There is a 1,500 foot adit, and there are winzes and crosscuts of the adit. The adits are caved.

Cook's Flat Manganese
MR008475

This site was visited by the MBMG on 05/05/98. It was a manganese mine. There were a series of trenches, almost like road cuts, on the hillside. The cuts had already started to slough in with boulders. There were no real highwalls. The rock consisted of massive very fine grained manganese oxide, silica, and carbonate in a orange, iron-stained limestone. The host rock is locally brecciated with siliceous gray clasts in an earthy orange matrix. Some of the manganese oxide is so fine grained that it has a concoidal fracture. Lower on the hillside, orange very fine grained, cherty, silicified rocks predominated. The rocks had a white to light bluish “blush” on them. The reference for this site is Garverich,1995, M.S. thesis p. 56.

Copes, Ajax 1&2, Leadville 1&2
CC002135

According to Robertson (1951), the property consists of four unpatented claims. The location is vague, reported as about one mile southeast of the Nilson Group. Workings consisted of numerous shallow shafts, open cuts, and short adits. An ore sample assayed at 0.005 ounces of gold, 3.6 ounces of silver, 19.8 percent lead, and 6.9 percent zinc. Robertson reported a 20 foot shaft as open in 1949, but the adits caved and an open cut in an outcrop partly filled. It was not visited because of an inaccurate location.

Copper State Mine
MR003567

The Copper State is located several hundred ft west of an ephemeral tributary to Sawmill Creek. The site consists of the Duke, Mammoth, Byron, and Mary Rose patented claims. The mine workings consisted of four shafts. The main shaft on the Duke claim was reported to be 200 ft deep; the other shafts were shallow (Roby, 1950).

The vein consists of quartz and calcite and occupies a steeply dipping fissure in thin-bedded Belt shales. The vein is reported to be 1 to 14 ft wide. Ore on the dump at the Duke shaft consists of dark sphalerite, or possibly marmatite, with some galena and a little chalcopyrite. Oxidized copper minerals also are present. A U.S. Bureau of Mines sample collected from an ore bin assayed 0.01 oz/ton gold, 0.33 oz/ton silver, 31.0 % zinc, 5.9 % lead, and 0.8 % copper. A Bureau of Mines sample from dump at the Duke shaft assayed a trace of gold, 0.2 oz/ton silver, 6.85 % zinc, 0.9 % lead, and 0.3 % copper (Roby, 1950).

The mine operated sporadically from 1920 to 1927. Two small shipments of sorted zinc ore were made to a custom mill in Salt Lake City, Utah (Roby, 1950). The site is also described in Dahl (1971).

The site was visited in June 1998 by the MBMG, and no environmental or safety hazards were noted.
Location: CDBB sec. 15, T11N, R8E.

Cornucopia/Ontario
CC002537

It was visited 05/17/98 by an MBMG geologist; no problems were noted. There were no mill tailings located at the site. There were no discharging adits or hazardous structures present.

According to Robertson (1951), the Cornucopia Mine had gold, silver, lead, and zinc as commodities. There are 12 patented claims in the group located on the northeast slope of Long Baldy Mountain, 3 miles north of Neihart. Development includes three adit drifts and a 300 foot shaft with two levels (one at 150 ft and the other at 300 ft). The vein is exposed at one of the adits.

Cowboy
CC002531

The area near the Cowboy was visited 05/16/98 by an MBMG geologist. The Cowboy claim is located two and a half miles north of Neihart and one half mile up Lucy Creek from its junction with Carpenter Creek (Robertson, 1951). There were no open pits or shafts, highwalls, or hazardous structures on the site. There was no discharge from adits and there were no hazardous wastes. No mill tailings were present, and there was no mill site. The site was dry and located on private land.

The adits had caved and all structures had collapsed. Two adits were driven (Robertson, 1951). The second adit was driven 25 ft lower than the main adit in an attempt to drain the winze from the main adit. The second adit was driven 75 ft. The winze followed an ore shoot that was approximately 75 ft long.

Cumberland
CC002525

There were no mill tailings located at the site, and there were no discharging adits. The area was visited 05/18/98 and only surface disturbances were noted. No hazardous materials or structures were observed. The claim is patented and is located west of the Moulton claim and adjoins the Equator claim (Robertson, 1951). The development work consisted of a 400 foot adit. The vein is in pink gneiss, and some high grade ore was reported to have been mined.

Dacotah
CC002837

The site was studied by Pioneer Technical Services (1995) and the following is a summary of their findings. Approximately 10,015 cubic yards of waste rock is present. The waste rock contains arsenic, cadmium, copper, iron, mercury, manganese, nickel, lead, antimony, and zinc. There was a discharging adit that had a pH of 2.38. The MCLs for cadmium, nickel, and antimony were exceeded. Rock Creek flowed adjacent to the site, and the MCL for nickel in Rock Creek was exceeded (related to the site). Hazardous structures included an open adit, numerous structures, and the highwalls.

The site is located one mile northeast of Neihart (Robertson, 1951). The site was prospected by shallow surface workings and two short adits. Total development work includes four adits ranging in length from 100 ft to 1,200 ft. The general area was visited 05/18/99 but the majority of the workings are on private land.

Dawn and Foster
CC002483

The Dawn and Foster Mine claims are located one mile west of the Silver Dyke Mine on the upper west fork of Mackay Creek (Robertson, 1951). There was not a mill or tailings present at the site, and there were no adits with discharges. No hazardous structures (open adits or shafts and highwalls) were noted. According to Robertson, the ore was low grade. The site was visited by MBMG staff on 05/16/98. No problems were noted.

Della and Quaker City
JB005347

A site in the approximate location of the Della and Quaker City was visited on 5/22/98. It is not known for sure if this is the proper location of the mine. The reference for this mine is USBM, 1952, Information Circular 7602 p. 38. The approximate location is sec. 30, T14N, R10E.

Dewey
JB004772

This site was screened out because the accuracy listed in MILS was within +/- 1km. There is no physical location given in the MILS database and the only reference given was MBMG Information Circular 20 (1957, p. 25).

Double X (XX)
CC002795

The Double X claim was a silver, lead, and zinc mine (Robertson, 1951). It is located on the upper fork of Mackay Creek three quarters of a mile upstream from its junction with Carpenter Creek. An adit was driven for 300 to 500 ft and a shallow shaft was sunk. There were also many pits. No tailings were present, and there were no discharging adits. Some erosion of waste was present, but there were no hazardous structures or materials present. The site was sampled upstream and downstream to test the effects of the mine.

Ducolin-Potter
MR003392

This site was screened out in the office because of the vague description in literature of its location. Roby (1950) says the claims are 28 miles north and 13 miles west of White Sulphur Springs and the original claims had been relocated. Roby also states the mine workings consisted of three short adits 25, 40, 165 ft–all caved and inaccessible.

Eighty-Eighty (88)
CC002513

The Eighty-Eighty Group includes five patented claims that are located up Carpenter Creek about one mile from its junction with Belt Creek (Robertson, 1951). The site is on private land, and the dumps were being eroded by Carpenter Creek. Carpenter Creek was sampled upstream and downstream of the Eighty-eight to test its effects on the water. There are two caved adits on the site. There are no tailings and there is no mill site at this location. The adits were not discharging and there were no hazardous structures or materials.

Two adits were driven southward (Robertson, 1951). The lower adit was approximately 1,700 ft long. The upper adit is 400 ft higher than and to the south of the lower adit.

Emma
CC008414

The Emma Mine is located in sec. 15, T14N, R8E on private land. It was screened out for this reason.

Pioneer Technical Services (1995) studied the site and the following is a summary. There were no mill tailings located at the site. Five hundred twenty cubic yards of waste rock was estimated. The waste rock contained elevated levels of silver, arsenic, cadmium, copper, manganese, lead, antimony, and zinc. There were no discharging adits, filled shafts, seeps, or springs present at the site. Squaw Creek cut through the site and releases of sediment were observed. Samples from Squaw Creek (upstream and downstream) contained exceeding MCLs for cadmium, copper, nickel, and antimony. The EPA action level for lead was also exceeded. A collapsing loadout structure and a slope that was unstable (above the caved adit) were potential safety hazards.

English Sapphire Mine
JB008488

This site was screened out because it is located on private land and there are no MILS references. The risk to National Forest land is unlikely. The approximate location of the English Sapphire Mine is sec. 22, T13N, R11E.

Equator Mine
CC002555

The claim is located in sec. 29 (T14N, R8E). There is no mill site or tailings present. There are no discharging adits or hazardous materials present. There is a hazardous structure. There are two caved adits at the site and one open adit. The adit intersected another vein and a crosscut was driven on that vein (Robertson, 1951). The vein was developed by an adit/drift.

Fairplay
CC002543

The Fairplay claim is located one and an eighth miles northeast of Neihart on the crest of the divide between Snow Creek and Belt Creek (Robertson, 1951). The site was not studied as a part of this inventory because it is on private land. Pioneer Technical Services (1995) studied the Fairplay and the following summarizes their findings. There were no tailings at the site. The waste rock volume was estimated to be 2,010 cubic yards. There was one discharging adit at the site. The pH was measure to be 6.09. The MCL for cadmium was exceeded. There were no hazardous openings or structures at the site.

According to Robertson (1951) the vein is a narrow fissure in Pinto diorite, and the development was a short adit. Galena, sphalerite, pyrite, silver sulfides, cerusite, and limonite are all found in the ore

Fitzpatrick and Ruth Mary
CC002297

There were tailings at the site but they were on private ground. MBMG did not sample the site but Pioneer Technical Services (1995) did. The Neihart tailings were hauled to the site during highway construction for driveway cover. The material is stock piled because it was not used. The volume of the tailings is approximately 50 cubic yards. The tailings contained elevated levels of arsenic, barium, cadmium, copper, manganese, lead, antimony, and zinc. The waste rock volume is approximately 5,458 cubic yards and contained arsenic, barium, cadmium, copper, iron, mercury, lead, antimony, and zinc. There were no discharging adits or shafts. The residents near the area use water from Belt Creek not groundwater. There were three adits that were hazardous.

Florence
CC002699

The Florence Mine is located 2,000 ft northwest of Neihart and includes 5 claims (Schafer, 1935). Development work includes six adits and a winze was developed for 500 ft from which levels were driven at 100 foot increments.

There were no mill tailings present, but there was a discharging adit. There were no signs of erosion and no hazardous structures or materials were observed. The site was not sampled because the discharge was estimated to be less than 1 gpm and the site is on private land.

Frisco
CC002501

The Frisco claim is located in sec. 29, T14N, R8E. It is on private land and there are no tailings present. It was observed from below on the hillside from LCNF-administered land. There are no hazardous wastes or structures and no discharging adits. There are dry workings on the hillside. An adit was driven 625 ft and intersected two veins (Robertson, 1951). Both veins were drifted for a short distance. The claim is north of Neihart.

Galt Mine
CC002495

The mine is on private land and so was screened out. The general area was visited, however. There is no mill site or tailings present. There are no discharging adits, hazardous materials, or structures.

The Galt Mine is a half mile north of Neihart (Schafer, 1935). The development work includes two adits. The main adit was 1,015 ft, and a 150 foot shaft was sunk. Also, a raise was driven and two levels off of the raise were developed. The ore consists of galena and sphalerite.

Gavander
CC002129

This site was screened out because it is on private land. According to Robertson (1951), the mine consists of three patented claims: Admiral Dewey, Overlook, and Gold Bug. A contact of quartz porphyry with thin-bedded, steeply dipping, shaly limestone has been prospected by many shallow pits and adits. Robertson noted that when he visited this site in 1949 the pits had partly filled in, and the adits were caved.

Gibson Peak Trail Prospects
JB012345

This site was visited by MBMG personnel on 10-14-98. The approximate location was sec. 3, T14N, R10E. This site consisted of several prospects only. There was no sign of any structures, adits, or hazardous waste of any kind.

Gold Bug (Weatherwax)
JB005082

This site was active when visited by MBMG personnel on 10-13-98. It is now named the Yukon Mine. The approximate location of the Yukon is sec. 29, T14N, R10E. The references for this mine are: USBM, 1952, Information Circular 7602, MBMG, 1949, Memoir 31, MBMG, 1957, Information Circular 20.

Graham and Hollowbush
CC002873

The location the Graham and Hollowbush Mine in on the west side of Belt Creek by its junction with O'Brien Creek at the southern end of Neihart (Robertson, 1951). This mine is located on private land. The following was observed from public land. There were no tailings or millsite. There were no discharging adits, but the floodplain contained mine waste and it showed signs of water erosion. There are no hazardous wastes present, but there were some hazardous structures.

Robertson (1951) states that the first development of the mine was an adit driven on the vein where it outcropped. Later, a 250-foot shaft was sunk, crosscuts were driven, and drift were driven north and south from the crosscuts.

Grasshopper Mine
MR003487

The Grasshopper Mine is a patented claim on a ridge west of Grasshopper Creek. Workings at the site include a collapsed shaft and several small prospects in manganese-stained limestone. Winters (1968) states that several carloads of high-grade silver ore apparently were shipped from the mine, but no silver minerals were revealed in a polished section of galena from the mine. No additional production records were found for the site.

The MBMG visited the site in June 1998 and found no environmental problems. A 15-foot deep pit that marks the location of the 100–200 foot shaft (Roby, 1950; Winters, 1968) was identified as a hazard. A “Grasshopper Creek Mine” was described in Dahl (1971) as consisting of a glory hole and four smaller pits at the contact of the Castle Stock and the Madison limestone. This mine was also described as iron manganese ore in jasperoid matrix. It is uncertain if the two mines are the same. Location: BBDB sec. 19, T9N, R8E.

Harner and Davis
CC002255

This site was screened out because of the general location (the accuracy in MILS was +/-5 km). There were no references listed for it.

Hartley Mine
CC002867

This site was on private land and so was screened out of this inventory. The Hartley was studied by Pioneer Technical Services (1995) and the following is a summary of their findings. Mill tailings were present at the site, and the volume of the tailings was estimated to be 255 cubic yards. The tailings contained elevated levels of silver, arsenic, barium, cadmium, copper, mercury, manganese, nickel, lead, antimony, and zinc. The volume of waste rock was estimated to be 21,860 cubic yards and had elevated levels of silver, barium, copper, manganese, lead, arsenic, cadmium, mercury, nickel, and zinc. There were no discharging adits present at the site. There were also no filled shafts, seeps and springs observed at the site.

The Hartley Mine is located on the northwest side of Neihart Baldy Mountain about a half mile northeast of Neihart (Robertson, 1951). The site was a silver, lead, and zinc mine. The main drift was 1,000 ft long and a winze was sunk 500 ft deep. The main vein reached widths of up to four ft.

Hatchet
CC002855

The Hatchet Mine was a lead, zinc, and silver mine (Robertson, 1951). It is located 1.25 miles up Carpenter Creek and 0.25 miles east of the "88" claim. The mine was developed by driving an adit 300 to 350 ft along a narrow vein. The vein was irregularly mineralized.

The mine is located on private land, and there was no mill site or tailings present. There were no hazardous structures or materials and there were no discharging adits. The adit was caved.

Hegener Group\Vilipa
CC002603

This site is on private, patented land and so was screened out from the AIM inventory. It was included in the Pioneer Technical Services (1995) report, and the following is a summary of their findings. There were no mill tailings present at the site. There was approximately 5,700 cubic yards of waste rock that had elevated levels of copper and mercury. One adit had a small discharge, two shafts had small amounts of accumulated precipitation, and there was one small seep at the toe of the rock dump. Mackay Creek flowed through the site and caused erosion. There was a observed release of copper. Downstream, elevated concentrations of copper, mercury, and manganese were found. Potential hazards include three partially caved adits and one open adit. There was also one partially caved cabin present at the site.

The Hegener Group includes ten patented claims on Mackay Creek located one half of a mile above Mackay Creek's junction with Carpenter Creek (Robertson, 1951). Development included a 100 foot adit, a 115 foot shaft, and a drift at the bottom of the shaft (300 ft). The adit was extended to a length of 400 ft.

Hidden Treasure
CC002597

According to Robertson (1951), the Hidden Treasure claim is located between the Broadwater claim and the Atlantus claim. There was an adit driven for several hundred ft along the Hidden Treasure vein.

The Hidden Treasure was visited 05/18/98 and only surface work was noted. The only thing found at the site were a few prospect pits. There were no tailings or mill site. There were no adits, shafts, highwalls, or hazardous structures.

High Tariff
MR003107

This site was screened out because it is primarily located on private ground. The references for this site are: Roby, USBM Information Circular 7540, p. 34-35 and Dahl, 1969 p.45-47. Dahl (1971) described a two-compartment shaft approximately 125 ft and 150 ft of crosscuts at the High Tariff (from Roby, 1950). The Dahl report has a mine map showing the configuration of the mine workings. According to Dahl, the mine was last worked in 1969 when the shaft was caved. The mine was located along the contact of a syenite dike and Newland limestone. Native silver, galena, arsenopyrite, pyrite, argentite, and sphalerite were listed as ore minerals.

Hurricane and Tornado
CC002909

This site was screened out because it is probably patented. According to Robertson (1951), the Hurricane and Tornado (also known as the Edna/Frank Marion Group) consists of 3 patented claims. The ore deposits form lenses about 20 ft wide. Assays showed 53% iron with small amounts of copper, lead, silver, and gold.

Ingersoll
CC002861

This site was visited 05/18/98 by an MBMG geologist and it was dry. There was no mill site or tailings present at the site. There were no discharging adits, and no hazardous structures were present.

The mine is located on Rock Creek about a half mile northeast of Neihart (Robertson, 1951). The mine is on the main ridge. The main drift was 1,100 ft long. A 75-foot crosscut was driven and a

112-foot raise was driven off of the drift. The main vein (the Ingersoll vein) is located in gneiss, Pinto diorite, and minette.

Iron Cliff
MR003537

This site was screened out because the commodity was iron, it is probably a duplicate of Sheep Creek Iron, and there were no references for it in the MILS database. The accuracy of its location from the MILS database was +/- 1 km.

Iron Mines Park
MR08376

This site was visited by MBMG personnel and consists of several small prospects, mainly shallow pits with no structures on a dry ridge on LCNF-administered land.

Iron Mountain
MR002519

This site was not visited because it is on a dry hillside. According to DeMunck (1956), the deposits form lenses composed mainly of magnetite and hematite with a calcite gangue in thin-bedded shaly limestone, argillites, and shale of pre-Cambrian age along the contact of a syenite body.

Iron Ore Deposits
JB004672

This site was screened out due to inaccurate location (it is believed to be near the vicinity of the New Deal and Blue Dick mines). There are no MILS references, and the commodity was iron.

Johannesburg
CC002111

This site was not visited because there was no public access. According to Gilbert (1935), the claim includes seven patented claims, and the claims are located 5 miles north of Neihart on Belt Creek. There was a 420 foot shaft, a 60 foot adit, 700 ft of drifts, and 500 feet of crosscuts.

Kids' Dream Prospect
MR008476

This site is located in sec. 15, T10N, R10E. This site had highwalls only. There was no evidence of tailings or discharge. The reference for this site is Garverich, 1995, M.S. thesis p. 57 and a mineral property file from the MBMG. Crushed rock found in drums on the property were sampled and the results are found in this report.

King Creek Mines
JB004637

This site was screened out because the accuracy of the location in the MILS database was listed as +/- 10 km.

King Group

MR003427

The only reference found for this site is MBMG Bulletin 95 "Directory Of Mining Enterprises For 1974". The King Group is listed as an open pit mine interested in lead, silver, copper, and gold. In 1974, the mine was reported as being in the development stage.

Kolar Bentonite

JB004632

This site was screened out due to unknown location and no references for it were noted in the MILS database.

Lexington

CC002717

This site was screened out because it is on private land. Pioneer Technical Services (1995) sampled it, however. The following is a summary of their report. No mill tailings located at the site. The waste rock was estimated to be 6,600 cubic yards and contained elevated levels of silver arsenic, cadmium, copper, mercury, lead, and zinc. There was one discharging adit, but the discharge did not reach any surface water. The MCL for cadmium was exceeded in the adit discharge. Potential safety hazards included a collapsing shed and several steep slopes (associated with rock dumps and a caved adit).

The mine is located a mile and a half up Snow Creek from its junction with Carpenter Creek (Robertson, 1951). An adit intersected a vein 20 ft from the portal. The rock dumps contain iron pyrite and quartz.

Little Belt Mine

MR003102

The Little Belt Mine is located in sec. 32, T10N, R10E. It is partially on LCNF-administered land, access is by driving through private land or by hiking through LCNF-administered land. It was visited 05/13/98.

This was an open pit, manganese mine. Potentially hazardous highwalls remain on approximately 5 acres of disturbance. Some of the highwalls were 30 ft or more. The area was benched to the south with dozer cuts near the center. There is additional trenching surrounding the main mine. The mineralized rock includes poddy, black manganese that occurs as hard, black rock or softer, sooty occurrences. The black rock is in very fine grained, crumbly, orange-stained cherty matrix. It occurs in irregular pods and fractures as bluish to white sinter or very fine grained somewhat rounded botryoidal quartz. The reference to this site is: MBMG Information Circular 20 (1957, p.35).

Lizzie

CC008494

The Lizzie site had no mill tailings, discharging adits, or hazardous materials or structures. The adits are caved and the mine is located on private land. The general area was visited by an MBMG geologist on 05/18/99.

The Lizzie claim is located near the head of Rock Creek (Robertson, 1951). There are four veins that occur within the claim. Two of the veins have been developed. The development includes six adits, a shaft, and crosscuts. There are also pits and large cuts.

London
CC002927

This site was not visited because of an inaccurate location. It is located on a dry hill side. According to Schafer, (1935) the mine adjoins the Evening Star Mine on the north side. Four adits developed 1,500 ft of the vein. According to Schafer, none of the adits could be accessed.

Lone Star
JB004717

The references for this site are: USGS MLA Open-file Report 92-82. It was screened out because of a location accuracy of +/-1 km.

Lucky Boy Shaft
MR008474

This site was visited by MBMG personnel. There was no evidence of mill sites or tailings, there was one recently reclaimed shaft with no evidence of discharge. This site is located in sec. 11, T10N, R10E. The reference for this site is: Garverich, 1995, M.S. thesis, p. 54-55.

Lucky Strike
CC002849

The LCNF-administered land was visited on 05/17/98. Mill tailings were not observed at the site. There was a discharging adit but the discharge did not leave private land. There were no signs of erosion and no hazardous structures/materials were located at the site.

According the Robertson (1951), the claims are located on the east slope of the ridge separating Snow Creek and Rock Creek, 1.5 miles northeast of Neihart. Development work consists of an adit driven on the vein which is located in Pinto dorite. The vein contains galena, sphalerite, and silver sulfides.

Lynn Mine/High Tariff
MR003107

This site was screened out because it is primarily located on private ground. The references for this site are: Roby, USBM Information Circular 7540 (p. 34-35) and Dahl, 1969 (p.45-47).

Manger Mine
MR003502

The only reference for this site was U.S. Bureau of Mines mineral properties file 41.010. According to the file, manganese was the commodity produced from the mine. The site is likely the same as the Alabama-Cleveland. The site was screened out by the MBMG because the entire section is privately owned.
Approximate Location: sec. 3, T8N, R7E.

Maybe Mine
MR003112

The Maybe Mine is located a half mile southeast of the Copper State Mine and actually may be part of the Copper State claim. The MBMG visited the site in June 1998 and found no environmental problems. The site consisted of a collapsed shaft with the remnants of a crude headframe plus several smaller workings. Because the site is adjacent to a small road, the steep-sided pit that marks the location of the collapsed shaft is considered hazardous. The site is on private land, however. Location: ABAB sec. 22, T11N, R8E.

Minute Man
CC002939

The Minute Man claim is located 3.5 miles northeast of Neihart and one quarter of a mile south of the Savage Mill (Robertson, 1951). Development includes many adits and a 48 foot shaft with a short drift. The main adit is 700 ft long. There were several ore shoots.

There were no mill tailings present and the adits had caved. The adits were not discharging, and there were no hazardous materials or structures. It was visited on 05/17/98.

Mongul Lode
CC002843

This site is located on private land. No references were found for this site. There were no mill tailings or discharging adits at the site. There were no hazardous materials or any hazardous structures located here. The mine is located in sec. 32, T14N, R8E

Morning Star
CC002723

No tailings were found at the site, but there was a mill. All are located on private land. There were no discharging adits or hazardous materials or structures. According to Lawson (1974), the Morning Star Mine was a gold, silver, lead, and zinc deposit. The mine is located in sec. 29, T14N, R8E.

Moulton/Molton/Compromise
CC002681

There were no tailings located at the site. Pioneer Technical Services (1995) did a site assessment at the Moulton and the following summarized their findings. There was approximately 100,000 cubic yards of waste rock. The waste rock contained arsenic, copper, and mercury. The only hazardous structures were six transformers. Two adits were discharging. The discharge associated with the large adit and dump had a flow of approximately 40 gpm and had a pH of 7.9. The other discharging adit (caved) had a flow of 15 gpm and a pH of 5.75. The MCL for cadmium, nickel, and antimony were exceeded at the second adit. The drainage from the second adit also seeped into the ground before reaching the drainage. Rock Creek flowed through the site but did not have any contaminants related to the mine discharge.

The Moulton Mine is located on Rock Creek about one quarter mile east of the main street in Neihart (Robertson, 1951). A mill was built at the site but burned down in 1921 and was not rebuilt.

The vein is in pre-Beltian black mica schists and pink gneiss and ranges from 3 to 7 ft in width. Development of the mine included two adits, a 550 ft deep shaft (with a level every 100 ft), a 125 foot winze (from the 500 foot level), and another winze from the 625 foot level to the 700 foot level. The mine was a lead, silver, and zinc deposit.

Mountain Chief
CC002951

The Mountain Chief Mine was a lead, zinc, and silver deposit that is located on the north slope at the top of the main ridge of Carpenter Creek, three quarters of a mile northeast of the Star group of claims (Robertson, 1951). Development included four shafts (the deepest was 310 ft) and at least three adits. The adits were 500 ft long, 900 ft long, and 1,700 ft long.

There were no mill tailings or discharging adits present at the site. The adits had caved, and no other hazardous structures or materials were observed.

Mountain Side and last Chance
JB05377

This site was screened out because it is private consisting of two patented mining claims. It was developed to explore a lead-silver deposit at the contact of limestone and an overlying minette sheet (Robertson and Roby, 1951).

Nevada
CC002957

At the Nevada site, there were no mill tailings, discharging adits, or hazardous materials or structures present. The Nevada Mine was a silver and lead deposit. The Nevada claim adjoins the Galt claim to the north (Robertson, 1951). Originally, there was a 250 foot shaft with several levels.

New Alicia & New Rodwell
CC002963

The New Alicia and New Rodwell claims were screened out because they are located on a dry ridge top. Additionally, they are most likely on private land. According to Robertson (1951), the site was a silver, lead, zinc, and copper mine. They are located a quarter of a mile north of the open pit of the Silver Dyke Mine. Development work included several trenches and open cuts as well as an adit drift that was 150 ft long. The vein contains galena, sphalerite, pyrite, chalcopyrite, and oxidized products of these minerals.

New Deal
JB005092

The general area of the New Deal was visited but its exact location was not found. Robertson and Roby (1951) state the property consisted of several unpatented claims a short distance northeast of the Blue Dick Mine. A gravity mill was constructed at the site, but later the property was abandoned and relocated. Gold and silver were found associated with magnetite, pyrite, and chalcopyrite.

New Mine Sapphire
JB004642

This site was screened out because it is mostly, if not all, private and its commodity was sapphires. It is located in sec. 23, T13N, R11E.

Neihart Tailings
CC008410

This site was screened out because it was private and because of a previous study. The Neihart tailings are located on private land in sec. 29, T14N, R08E. According to Pioneer Technical Services (1995), there are mill tailings present, but there are no discharging adits. The estimated volume of tailings is 23,000 cubic yards. The tailings contain elevated levels of arsenic, cadmium, lead, antimony, and zinc. There was no waste rock. Belt Creek flowed between the tailings and U.S. Highway 89. Stream sediment samples taken from Belt Creek documented the release of arsenic.

Nilson
CC002969

This site was screened out because it is probably patented. According to Robertson (1951), the Nilson group consists of 21 patented claims with two inaccessible adits. No ore was shipped from any of the claims.

North Pacific
MR008528

This site was screened out primarily because it is on private property with unlikely impacts to Forest Service ground. The location is in T10N R9E Sec. 29.

Ole Grendal ET
JB004712

The references for this site are: USBM MLA Open-file Report 92-82. It was screened out.

Our Last Chance
JB004722

This site was screened out because there are no references to it in the MILS database

Overlook Claim
JB004702

This site was noted to have one partially open adit when visited on 5-22-98. The opening was approximately 1 ft by 2 ft. The position of this plot was moved to the adit symbol on the Bandbox Mountain 7.5-min. quadrangle. The location of this mine is sec. 32, T14N R10E. The reference for this site is MLA Open-File Report 92-82. There was no other evidence of hazardous structures/materials.

Palmetto No. 2
CC002915

This site was screened out because it is probably patented, there are no mine symbols in the general vicinity on the topographic map, and Robertson (1951) had no further information on it.

Peabody
CC002813

The Peabody site was screened out because of the inaccurate location of the site. The mine was a silver and lead mine that was located somewhere between the Galt and the Queen of the Hills claim (Robertson, 1951). The vein is located in pink gneiss. According to Robertson (1951), the workings were inaccessible.

Pierce-Higbee
JB005392

The Pierce-Higbee also known as the Dry Wolf consists of three patented claims. Robertson (1951) describes its location as on the west slope of the ridge east of Lions Gulch, about a half mile above its junction with Dry Wolf Creek Canyon. Robertson (1951) also states the mine workings consisted of several short adits that were caved and inaccessible at the time. This site was screened out because it is on private property.

Pig-Eye Basin Gypsum
JB005292

This site was screened out because the commodity was listed as gypsum and it was private. The reference for this site is Robertson and Roby (1951, p.47).

Placer Creek Deposit
MR003117

This site was screened out because it is a placer deposit. Lyden (1948) states that claims along Placer Creek have been worked intermittently with invariably, small returns.

Placer Creek
MR003122

This site was screened out because it is a placer claim. According to Lyden (1948), the source of the placer gold is unknown, and returns have been small.

Princess Claim
MR003737

The Princess claim, Survey No. 3331, is on a ridge between Alabaugh and Rattler creeks, approximately a mile southwest of Castle Lake. A replacement pod in the Amsden Limestone was developed by a 45-foot shaft and 70 ft of crosscuts (MacKnight, 1892). The minerals of the pod consist chiefly of jasper but include some galena, cerussite, and copper oxides. The limestone in the vicinity of the shaft strikes N72/W and dips 45/NE (Winters, 1968).

The MBMG visited the site in June 1998 and located a steep-sided, 10-foot deep pit that is the remains of the main shaft. It was determined that it was probably on patented land, however. Several other small prospects were observed on the ridge top.
Location: AAC sec. 28, T8N, R8E.

Prospects sec. 2, T8N, R8E
MR008500

This site was visited on 05-08-98 by an MBMG geologist and the property consisted of prospects only. There were no other hazards noted.

Prospects in sec. 6
JB008483

This site was screened out because there were no references in the MILS database. The location of this site is in sec. 6, T13N, R11E.

Ponderosa
CC002843

The Ponderosa Mine was a silver, copper, lead, and zinc deposit (Lawson, 1974). It is located in sec. 15, T14N, R8E. The Ponderosa Mine was screened out because of the inaccurate location in the references to it.

Prospects in sec. 05
MR008485

There is no information in the MILS database or references about these prospects located in sec. 5, T14N, R5E, on a ridge on the south slopes of the Smith Fork Deep Creek. This site was screened out because it is most likely on a dry ridge.

Queen of the Hills
CC002819

At the Queen of the Hills site, there were no mill tailings. The environmental condition of the area was assessed by Pioneer Technical Services (1995) and the following is a summary. The volume of waste rock was estimated to be 54,640 cubic yards, and the waste rock contains silver, arsenic, barium, cadmium, copper, mercury, manganese, nickel, lead, antimony, and zinc. There was one discharging adit and the water seeped into the waste rock after flowing a short distance. There was a lack of runoff and the nearest surface water was at a distance. Safety hazards at the site include three open adits and some collapsing structures.

The location was visited 05/18/98 by an MBMG geologist but since it was private and because the discharge was estimated as less than one gallon per minute, the site was not sampled. The discharge did not exit private land.

The Queen of the Hills adjoins the Galt and the Equater mines (Robertson, 1951). A drift was driven for about 1,000 ft, and a shaft was sunk 300 ft. There were levels at 100 and 300 ft off of the shaft. Other development work included two adits. The mine was a lead, silver, and zinc deposit.

Ringling Mine-Willow Creek Deposit
MR003512

According to Roby (1950), the Ringling Mine is a patented claim that operated in the early 1920s and produced iron ore consisting of dense, fine-grained magnetite and limestone partly replaced by magnetite. The ore occurs in a contact replacement between crystalline limestone and coarse-grained granite. The contact is irregular, but the deposit appears to strike northeast and to have a vertical dip.

Ore was mined from a “glory hole”, or stope open to the surface, and trammed through an adit 50 ft below the outcrop of the ore body. A second adit was driven 100 ft below the first, but little or no ore was mined from it. Both adits are inaccessible now because of caving near the portals (Roby, 1950).
Location: T09N R07E Sec. 26 ABCA

Ripple
CC002807

Pioneer Technical Services (1995) assessed the Ripple site. The safety hazards included three open adits, a collapsing loadout structure, and a collapsing cabin. There were no mill tailings. The volume of waste rock was estimated to be 6,100 cubic yards and contained silver, arsenic, barium, cadmium, copper, mercury, lead, and zinc. Four discharging adits were observed but none of the flows reached surface water. The discharge from adit #1 exceeded the MCLs for arsenic and cadmium, and from adit #3, the MCL for cadmium was exceeded.

The Ripple Mine is located about two miles northeast of Neihart in the upper Snow Creek valley (Robertson, 1951). The development work includes four main adits and two short adits. Several ore shoots were developed from the lower ore shoot. The vein is 2 to 4 ft in width. It was snow covered on 05/17/98 and so it was not inventoried.

Rochester and Unity
CC002801

The Rochester and Unity site is privately owned and so was not inventoried in this study. It was assessed by Pioneer Technical Services (1995). There were no mill tailings at the site. The waste rock was estimated at 3,280 cubic yards. The waste rock contained arsenic, cadmium, copper, mercury, lead, zinc, barium, chromium, iron, nickel, and antimony. The dumps were sparsely vegetated. An unstable highwall was formed where Rock Creek undercut the waste dump. There were no discharging adits, seeps, or springs on the site. There were some partially caved adits that had steep sides.

According to Robertson (1951), the Rochester and the Unity claims are located east of the Moulton claim. Many veins were exposed in surface working and an adit was driven for 540 ft. Drifts were driven off of the adit on many veins.

Sage Creek Iron Deposit
JB005257

This site was screened out because it was located on private land, and there were no references in the MILS database. The location of this site is sec. 22, T14N, R11E.

Savage
CC002777

The Savage Mine is located about one quarter of a mile up Squaw Creek from its junction with Carpenter Creek (Robertson, 1951). It was included in the Silver Dyke claims for many years. There was a 100 foot shaft and a drift driven to the north. Later an adit drift was driven to the shaft and 400 to 500 ft beyond the shaft. It was screened out because it plotted on private land.

Setter Mine/Hans Setter
JB05072

This site was screened out because literature describes it as consisting of mainly shallow prospects on a dry ridge. Robertson and Roby (1951) state there is no record of production from the site. The ore deposit consist of silver lead ore as a replacement in limestone near a contact with a syenite porphyry.

Shaft in Sec. 35 T9N R8E
MR008499

This property consists two shallow shafts and of a 10 ft by 12 ft board-on-board shack over a third shaft or prospect pit. None of the shafts were over 20 ft deep; the dumps are small. The third shaft or prospect with the cabin over it has dark gray shales on the waste dump while the one to the west has diorite porphyry. The shales have micro-veinlets (< 1–2 mm) in a stockwork with pyrite on the fractures.

Sheep Creek Iron
MR003037

The references for this site are: DeMunck, 1956, MBMG Information Circular 13; Reed, 1949, USBM Report of Investigations 4400; Ruby, 1950, USBM Information Circular 7540; Julian, USBM Report of Investigations 3801; Geach, MBMG Special Publication 28; Goodspeed USGS Open-file Report; and Lind, 1942, Montana School of Mines thesis. It was screened out because of the small size of the workings.

Sherman
CC002765

The Sherman site was a silver, lead, and zinc mine. The site was assessed by Pioneer Technical Services (1995). The following is a summary of their findings. There are no mill tailings at the site. There was a partially caved adit that was accessible. Below the site in Carpenter Creek, there were tailings but they were from the dam failure at the Silver Dyke tailings upstream. There was a small discharge from the adit and the pH was 7.1. There were no other discharges. There were approximately 200 cubic yards of waste rock that contained iron, lead, manganese, and zinc.

Robertson (1951) states that the Sherman claim was previously named the Flamsburg and is located three and a half miles up Carpenter Creek from Belt Creek. Development includes an adit drift that is 400 ft long, an adit crosscut that is 50 ft long, and a shaft that is 35 ft deep. It plots on patented land and so was screened out in this study.

Silver Horn
CC002453

This site was screened out because the location was inaccurate (+/- 5 km) in MILS. As described in MBMG Memoir 20, p. 17, it may be the same as the Big Seven Mine in the Neihart mining district, but this report locates it as 3 mi. southeast of Neihart which must be incorrect if it is the same as the Big Seven.

Sir Walter Scott and Mystery
JB005412

This site was screened out because it is private. Robertson and Roby (1951) described the site as a silver lead mine with the workings consisting of a 75 foot inclined shaft and a 300 foot vertical shaft, both inaccessible. The report also notes locals claimed the vertical shaft encountered an underground lake, and was abandoned.

Ski Doo
MR003697

Described as a lead-silver mine by Roby (1950), mineralization at the site consisted of galena and cerussite. A small amount of production occurred in 1917. According to Roby (1950), the workings are now caved.

The MBMG visited the general vicinity of the site as described by Roby (1950), but the site was not located.
Approximate Location: T08N R08E Sec. 11

Silver Belt
CC002741

The following summarizes the findings of Pioneer Technical Services (1995). There were no tailings at the site. There was approximately 9,005 cubic yards of waste rock that contained arsenic, copper, mercury, lead, zinc, cadmium, iron, manganese, and antimony. A pH measurement of 6.63 was taken at a discharging adit. The MCL for cadmium was exceeded in the discharge. There were no hazardous materials or hazardous structures at the site.

The mine is located about 3,000 ft north of the Broadwater Mine (Schafer, 1935). A shallow shaft was sunk and later a crosscut adit was driven 425 ft to the vein. A winze was sunk from the adit and an ore shoot was mined out. It is located on patented land. There is a small sliver of LCNF-administered land downhill from it but there is no access because of the private land position.

Silver Dyke
CC002711

The Silver Dyke Mine is located about three and a half miles up Carpenter Creek from its junction with Belt Creek (Robertson, 1951). The mine is a lead, silver, and zinc deposit. It is on patented land and people were living in a cabin at the site in 1998.

Pioneer Technical Services (1995) sampled the Silver Dike. There are no mill tailings on the site; the waste dumps were unvegetated. One adit had a significant flow. The water had a pH of 5.12, and the water exceeded drinking water standards for cadmium, copper, nickel, and antimony. The discharging water flowed over the waste rock and into Squaw Creek. There were exceedances of drinking water standards for cadmium, copper, nickel, and antimony. The one hazardous opening is the glory hole on the hilltop (above the adit) which had very steep sides and the fence (erected by the DSL) was down in places. The Silver Dyke Mine was dry but the waste was eroding.

The ore body had a length of about 600 ft and a width of about 400 ft (Schafer, 1935). Schafer states that there were two adits located at different elevations. The lower adit was about 1000 ft long and a 36 gage track was installed. There is also an open pit.

The Silver Dyke deposit was dated by Armstrong and others (1982) as 46.9+/- 1.6 m.y. (K-feldspar) by testing a granite porphyry dike that was late intra-mineral or early post-mineral age.

Silver Dyke Mill
CC008412

The Silver Dyke Mill is located on private land in sec. 15, T14N, R08E. It was a silver, lead, and zinc mine, and there are tailings spilling down the hill. The volume of waste rock was estimated to be 82,600 cubic yards by Pioneer Technical Services (1995). The waste rock dumps were unvegetated, but the dumps did contain sulfides. Two ore bins and the mill building were mostly collapsed.

Silver Dyke Tailings
CC008411

The location of the Silver Dyke tailings is in sec. 15, T14N, R8E. The tailings are on private ground. They were tested by Pioneer Technical Services (1995) the following is a summary of their findings. There were no hazardous structures or openings at the site, and there were no discharging adits, springs, or seeps. It was estimated that 56,350 cubic yards of mill tailings remain at the site, but it is unknown what the volume of the tailings was previously. The tailings were not contained; the dam was washed away during a failure. There was no waste rock, but there was a tailings pile that consisted of small uniform rock fragments.

Sediment samples showed that arsenic, barium, cadmium, copper, manganese, and lead were present. Water samples also showed copper, manganese, and lead. There were no exceedances of the drinking water standards.

Skunk Creek Deposits
JB004802

This site was screened out because there were no MILS references, the location was inaccurate, and the commodity was iron.

South Fork Placer
JB004762

This site was screened out because it was a placer with an inaccurate location. The only MILS reference to it was McClernan (1980), p. 13, Geologic Map 7.

Spotted Horse
CC002735

The Spotted Horse claim was screened out because it is located on a ridge top. According to Robertson (1951), the claim is located about 2.5 miles southeast of Neihart on the west slope of Long Baldy Mountain. Development consisted of a crosscut adit that is 120 ft long and a drift was driven southward from the end of the crosscut for several hundred feet. The mine was a gold and silver deposit.

Sweepstakes
JB005417

The references for this site are: USBM Information Circular 7602 p. 35-36. The site was screened out.

Thorson/Hoover Creek
CC002579

This site was screened out because the commodity was silicon. There were no references found for this site.

Twentieth Century
MR003517

This site was screened out because it is probably patented, and there are no references to this site other than a mineral property file (34.030). The general area was visited with only a few small prospects seen. No structures or hazardous materials were noted.

Unnamed 09N08E19BDDC Mine
MR008512

This unnamed site just west of Grasshopper Creek consisted of a series of shallow trenches and pits and a collapsed shaft surrounded by the remains of a log building. When the site was visited in June 1998, two of the pits held shallow pools of water. Because the site is apparently on patented land, the water was not sampled.

The mineralogy at the site is similar to that of the Grasshopper Mine, with limestone as the host rock. No production records or other historical information were found during the literature search for this area..
Location: BDDC sec. 19, T9N, R8E.

Unnamed 09N08E20DAAA Prospect

MR008510

This site was identified by the mineral resource specialist at the White Sulphur Springs Ranger District and was described as a hazardous pit/shaft that is 30 to 40 ft deep and situated next to a pack trail in the Castle Mountains. The site is on land administered by the Lewis and Clark National Forest.

Location: DAAA sec. 20, T9N, R8E.

Unnamed BDCAsec.20T9NR8E Prospects

MR008511

This site was identified by the mineral resource specialist at the White Sulphur Springs Ranger District and was described as three dry prospect pits on LCNF-administered land.

Location: BDCA sec. 20, T9N, R8E.

Unnamed Sec. 27 Prospect

MR008526

This prospect consists of a pit/shaft on LCNF-administered land. Barbed wire and other fencing materials cover the bottom of the pit.

Location: ABCC sec. 27, T8N, R8E.

Unnamed Gypsum

JB005342

This site was screened out because the commodity was listed as gypsum, the location was only accurate to +/- 1 km, and there were no references to it in the MILS database.

Unnamed Quarry

CC002183

This site was screened out because it was only a quarry. There were no references listed for this site.

Van Dor

MR003482

At this site, there was a series of open cuts with the remains of the original adit nearly obliterated by more recent cuts. The flattened remains of a building dump has abundant magnetite. References included USBM, 1950, Information Circular 7540, p. 31.

Venus

CC002507

This site was screened out because of the inability to locate the mine. There were no references listed for the site.

Weatherwax and King Claims (Lenny)
JB005112

The references for this site are: DeMunck, 1956, MBMG Information Circular 13. Robertson and Roby, 1951, USBM Information Circular 7602. Weed, Geology of the Little Belt Mtns. 20th Annual Report, Montana Western History Vol. 25, No. 21975, Montana History Society p. 62.

This site was screened out; DeMunck described it as being patented claims in sec. 31, T13N, R9E. Madison limestone was host to veins of limonite and hematite (5 ft wide locally). The deposit was classified as a replacement deposit. An assay sample taken by DeMunck ran 0.005 oz gold, 0.05 oz silver, 0.05% lead, and 50.7% iron.

Whippoorwill (Blotter)
CC002747

The Whippoorwill was visited 05/16/98. There were no tailings, discharging adits or any hazardous materials or structures present at the site. The Whippoorwill claim is located a half mile southwest of the Silver Dyke Mine on a ridge between the headwaters of Mackay Creek and Squaw Creek (Robertson, 1951). Development work included a shaft that is 250 ft deep. There are many crosscuts and drifts off of the shaft at many levels. There is also a 40 foot winze. The ore contains galena, sphalerite, and chalcopyrite.

Whitetail Adit
MR008482

The site was visited 05/13/98 by an MBMG geologist. This site is located in sec. 16, T10N, R10E. There is one open shaft and one adit. The top of the lower dump measured 60 ft. Splinter-y Belt shales and brecciated quartz veins were locally stained with copper oxides. The adit's dump was not in contact with the creek. The shaft seemed to follow centimeter-wide veins which were seen in the walls. The shaft had 20 ft high walls. The site is remote and accessible only by foot. The reference for this site is: Garverich, 1995, p. 56.

Whittaker
MR003137

This site was screened out because it is probably patented, there are no references to this site, the general area was visited with only a few small prospects seen. No structures or hazardous materials were seen.

Willow Creek Deposit
JB005262

This site was screened out becasue it is on private land and the National Forest is unlikely to be impacted by this site. The location of this site is sec. 7, T14N, R11E. The reference for this site is mineral property file MPF 34.29 (see Running Wolf Iron Deposits).

Woodhurst and Mortson

JB005432

This site was screened out, because it is located on private ground. The reference is USBM, 1951, Information Circular 7602.

Yellowstone Mine

MR003387

This site is referenced in MBMG Bulletin 95, p. 19. The owner is listed as George Voldseth of Hamilton Mines, Inc., Martinsdale, MT 59053. In June 1998, the MBMG was unable to locate the site with the existing information.
Approximate Location: sec.18, T8N, R8E.

Yogo Creek Placer

JB004787

Screened out, drove by this site still active. The Yogo Creek Placer mine is located in sec. 4, T13N, R10E. The references for this site are MBMG Geologic Map 7, 1980 p. 15. There were no visually apparent hazards.

ROCKY MOUNTAIN DIVISION SITES

Babe Prospect

LC007362

This property was screened out because it's accuracy was +/- 1 km, the commodity was lead and there were no references for it in the MILS database except for a mineral property file (37.104) and Mudge (1974). It was located in the Scapegoat Wilderness by Mudge (1974) and the workings consisted of two trenches. Their samples assayed 0.05% lead and a trace of gold. The workings explored iron-oxide stained Mississippian limestone near a thrust contact with Precambrian Mount Shields Formation.

Biggs Creek Prospects

TE001004

The only reference to this site is Marks (1978) where it is described as consisting of one caved adit driven along an unconformity in sandstone and carbonaceous shale. It was screened out because of the small nature of the deposit. Minerals associated with the occurrence are described by Marks (1978) as “iron-rich” minerals. Some zinc was also found in the samples taken by Marks.

Burrell and Evans

LC004259

This site was screened out in the office because the only commodity listed was iron, there were no other references to it except for a mineral property file, and the precision was +/- 1 km. It was tentatively identified as being located on the Steamboat Mountain 7.5-min. quadrangle.

Chief of the Mountains Patented Claim
LC004514

This site was screened out because it was listed as a silicon/sandstone deposit, the land was patented and because of the remoteness of the site. The only reference to the Chief of the Mountains patented claim is Marks (1978) in which the claim is described as an evaporite "bloom" along the unconformity of sandstone and shale. The USBM took a 25 ft long sample and did not detect any metals. They also found no workings at the site.

Cinnamon Lode
LC001825

This site was screened out because the only reference for it was a USBM mineral property file (37.148), the accuracy was +/- 100 m, and the commodity was listed as lead. It is located in the Scapegoat Wilderness. No workings were noted by Mudge (1974). Of the three samples assayed by Mudge, the grade was <0.01% lead and a trace gold. The samples were taken from a Mississippian, iron oxide stained limestone.

Dexter Lode
LC001837

This site was screened out because it had no references in the MILS database except for the mineral property file (37.245). Its commodities were listed as lead and zinc; its accuracy was +/- 500 m. No mention of it was found in any of the wilderness studies done by the USBM and USGS.

Goat Ridge
LC004509

This site was screened out because its commodity was listed as dimension stone or stone (although Marks' description made it sound like this was a copper-lead occurrence). The only reference was Marks' Bob Marshall Wilderness Study. This site was screened out because of the remote location (it is 32 miles by pack trail), the small nature of the disturbance and the commodity. Marks (1978) describes one west trending, caved adit, and two prospect pits. These workings explored the contact between the Helena Formation and an underlying diorite sill. Minerals associated with the occurrence include malachite, limonite, bornite, chalcopyrite, smithsonite, sphalerite, and auricalcite (Marks, 1978). The occurrence was claimed in 1919 by Otto Waddell, N.S. Dobbs, and Harry Marks. Claim names include the Old Hickory, High Land, Mable, Lucky Strike, and Evening Star.

Jessie
LC001735

Mudge and others (1974) described this site as having two pits that explored Devonian age limestone with hematitic and limonitic stain. Minimal metals values (<0.01% lead and trace gold) were found in the one sample that the USGS took. The site was screened out and not visited.

Jewell Mountain Mining Co.

LC001891

This site was screened out because it was described in Mudge and others (1974) as having one pit in the Precambrian McNamara Formation exploring a sandstone with red and white chalcedony filling some of the vugs. A sample taken by the USGS assayed <0.01% copper.

Magma

LC004214

The Magma was screened out because the accuracy of the location according to the MILS database was +/-5 km, there were no references to it except for a mineral property file (37.160) and it may have been on private land.

Ready Money

LC001747

This site was screened out because it had no references except for a USBM mineral property file 37.048, the commodity was lead and it had an accuracy of +/-1 km. It was tentatively located on the Steamboat Mountain 7.5-min. quadrangle.

Roosevelt Claim

LC001603

This site was screened out because it had an accuracy of +/-1 km in the MILS database, it had no references except for the mineral property file (21.154) and Mudge and others (1974). The commodity listed was copper. Mudge and others (1974) found no workings on the claim area. They described the country rock near Welcome Pass as Precambrian Mount Shields Formation (green argillite). Their rock chip samples showed <0.01% copper and trace of gold.

Appendix IV
Soil and Water
Analytical Results
Lewis and Clark National Forest

Lewis and Clark National Forest

Analytical results of soil/waste samples (qualified data)

Units: (mg/kg dry weight)

Site	Sample	Lab. ID	Ag	C	Q	As	C	Q	Ba	C	Q	Cd	C	Q	Cr	C	Q	Cu	C	Q	Ni	C	Q	Pb	C	Q	Zn	C	Q
Block 'P' Tailings																													
	GPTD10H	98S0154	2.32	U	N	465			117	B		4.63	U		4.63	U		75.9			4.6			611			562		
	GPTT20H	98S0156	80.1		N	191			527			4.47	U		4.47	U		48.4			4.47			952			48.2		
	GPTT30H	98S0155	35.9		N	395			210	B		4.22	U		4.22	U		68.7			4.22			1046			224		
Kid's Dream																													
	SKDD10H	98S0148	2.23	U	N	972			120	B		4.47	U		9.02	B		1259			47	B		42.3			1133		
Belle of the Castle																													
	HBCD10H	98S0149	2.65	U	N	7.4	B		67.7	B		5.29	U		25.6	B		356			6.45	B		16.8			35.3		
Powderly																													
	RPOD10H	98S0150	2.4	U	N	15.7	B		1010			4.86	U		15.4	B		65.3			38.3	B		4666			572		
	RPOD20L	99S0215	7.07			14.76			768			3.115			11.15			31.94	*		19.42			12609	*		419.7		
NF site on Hensley Creek - unnamed in sec. 11, T08N, R08E																													
	HNFD10L	99S0216	<.242	U		17.01			309.8			2.111			24.02			17.94	*		21.94			47.2	*		44.28		
Hamilton Mine																													
	HHAD10H	98S0151	2.25	U	N	60.2			129	B		4.5	U		7.93	B		67.6			19	B		826			2919		
Dr. Barnette's or Montana Copper																													
	CDBD10H	98S0153	2.44	U	N	6.56	B		30.6	B		4.87	U		7.44	B		9.14			17.9	B		27			43.3		
Blue Dick Mill																													
	EBDD10H	99S0130	<4.8			12.6			126			<9.6			41.1			907			50.4			40.2			76.3		
	EBDT10H	99S0132	7.96			3.39			26.6			<4.4			7.27			6230			38.6			6.16			75.6		
Ben Franklin																													
	LBFD10H	99S0131	3.09			11.2			106			<5.6			39.9			1410			46.1			17.4			89.4		

Note: U = Under detection limit value

B = below reqiured reporting value, but above detection limit

N = poor spike recovery

* = duplicate was outside the accepted limit for accuracy (+/-20%), probably due to soil inhomogeneity

Appendix IV. Analytical results and exceedences of water analysis
µg/l = micrograms/liter; mg/l = milligrams/liter: < = below method detection limit; P = primary drinking water standard exceeded
S = secondary drinking water standard exceeded; A = acute aquatic standard exceeded; C = chronic aquatic standard exceeded; NR = not reported
SC = specific conductance in micromhos/centimeter; Temp. = temperature in degree Celcius; GPM = gallons/minute; CFS = cubic feet/second

Sample		Al µg/l	As µg/l	Ba µg/l	Cd µg/l	Cr µg/l	Cu µg/l	Fe mg/l	Pb µg/l	Mn mg/l	Hg µg/l	Ni µg/l	Ag µg/l	Zn µg/l	Cl mg/l	F mg/l	NO3 as N mg/l	SO4 mg/l	SiO2 mg/l	Field pH	Field SC µmhos	Temp. °C	Lab SC µmhos	Lab pH	Flow Rate	Units
Silver Dyke Mine - sample date 05/26/98																										
BCCS30L	upstream	<15	<1	26.20	<2	<2	<2	0.011	<2	<.001	<1	<2	<1	9.7	<.5	<.05	<.05	4.3	7.8	6.44 S	60.1	7.5	63.1	7.15	3.8	CFS
BSQS10H	adit discharge	1088 S A C	1.50	31.82	178.80 P A C	<2	2456 S A C	0.022	171.10 P A C	17.360 S	<1	70.96	<1	15850.0 S A C	0.848	0.148	0.11	569.9 P	23.9	4.90 S	875.0	14.2	908.0	4.81 S	23.0	GPM
Double X Mine - sample date 05/27/98																										
BXXS10M	upstream	<15	<1	32.10	<2	<2	3.60	0.020	<2	<.001	<1	<2	<1	99.2	<.5	0.119	<.05	28.5	19.1	7.34	113.2	5.3	122.4	7.10	5.0	GPM
BXXS20M	downstream	52.6 S	<1	56.10	<2	<2	59.40 A C	0.049	<2	0.080 S	<1	3.80	<1	332.0 A C	0.524	0.265	<.05	50.5	20.9	6.48 S	149.6	12.4	157.9	7.02	0.2	CFS
Haystack Iron Spring - sample date 05/26/98																										
BHFS10H	spring	<30	3.30	9.80	<2	3.6	<2	5.812 S A	<2	0.769 S	<1	21.30	<1	282.6 A C	0.781	3.090 S	<.05	434.0 S	28.4	6.85	906.0	7.1	903.0	6.86	4.0	GPM
Haystack Creek Mine - sample date 05/26/98																										
BHCS10M	upstream	<15	<1	29.90	<2	<2	7.70	0.036	<2	0.021	<1	2.10	<1	62.3	<.5	0.307	<.05	48.8	24.8	7.10	135.0	11.8	145.5	6.88	20.0	GPM
BHCS20M	downstream	<15	<2	23.10	<2	<2	6.20	0.007	<2	<.001	<1	2.40	<1	196.6 A C	<.5	0.326	<.05	50.0	23.9	6.86	133.2	10.4	139.0	6.78	0.2	CFS
Big Seven Group - sample date 05/27/98																										
BSNS10L	upstream	<15	<1	16.01	<2	<2	<2	<.005	<2	<.001	<1	<2	<1	8.4	<.5	<.05	<.05	3.8	6.3	7.10	46.8	5.3	53.5	7.06	2.1	CFS
BSNS20M	downstream	<15	<1	24.79	2.70 C	<2	<2	0.097	<2	0.179 S	<1	8.60	<1	1050.0 A C	<.5	0.074	<.05	58.0	8.7	7.09	150.5	7.1	172.4	6.80	5.6	CFS
Carpenter Creek Tailings - sample dates 05/25-26-27/98																										
BCCS10L	upstream	<15	<1	26.70	<2	<2	30.20 A C	<.005	3.00	0.048	<1	<2	<1	353.3 A C	<.5	<.05	<.05	12.1	8.7	6.92	30.2	11.1	86.7	7.00	8.6	CFS
BCCS20L	downstream	<15	<1	41.30	<2	28.3	<1	0.006	<2	0.047	<1	<2	<1	<5	<.5	<.05	<.05	16.9	9.4	7.51	95.2	10.9	93.8	6.87	6.3	CFS
BCCS40L	downstream	<15	<1	34.90	2.10 C	<2	30.40 A C	<.005	<2	0.071 S	<1	<2	<1	384.5 A C	<.5	0.054	<.05	14.9	9.2	6.39 S	82.8	6.5	88.6	7.00	7.8	CFS
BBCS50L	downstream	63.9 S	<1	72.90	<2	<2	<2	0.032	<2	0.026	<1	<2	<1	124.7 A C	0.584	<.05	<.05	7.9	7.3	7.74	82.9	5.3	97.6	7.10	42.0	CFS
Eighty-eight Mine - sample date 05/27/98																										
BEES10M	upstream	<15	<1	23.50	<2	<2	16.70 C	0.009	<2	0.069 S	<1	4.02	<1	537.0 A C	<.5	0.067	<.05	33.0	9.2	7.58	114.1	9.3	118.2	6.98	12.3	CFS
BEES20M	downstream	<15	<1	30.67	<2	<2	16.10 C	0.008	<2	0.062 S	<1	3.80	<1	529.2 A C	<.5	0.069	<.05	32.4	9.2	7.62	113.7	9.7	125.0	6.73	11.1	CFS
Compromise Claim - sample date 05/28/98																										
Broadwater																										
BBCS10M	upstream	<15	<1	98.70	<2	2.5	<2	0.012	<2	<.001	<1	<2	<1	<2	0.639	<.05	<.05	4.1	6.8	7.25	101.5	3.1	122.5	7.45	40.9	CFS
BBCS20L	downstream	44.6	<1	89.00	<2	<2	2.40	0.025	<2	<.001	<1	<2	<1	28.5	0.685	<.05	<.05	4.5	6.6	7.89	94.8	3.4	103.8	7.16	40.4	CFS
Moulton / Moulton Group - sample date 05/28/98																										
BBCS20L	upstream	44.6	<1	89.00	<2	<2	2.40	0.025	<2	<.001	<1	<2	<1	28.5	0.685	<.05	<.05	4.5	6.6	7.89	94.8	3.4	103.8	7.16	40.4	CFS
BRCS10H	downstream	56.2 S	<1	29.65	32.10 P A C	<2	6.75		12.93 C			37.73	<1	10080.0 S A C						6.84	315.0	4.2			0.4	CFS
Neihart Tailings - sample date 05/28/98																										
BBCS40L	upstream Carp. C	52.6 S	<1	91.10	<2	2.3	<2	0.047	<2	0.025	<1	<2	<1	70.7	0.693	<.05	<.05	5.2	6.6	7.75	93.9	4.6	107.4	7.46	48.6	CFS
BBCS30M	downstream Rock	39.1	<1	80.90	2.05 C	<2	<2	0.020	<2	0.444 S	<1	4.20	<1	963.8 A C	0.634	0.054	<.05	17.1	7.1	7.33	113.2	3.9	121.0	7.14	41.0	CFS
BBCS50L	downstream	63.9 S	<1	72.90	<2	<2	<2	0.032	<2	0.026	<1	<2	<1	124.7 A C	0.584	<.05	<.05	7.9	7.3	7.74	82.9	5.3	97.6	7.10	42.0	CFS
NE SE S7 (Lucky Strike) - sample date 05/28/98																										
GBAS10H	downstream	41.6	<1	30.70	25.19 P A C	<2	34.98 A C	1.414 S A	<2	7.400 S	<1	9.30	<1	5213.0 S A C	0.551	0.270	<.05	159.7	21.6	6.75	307.0	15.0	345.0	5.45 S	0.8	CFS
Block 'P' Tailings - sample date 05/19/98																										
GPTS10H	downstream	<30	<1	56.97	7.12 P A C	2.5	2.50	0.006	<2	2.610 S	<1	5.51	<1	1479.0 A C	<.5	0.165	<.05	81.8	13.7	6.74	254.0	**12.7?**	284.0	7.53	1.5	CFS
GPTS20H	upstream	<30	<1	65.32	8.80 P A C	2.6	2.98	0.133	<2	2.804 S	<1	<2	<1	2120.0 A C	0.559	0.163	<.05	82.4	14.2	6.51	248.0	5.0	282.0	7.47	1.5	CFS
Dry Fork Belt Creek Lower Tailings - sample date 05/28/98																										
DBAS30M	upstream	38.9	<1	63.30	<2	2.5	2.68	0.197	<2	0.552 S	<1	2.80	<1	218.4 A C	<.5	0.079	<.05	15.7	8.6	7.89	189.2	9.7	168.7	7.50	23.0	CFS
SBAS10M	upstream	<15	<1	57.20	<2	4.1	<2	<.005	<2	<.001	<1	2.50	<1	9.5	<.5	0.083	0.09	6.9	7.0	8.36	182.8	7.2	197.0	8.01	2.3	CFS
DBAS10M	downstream	<15	<1	55.60	<2	2.6	2.50	0.169	<2	0.507 S	<1	2.40	<1	209.7 A C	<.5	<.05	<.05	15.0	8.9	8.10	139.8	9.6	150.4	8.09	23.2	CFS
DBAS20M	downstream	30.4	<1	54.40	<2	2.7	<2	0.073	<2	0.498 S	<1	2.60	<1	198.6 A C	<.5	0.073	<.05	15.0	8.7	8.10	139.8	9.6	165.4	7.66	23.2	CFS
Dr. Barnette's / Montana Copper - sample date 05/21/98																										
CDBS30H	upstream	<30	<1	82.90	<2	15.4	<2	0.007	<2	<.001	NR	5.29	<1	8.8	1.363	0.052	<.05	23.7	7.3	7.81	406.0	5.7	444.0	8.03	4.0	GPM
CDBS10H	pond	<30	<1	80.03	<2	15.8	<2	0.018	<2	0.047	NR	5.83	<1	5.8	1.354	0.051	0.45	23.5	5.8	8.16	414.0	6.8	406.0	7.95	0.0	GPM
CDBS20H	downstream	<30	<1	69.20	<2	15.1	<2	<.005	<2	<.001	NR	5.15	<1	4.6	1.458	0.054	<.05	24.8	6.9	7.49	454.0	5.3	468.0	7.56	1.0	GPM
Belle of the Castle - sample date 05/26/98																										
HBCS10L	upstream	36.7	<1	31.50	<2	<2	<2	0.019	<2	<.002	NR	<2	<1	22.4	0.688	0.130	<.05	6.2	15.0	6.79	34.9	3.5	28.4	6.57	4.0	CFS
HBCS20L	upstream	<15	<1	28.40	<2	<2	<2	0.014	<2	<.002	NR	<2	<1	3.3	<.5	<.05	0.05	3.8	15.0	6.96	51.3	4.3	54.3	6.91	1.0	CFS
HBCS30L	downstream	<15	<1	30.90	<2	<2	2.14	0.054	<2	0.008	NR	<2	<1	6.5	0.522	<.05	0.06	4.1	15.7	7.41	57.6	5.9	73.7	7.47	6.0	CFS
HBCS40L	downstream	31.96	<1	41.40	<2	<2	5.30	0.033	<2	<.002	NR	<2	<1	23.2	<.5	<.05	<.05	7.1	15.5	7.32	21.0	4.5	40.0	6.86	6.0	CFS
Powderly Mine - sample date 06/23/98																										
RPOS10L	upstream	46.26	<1	46.25	<2	<2	<2	0.062	<2	0.001	NR	<2	<1	10.0	0.639	0.083	0.22	5.8	15.9	7.67	61.0	11.0	69.1	7.23	6.5	CFS
RPOS20L	downstream	43.11	<1	70.73	<2	<2	<2	0.062	<2	0.001	NR	<2	<1	9.4	0.624	0.078	0.23	5.5	16.0	7.81	63.0	12.4	68.4	7.39	6.5	CFS
Unnamed sec. 02 DCAA - sample date 08/17/98																										
HPSS10L	upstream	<30	<1	55.40	<2	<2	3.73	0.031	<2	<.001	NR	<2	<1	33.8	0.542	0.072	0.07	6.3	14.7	7.51	35.0	7.1	41.0	7.02	8.2	CFS
HNFS10L	downstream	48.1	<1	52.05	<2	<2	2.61	0.033	<2	0.001	NR	<5	<1	70.8	0.503	0.071	<.05	6.4	15.1	7.84	52.0	6.7	54.6	7.34	8.2	CFS
Unnamed sec. 11 AABD - sample date 08/17/98																										

Appendix IV. Analytical results and exceedences of water analysis
µg/l = micrograms/liter; mg/l = milligrams/liter: < = below method detection limit; P = primary drinking water standard exceeded
S = secondary drinking water standard exceeded; A = acute aquatic standard exceeded; C = chronic aquatic standard exceeded; NR = not reported
SC = specific conductance in micromhos/centimeter; Temp. = temperature in degree Celcius; GPM = gallons/minute; CFS = cubic feet/second

Sample		Al µg/l	As µg/l	Ba µg/l	Cd µg/l	Cr µg/l	Cu µg/l	Fe mg/l	Pb µg/l	Mn mg/l	Hg µg/l	Ni µg/l	Ag µg/l	Zn µg/l	Cl mg/l	F mg/l	NO3 as N mg/l	SO4 mg/l	SiO2 mg/l	Field pH	Field SC µmhos	Temp. °C	Lab SC µmhos	Lab pH	Flow Rate	Units
HNFS30L	adit discharge	<30	1.03	75.20	<2	6.0	<2	<.005	<2	<.001	NR	5.38	<1	10.4	0.529	0.080	0.07	3.7	19.5	7.68	223.0	5.4	225.0	7.59	1.0	GPM
HNFS20L	downstream	<30	<1	57.10	<2	<2	2.40	0.020	<2	<.001	NR	<2	<1	20.4	0.540	0.073	0.07	6.5	10.0	7.84	52.0	6.7	66.8	7.29	8.2	CFS
Hamilton Mine - sample date 05/10/98																										
HHAS30L	upstream	<15	1.10	34.40	<2	<2	<2	0.009	<2	<.002	NR	<2	<1	10.0	<.5	<.05	<.05	4.5	13.6	7.50	48.4	3.7	58.1	6.99	1.0	CFS
HHAS40L	upstream	<15	<1	42.10	<2	<2	<2	0.007	<2	<.002	NR	<2	<1	9.9	<.5	0.063	<.05	2.9	10.6	7.41	33.9	4.0	33.4	6.85	1.0	CFS
HHAS20M	adit discharge	<15	1.00	84.40	<2	6.3	<2	0.007	<2	0.001	NR	2.80	<1	16.6	0.760	0.120	0.18	14.0	20.9	7.71	212.0	5.1	263.0	7.70	0.1	CFS
HHAS10L	downstream	<15	<1	24.40	<2	<2	<2	0.011	<2	<.002	NR	<2	<1	3.9	<.5	0.060	<.05	3.3	11.3	8.14	33.9	4.0	40.2	6.98	2.0	CFS
Cumberland Mine - sample date 05/12/98																										
CCUS10M	upstream	<15	<1	38.50	<2	2.8	<2	0.021	<2	<.001	NR	<2	<1	5.0	<.5	0.091	<.05	6.5	15.6	8.06	120.3	10.8	124.4	7.89	0.1	CFS
CCUS20L	upstream	<15	<1	273.00	<2	<2	<2	0.009	<2	<.002	NR	<2	<1	6.9	<.5	0.075	<.05	2.7	12.3	8.02	34.6	6.0	36.5	7.45	250.0	GPM
CCUS30L	spring	<15	<1	33.30	<2	<2	<2	0.009	<2	<.002	NR	<2	<1	11.3	<.5	0.053	<.05	3.4	14.3	7.32	33.3	4.3	42.0	6.51	40.0	GPM
CCUS40L	downstream	37.9	1.23	26.90	<2	<2	<2	0.018	<2	<.002	NR	<2	<1	4.8	<.5	0.057	<.05	3.5	13.6	7.65	44.3	8.4	51.9	7.06	150.0	GPM
New Deal & Jumbo - sample date - 05/13/98																										
SNDS10M	pond	<15	1.60	82.10	<2	3.2	4.10	0.013	<2	0.003	NR	<2	<1	4.8	<.5	<.05	0.10	4.7	7.1	7.45	113.3	8.4	137.4	7.29	0.0	GPM
Blue Dick Mill - sample date 10/13/98																										
EBDS10H	upstream	<30	<1	35.60	<2	<2	<2	<.005	<2	<.001	NR	12.09	<1	<2	0.901	0.112	<.05	19.2	9.6	7.42	273.0	5.0	280.0	7.49	2.0	GPM
EBDS20H	downstream	<30	<1	38.70	<2	<2	<2	<.005	<2	<.001	NR	11.71	<1	3.3	0.537	0.066	<.05	19.3	9.7	8.50 S	274.0	5.6	278.0	7.99	1.0	GPM
Ben Franklin - sample date 10/15/98																										
LBFS20L	upstream	<30	<1	35.30	<2	<2	<2	<.005	<2	<.001	NR	<2	<1	7.7	<.5	<.05	<.05	4.3	10.6	7.37	45.0	3.3	60.2	6.97	15.0	GPM
LBFS10L	downstream	<30	<1	36.50	<2	<2	<2	0.009	<2	0.002	NR	<2	<1	7.2	<.5	<.05	<.05	4.5	10.7	7.85	50.0	3.3	51.5	7.19	15.0	GPM