Red Cloud Mine

aka

Red Cloud, Troy, Whale, Bay State,

Regulator And Vindicator

Patented Mining Claims

Preliminary Assessment Report

Blaine County
State of Idaho

Department of Environmental Quality

February 2008

Submitted to:
U. S. Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

1410 North Hilton • Boise, Idaho 83706 • (208) 373-0502

C.L. "Butch" Otter, Governor
Toni Hardesty, Director

February 13, 2008

Mr. Dan Henry
308 North 2nd Street
Hailey, ID 83333

RE: Site Assessment of the Red Cloud Mine (aka Red Cloud, Troy, Whale, Bay State, Regulator and Vindicator Patented Mining Claims.)

Dear Mr. Henry:

The Idaho Department of Environmental Quality (IDEQ) has completed a review of historical mining data and geological information of the above referenced mining claims. Subsequent to that review, IDEQ conducted a site visit of the Red Cloud Mine and associated claims. During the site visit, mining facilities were mapped and sampled to complete a Preliminary Assessment (PA).

PAs are conducted according to the Federal Comprehensive Environmental Response, Compensation and Liabilities Act (CERCLA). The reasons to complete a PA include:

1) To identify those sites which are not CERCLIS caliber because they do not pose a threat to public health or the environment (No Remedial Action Planned (NRAP));

2) To determine if there is a need for removal actions or other programmatic management of sites;

3) To determine if a Site Investigation, which is a more detailed site characterization, is needed; and/or

4) To gather data to facilitate later evaluation of the release through the Hazard Ranking System (HRS)

IDEQ also completed PAs under contract with the U.S. Environmental Protection Agency in order to identify risks to human health and the environment, and make recommendations to land owners regarding how risks might be managed, if necessary.

Although heavy metals concentrations in the mine and mill wastes warrant some risk management, it is doubtful that there is sufficient volumes of waste to trigger extensive remedial actions by the State. Based on the remoteness of the site, minimal area of exposure and few receptors, IDEQ is recommending to EPA that there is no calculation of a Hazard Ranking Score for the Red Cloud, Whale, Regulator and Vindicator Patented Claims and that No Remedial

Letter to Dan Henry
Red Cloud Mine
Preliminary Assessment Report
February 13, 2008

Action is Planned for these properties. However, IDEQ has concluded that Hazard Ranking Scores may be appropriate for the Troy and Bay State Claims. IDEQ is also recommending to the owner, that all six mine openings discussed in the following report are closed as these are very dangerous hazards particularly since each is directly on a frequently used ORV trail.

Attached is the Preliminary Assessment Report of the property and mine facilities. The report contains a brief mine history, limited geologic information, maps and additional discussion of observations made at the property. There are also photos of the mine facilities.

IDEQ very much appreciates your cooperation and approval for our access, and looks forward to addressing any questions you may have regarding our findings. Please call me if you have any comments, questions, or I may be of any other assistance. We very much appreciate any feedback you can give us relative to our services.

Sincerely,

Bruce A. Schuld
Mine Waste Projects Coordinator
Waste Management and Remediation Division

Attachments

cc: Ken Marcie – U.S. Environmental Protection Agency
Megan Stelma – Blaine County
Jeff Gabardi – USDA Sawtooth National Forest
Maggie Manderbach – USDA Forest Service Region IV
file

Section 1 Introduction

The Idaho Department of Environmental Quality (IDEQ) was contracted by Region 10 of the United States Environmental Protection Agency (EPA) to provide technical support for completion of preliminary assessments at various mines within the Mineral Hill Mining District in Blaine County, Idaho.

IDEQ often receives complaints or information about sites that may be contaminated with hazardous waste. These sites can include abandoned mines, rural airfields that have served as bases for aerial spraying, old landfills, illegal dumps, and abandoned industrial facilities that have known or suspected releases.

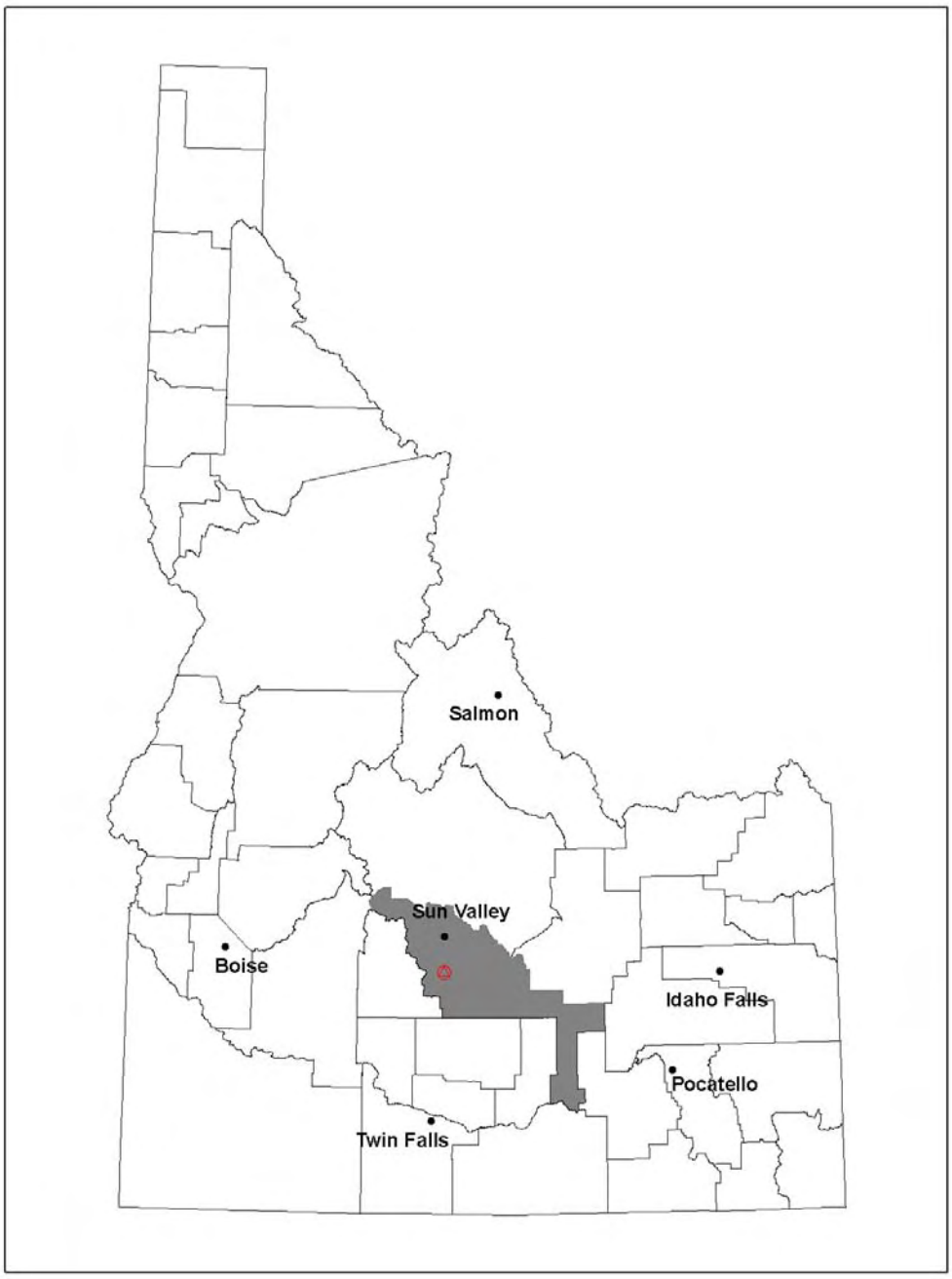
In February 2002, IDEQ initiated a Preliminary Assessment Program to evaluate and prioritize assessment of such potentially contaminated sites. Due to accessibility and funding considerations, priority is given to sites where potential contamination poses the most substantial threat to human health or the environment.

For additional information about the Preliminary Assessment Program, see the following:

http://www.deq.idaho.gov/waste/prog_issues/mining/pa_program.cfm

This document presents the results of the preliminary assessment (PA) of the Red Cloud Mine (aka Red Cloud, Troy, Whale, Bay State, Regulator and Vindicator
Patented mining claims.)

Access to the Red Cloud Mine was given by Mr. Daniel Henry. Public access and use of the area is unrestricted by way of the Wolftone Creek road across the surrounding public lands which are administered by the U.S. Department of Agriculture Forest Service (USDA). No physical or posted access restrictions exist on the boundaries of the private properties which the public routinely enters.



Location of the Red Cloud Mine within the State of Idaho.

Section 2 Ownership

IDEQ does not warrant the ownership research or location of property boundaries contained in this report. The information regarding ownership and property boundaries was obtained from the Blaine County Tax Assessor's Office in Hailey, Idaho.

Within the following ownership descriptions the **"Partial Determination"** is meant to convey a very brief summary of IDEQ's assessment of individual claims and parcels relative to human health and ecological risk factors associated with toxicological responses to mine wastes. A determination of No Remedial Action Planned or "**NRAP**" means that based on current conditions at the site IDEQ did not find any significant evidence that would indicate the potential of adverse effects to human or ecological receptors on the parcel of land. This determination says nothing about risks associated with physical hazards such as open adits, open shafts, high walls, or unstable ground. "**Partial Determination"** of "**calculate HRS**" indicates that IDEQ has determined that there is sufficient evidence to warrant calculation of a Hazard Ranking Score (HRS) by EPA's contractors. It also indicates that IDEQ has made significant conclusions and recommendations that additional site assessment and/or remedial actions are necessary to prevent adverse affects to human or ecological receptors. These conclusions and recommendations are contained in the final section of this report.

Owner	Claim	Parcel Number	Partial Determination
Daniel Henry	Red Cloud	RP1M0000000630	Major Workings (NRAP)
308 North 2nd Ave	Troy	RP1M0000000630	Maj. Workings (calculate HRS)
Hailey, ID 83333	Bay State	RP1M0000000630	Maj. Workings (calculate HRS)
	Whale	RP1M0000000630	No Workings (NRAP)
	Regulator	RP1M0000000630	No Workings (NRAP)
	Vindicator	RP1M0000000630	No Workings (NRAP)


Legend
Mining Claim Boundaries (Approximate)
Forest Creek
Florence
Bay State
Troy
Bannock
Moscow
Geraldine
Whale
Libby Jane
Red Cloud
Passumpic
Mammoth
Green Mountain Boy
Vindicator
Marianna
Catherine
Eighty Nine
Meters
0 100 200 400 600 800
N

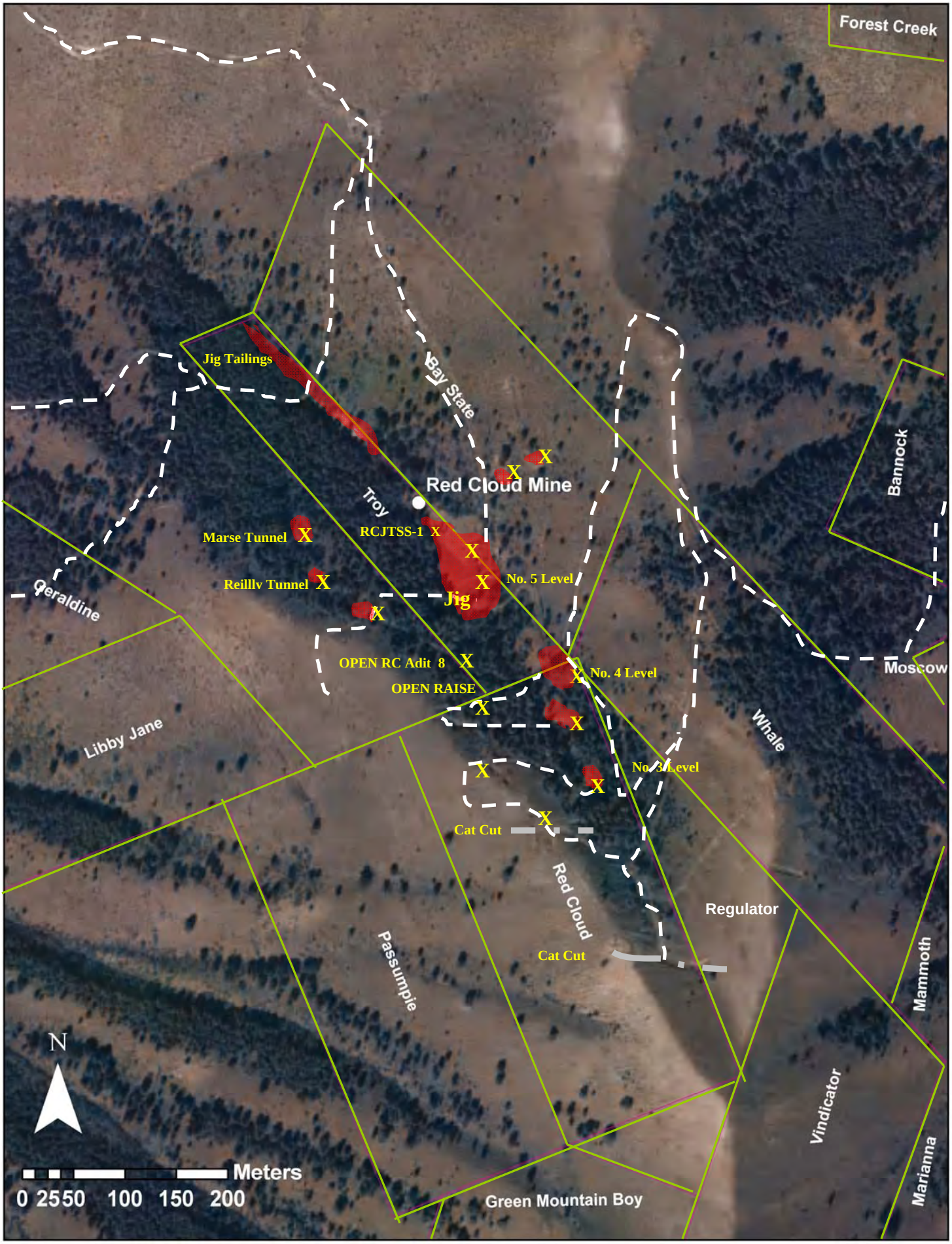
Section 3 Overview

The Red Cloud Mine is located high above Wolftone Creek between two small ridge that separate Red Cloud Gulch from Narrow Gauge Gulch. The location of the Red Cloud Mine approximately Latitude 43 31.064' N and Longitude 114 27.983' W, within Sections 8, 9, 16 and 17 in T2N R17E. The closest town to the mine site is the City of Hailey, approximately seven miles by road. The facilities are located entirely on private land; they are surrounded by public lands administered by the USDA Forest Service.

The mine can be reached from Hailey by driving north to the Deer Creek Road then west for about six miles to the mouth of Wolftone Creek. Once one turns onto the Wolftone Creek the road turns from improved dirt to unimproved non-maintained FS Road 111, which requires a four wheel drive vehicle to pass through a non-armored stream channel crossing of Deer Creek. From the mouth, one travels upstream on Wolftone Creek approximately one mile where FS 111 crosses the debris flow that is the tailings from the M.G. Smith, which is located at the mouth of Red Cloud Gulch. From one travels by foot or ORV up a steep windy Red Cloud Gulch trail approximately 1.5 miles to the mine.

Local waters are dominated by surface water and near surface ground water which is recharged by seasonal precipitation. Annual precipitation for Hailey, Idaho, located approximately five miles to the east, is 16 inches, predominately during the winter months, with an average annual snowfall of 81 inches (WRCC, 2006).

Dry-season rainfall occurs almost exclusively in relatively short bursts, usually related to thunderstorm activity. It is expected that except for rare flash flood-type events, almost all dry-season rainfall events would be completely absorbed by the soils and plants, without much, if any, contribution to the ground water.


Forest Creek
Jig Tailings
Bay State
Red Cloud Mine
Troy
Marse Tunnel
RCJTSS-1
Reilly Tunnel
No. 5 Level
Jig
Geraldine
OPEN RC Adit 8
OPEN RAISE
No. 4 Level
Bannock
Moscow
Whale
Libby Jane
No. 3 Level
Cat Cut
Red Cloud
Cat Cut
Regulator
Passumpie
Mammoth
Vindicator
Marianna
Green Mountain Boy
N
Meters
0 25 50 100 150 200

Section 4 Historical Perspective

In 1930, J.B. Umpleby, L.G. Westgate and C. Ross briefly described the Red Cloud Mine. In their report to the Department of Interior they said:

> *…..Only the lowest level was accessible in 1913 and in it most of the side drifts were flooded. Except for the account of the work on the tailings in progress in 1923, the following description is compiled from published descriptions by Lindgren and Turner and from observations of Umpleby in the small part of the workings accessible to him. Between 1880 and 1902 the Red Cloud Mine produced ore of gross value of $815,802. The period of greatest activity was between 1888 and 1889. The tailings dump was reworked in 1906, and there has been intermittent mining since then.*

Production records indicate that between 1884 and 1918 1,740 tons f ore were removed from ten levels. From that 1,695 ounces of gold, 506,083 ounces of silver, 13,351,655 pounds of lead and 82,235 pounds of copper were extracted.

J.B. Umpleby, L.G. Westgate and C. Ross continued to describe:

> *The property has been extensively developed on 10 levels, opened by tunnels and shafts, and there is a still deeper tunnel* (Libby Tunnel) *which with its various branches has a total length of 5,000 feet. This tunnel is nearly 1,100 feet below the outcrop of the lode. It runs N 88 E for 1,825 feet then extends several hundred feet southward with long drifts to the east and west at several places. About 500 feet from the turn is a raise to the upper workings.*
>
> *The country rock is limestone and calcareous shale of the Wood River formation. The main vein strike N 23 W and dips steeply southwest, and a branch of it, known as the hanging wall vein strikes N 46 degrees W and dips more than 60 degrees SW. Nearly all ore was mined from stopes above the level 9, which is 706 feet below the surface at the portal of No. 1 adit.*
>
> *This mine has now been shut down for some time, and most of the workings are inaccessible. In the summer of 1923 M.G. Smith was setting up jigs and tables at the mouth of Red Cloud Gulch to treat tailings from the old mill. He planed to operate his machinery with water power from a ditch out of Wolftone Creek and to sluice the tailings down to his plant with water from one of the mine tunnels* (Libby Tunnel). *He intended to make pyrite, lead-silver, and zinc concentrates but expected to derive most of his profit from pyritic*

> *concentrate. He estimated from his own assays that the clean pyrite here carries an average of an ounce of gold per ton.*

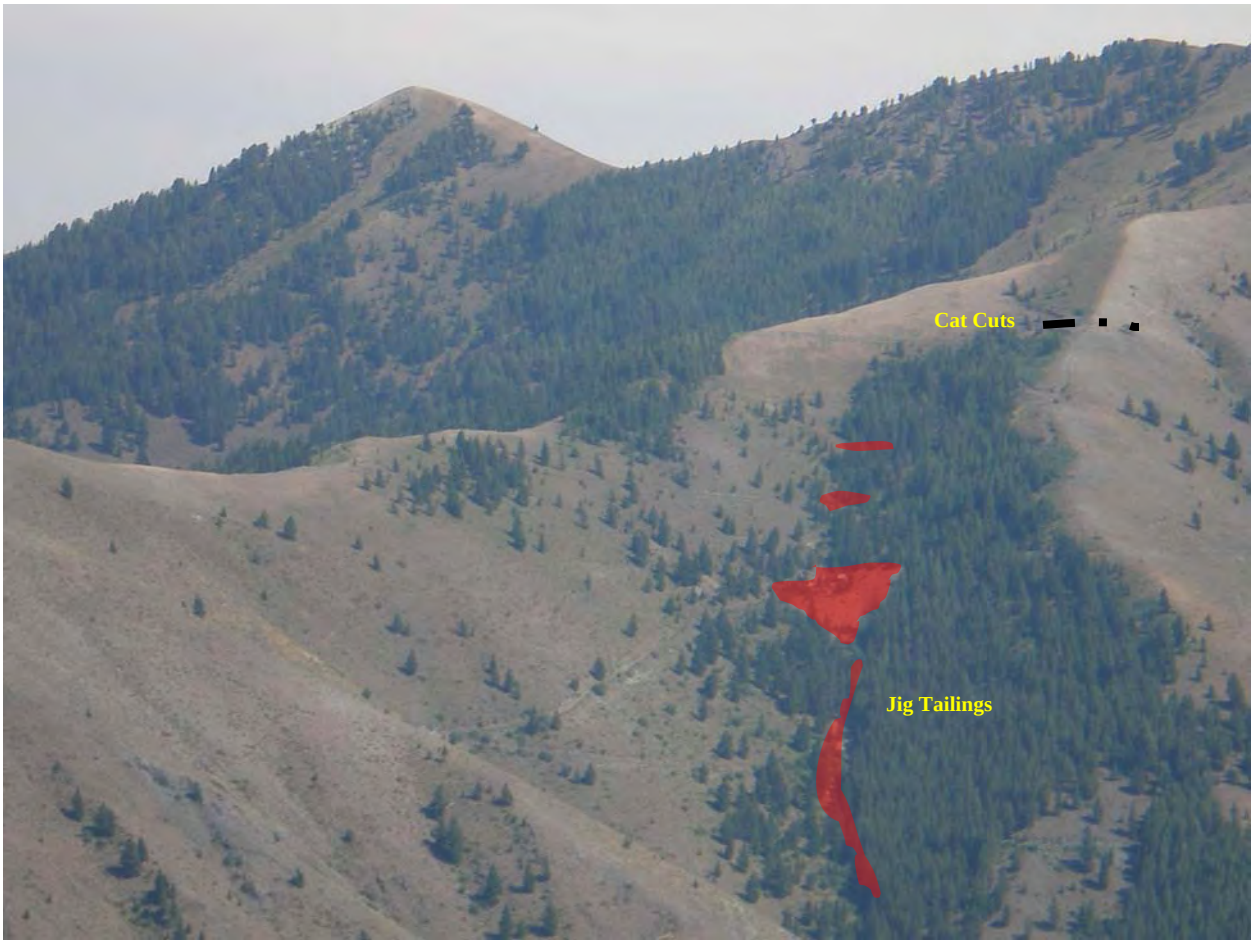
In 1950 A.L Anderson, T.H. Kiilsgaard and V.C. Fryklund, Jr. reported in their discussion of the Red Cloud Mine and their maps of the Red Cloud (after Louis W. Cramer – May 1946) that:

> *…….…The mine has been more or less idle since the early nineteen hundreds and most of the workings are now inaccessible. In 1949 only the No. 5 and No. 13 levels were open. Owing to inaccessibility of the mine workings, most of the following description was taken from Turner, Lindgren and Cramer.*
>
> *The Red Cloud Mine was active between 1880 and 1902, and during that time produced lead-silver and gold with a gross value of $815,802. Some tailings from the old Mill were jigged and shipped during the early twenties, and in 1941-42 some jig tailings (from Red Cloud Gulch) were shipped to the smelter. During the early forties some RFC funds were expended in opening the caved mine portals, otherwise mining activity has been negligible since the period of early operation.*
>
> *The property has been developed on 11 levels. The lowest level, or 13th* (Libby Jane Tunnel) *is at an altitude of 7038, which is 1,065 feet below the outcrop. Most of the ore came from above the No. 9 level or 706 feet below the surface as measured from the No. 1 level.*
>
> *In the Red Cloud workings, the Red Cloud Vein and Hanging Wall Vein have been affected by faulting at several points, but only two fault movements are described by Turner as being of any consequence. The fault with the greatest displacement occurs between the levels No. 5 and No. 6 where an ore body has been displaced N 20 W for 240 feet along a fault that dips 8 degrees NW. A lower fault cuts the Hanging Wall vein at a point 15 feet above the No 9 level. A crosscut driven southwest from the No. 9 level encountered a vein at a point that showed it had been displaced 90 feet to the southwest along a fault dipping 15 degrees NW. another fault, encountered a few feet below the No. 9 level, displaced the Hanging Wall vein, and ore bodies were not found below it in No. 10 and No 13 levels.*
>
> *Three strong faults with some evidence of mineralization were found in the No. 13 level – these are the Yellow Dog, Kelly, and Vindicator. A few tons of ore were taken from the Kelly fault, but no significant ore bodies were found in any of these faults.*

The historical information indicates that a raise in the Red Cloud Mine (aka Red Cloud No. 13 Level) was connected to the rest of the Red Cloud workings underground. It appears that the waste produced during development of the Libby Jane Tunnel aka No. 13 level could have produced most of the volume of waste found in Red Cloud Gulch. However, the jig tailings were most likely, (according to Umpleby's et al 1930 report) the result of tailings sluiced down from the old mill site on the Red Cloud No. 5 Waste Dump (IDEQ's RCWD#10), plus some minor amounts of ore hit in chutes developed from the No 13 level.

Current Site Conditions

The Red Cloud Mine may be accessed from two directions on old mining roads that have since deteriorated, but are somewhat maintained by "Off Road Vehicle" (ORV) enthusiasts and hunters. The first road comes up the ridge to the east of the mine from Narrow Gauge Gulch, which drains into Deer Creek. The second comes up the western ridgeline from the Libby Jane Tunnel (aka Red Cloud No. 13) in Red Cloud Gulch, which drains into Wolftone Creek.



During the visitation of the Red Cloud Mine, IDEQ staff designated identification of mine facilities in the order in which they were encountered. The site visit began high on the ridgeline at a series of "cat cuts" and ended down in the drainage where a jig was used to reprocess "old mill" tailings and some of the mine from the Red Cloud Waste Dump No. 5 Dump (Cramer 1946), which was designated by IDEQ as RC Waste Dump #10 for field mapping. These jig tailings were sampled below RC Waste Dump #10.



Looking west from the Narrow Gauge Road towards the upper Ridge Vein, one observes terraces that resulted from numerous exploration cut cuts on the southern Red Cloud Claim.



Development of cat cuts on the Ridge vein resulted in displacement of thousands of tons of dirt and rock, probably in the 1940's when M.G Smith was trying to redevelop the mine.



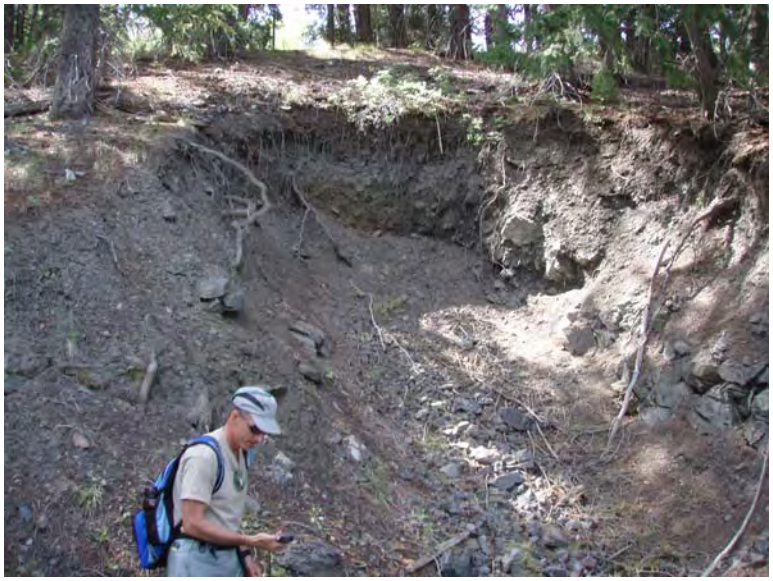
Looking northwest down the Ridge Vein towards Wolftone Creek
The Ridge Vein is very a very prominent geologic as well as topographic (high) feature which marks the western boundary of an area containing adits, waste dumps and roads of the Red Cloud Mine.



Although cat cuts are the most prominent exploration features at the Red Cloud Mine, there are numerous "dog holes" that were excavated by earlier explorers. This "dog hole" is designated in IDEQ field notes as RC Adit#1 and is just below the ridgeline to the east.



RC Adit #2 is another "dog hole" just below the ridgeline on the east. RC Adit #2 is partially open and appears to have targeted the Ridge Vein. RC Adit #2 waste dump contained less than 50 tons of wastes. RC Adit #2 is a dangerous physical hazard which should be closed.



RC Adit #3 is another "dog hole" just below the ridgeline on the east. RC Adit #3 is partially open and appears to have targeted the Ridge Vein. RC Adit #3 waste dump contained less than 50 tons of wastes.



RC Adit #4 is directly on the Ridge Vein. Although it may have been an adit at one time, hence its designation. It appears to have been re-excavated with a bull dozer, to construct a platform that may have been used for drilling. There was no evidence, however, of drilling at this location.



Although it appears from the size of RC Waste Dump #5 that the adit was just another "dog hole", RC Adit #5 is open and is a dangerous physical hazard. RC Waste Dump #5 contains approximately less than 50 cubic yards of waste.



Between RC Adit#5 and RC Adit #6 is and open raise that is likely at least 30" deep. It was determined to be a raise since there is no evidence of a waste dump, which would be indicative that it was driven as a shaft. This opening is a very dangerous physical hazard that should be closed.



It is obvious upon approach the RC Adit# 6 was probably what was historically called Adit No. 3 by Louis W. Cramer (1946). RC Waste Dump #6 contains approximately 3,000 cubic yards of waste.



Open RC Adit #6 is a very dangerous physical hazard. Site visitors frequently approach the unstable ground in the adit, particularly at the portal. This opening is a very dangerous physical hazard that should be closed.



RC Waste Dump #7 is likely that referred to by Cramer as Waste Dump No.4. RC Waste Dump #7 contains approximately 5,000 cubic yards of waste.



Looking due south on to RC Waste Dump #7 (Cramer's Waste Dump No. 4) from the road to Narrow Gauge Gulch



Looking due west from RC Waste Dump #7 one can see the small RC Waste Dump #8 tucked into the timber just below the Ridge Vein. At less than 200 cubic yards, the open RC Adit #8 was most likely just another exploration "dog hole".



Open RC Adit #8 may be only and exploration "dog hole", but it is a very dangerous physical hazard. Site visitors frequently approach the unstable ground in the adit, particularly at the portal. This opening is a very dangerous physical hazard that should be closed.



The location of the RC Adit #9, which is just down slope from RC Adit #6 appears to have been a serious effort to drive on the Hanging Wall vein and intercept the Ridge vein. However, the waste volume of less than 200 cubic yards indicates that work may have been abruptly stopped.



Looking down (due north) on to RC Waste Dump#10 (Cramer's Waste Dump No. 5 (1946)) from the road between RC Waste Dump #6 and RC Waste Dump #7.



Two adits are present of RC Waste Dump #10. One is collapsed and one is open. This second opening is a very dangerous physical hazard that should be closed.



The open RC Adit #10 has a very high wall above the portal.



Jig Tails dominate the lower slopes of RC Waste Dump #10 which confirms that serious effort, presumably by M.G. Smith, had been made to reprocess the mine wastes on Cramer's (1946) Waste Dump #5.

RC Waste Dump #10 exceeds 5,000 (estimated) cubic yards of waste rock, with well over 1,000 additional cubic yards of jig tailings. These tailings which extend for over two hundred meters down hill indicate that a substantial effort had been made to reprocess the waste dump. Sample RCJTSS- 1 was collected to evaluate the metals concentrations in the wastes. No background samples were collected above the mine site as background samples in both Narrow Gauge Gulch and Red Cloud Gulch above the Libby Jane Tunnel seemed applicable for screening level comparisons.

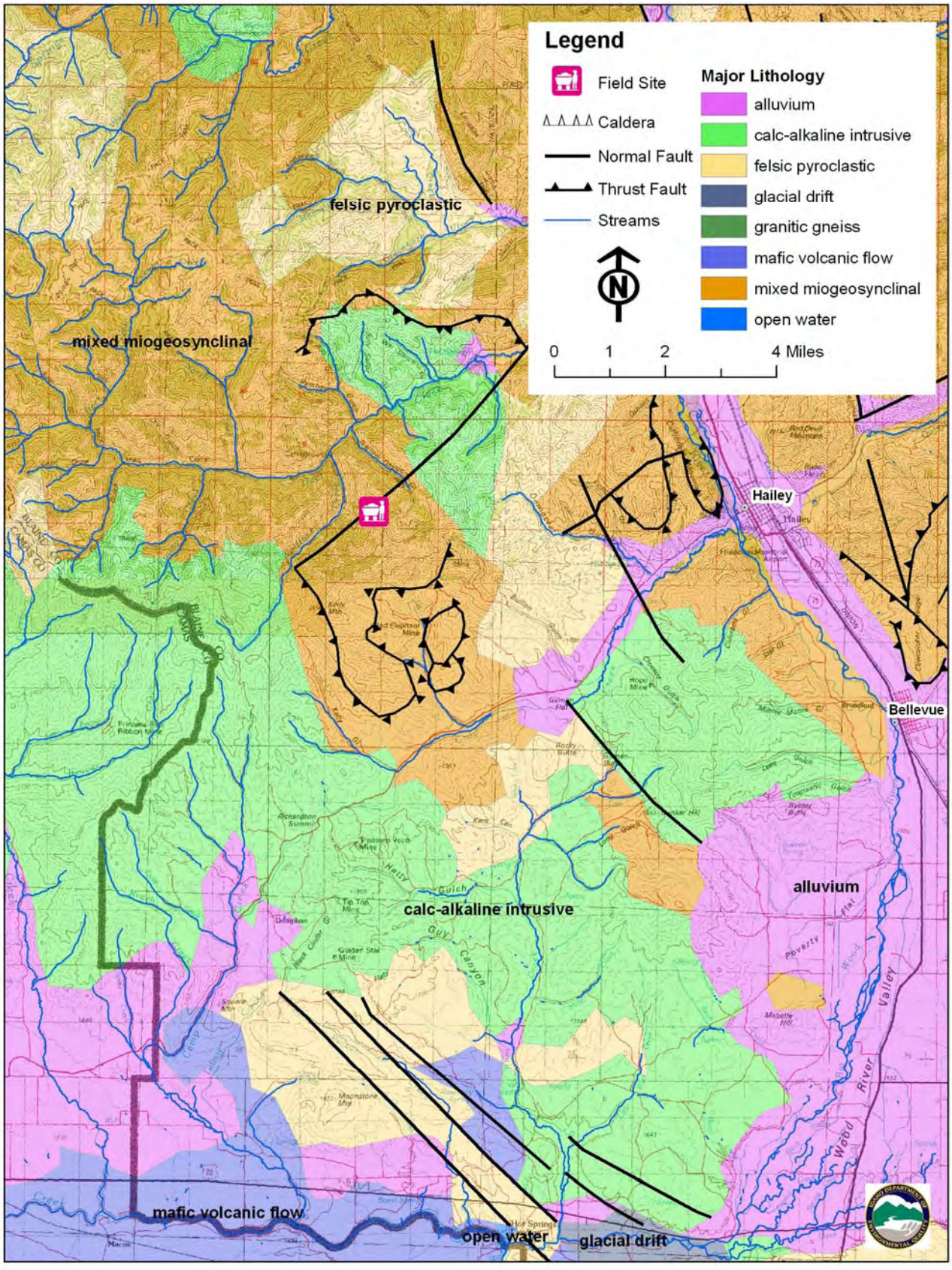
Section 6 Geology

In 1930, J.B. Umpleby, L.G. Westgate and C. Ross briefly described the geology of the Red Cloud Mine and Red Cloud Mine area. In their report to the Department of Interior they said:

> *…..Only the lowest tunnel was accessible in 1913 and in it most of the side drifts were flooded. Except for the account of the work on the tailings in progress in 1923, the following description is compiled from published descriptions by Lindgren and Turner and from observations of Umpleby in the small part of the workings accessible to him.*
>
> *The country rock is limestone and calcareous shale of the Wood River formation. The main vein strike N 23 W and dips steeply southwest, and a branch of it, known as the hanging wall vein strikes N 46 degrees W and dips more than 60 degrees SW. Nearly all ore was mined from stopes above the level 9, which is 706 feet below the surface at the portal of No. 1 adit.*
>
> *The ore as seen on the lower dump and near the old mill consists of sphalerite, galena, pyrite, arsenopyrite, and small amounts of tetrahedrite and chalcopyrite in a siderite-quartz gangue. In this ore, as in that from the North Star Mine, the sphalerite and siderite have been extensively brecciated and cemented, largely by pyrite and arsenopyrite. The ore contains any partly replaced inclusions of the limestone wall rock. Although worked for the lad and silver, the ore carries a noteworthy amount of gold.*

In 1950 A.L Anderson, T.H. Kiilsgaard and V.C. Fryklund, Jr. reported in their discussion of the Red Cloud Mine and their maps of the Red Cloud (after Louis W. Cramer – May 1946) that:

> *The country rock is dark limy argillite of the Wood River Formation. There are three prominent veins on the property – the Ridge vein, the Red Cloud Vein, and the hanging Wall vein. Of these, the Red Cloud and Hanging wall veins have produced practically all of the ore. The Red Cloud vein strikes N 23 W and dips at a high angle to the west. The Hanging Wall vein branches off of the Red Cloud Vein to the northwest, striking N 50 W and dipping southwest at about 60 degrees. The Ridge vein, which is explored by several short tunnels, strikes N 45 W and dips 70 degrees 90 degrees southwest. It appears to be cutoff by the Ridge fault at depth.*


Legend
Field Site
Caldera
Normal Fault
Thrust Fault
Streams
Major Lithology
alluvium
calc-alkaline intrusive
felsic pyroclastic
glacial drift
granitic gneiss
mafic volcanic flow
mixed miogeosynclinal
open water
0 1 2 4 Miles
N
felsic pyroclastic
mixed miogeosynclinal
Hailey
Bellevue
alluvium
calc-alkaline intrusive
mafic volcanic flow
open water
glacial drift
Wood River Valley
Guy Canyon
Hailey Gulch
Poverty Flat

> *In the Red Cloud workings, the Red Cloud Vein and Hanging Wall vein have been affected by faulting at several points, but only two fault movements are described by Turner as being of any consequence. The fault with the greatest displacement occurs between the levels No. 5 and No. 6 where an ore body has been displaced N 20 W for 240 feet along a fault that dips 8 degrees NW. A lower fault cuts the hanging Wall vein at a point 15 feet above the No 9 level. A crosscut driven southwest from the No. 9 level encountered a vein at a point that showed it had been displaced 90 feet to the southwest along a fault dipping 15 degrees NW. another fault, encountered a few feet below the No. 9 level, displaced the Hanging wall vein, and ore bodies were not found below it in No. 10 and No 13 levels.*
>
> *Three strong faults with some evidence of mineralization were founding the No. 13 level – these are the yellow Dog, Kelly, and Vindicator. A few tons of ore were taken from the Kelly fault, but no significant ore bodies were found in any of these faults.*
>
> *Turner, thinks the Yellow Dog may be a major fault, upon which the upper productive area has been moved to the southwest. He also considers that the Kelly vein might be a continuation of the Hanging wall vein. Furthermore, he reasons that the large mineralized outcrop east of the upper Red Cloud workings might be the upward projection of one of the faults found on the No. 13 Level.*
>
> *The Hailey-Bellevue mineral belt is underlain by a varied assemblage of sedimentary and igneous rocks, which, except for volcanics of mid-Tertiary age and some still younger unconsolidated sedimentary rocks, are all older than the ore deposits. The earlier rocks include fairly wide exposures of the Milligen and Wood River formations-the host of so many of the ore deposits in the Wood River region-and also rather large intrusive bodies of diorite and quartz monzonitic rock which are regarded as outliers of the Idaho batholith. There is also a younger group of intrusive rocks which are of more pertinent interest because of their close association with the mineralization.…In addition to the Milligen formation (Mississippian age) and the Wood River formation (Pennsylvanian age), the area contains some strata in and beneath a series of Tertiary volcanics (Oligocene) and much poorly consolidated and unconsolidated slope wash, terrace gravels, and stream alluvium of Quaternary age.* (Anderson, 1950, p. 2)

Anderson (p 7) went on to note that, *"The folding within the area is comparatively simple and consequently faulting constitutes the outstanding feature."*

Numerous previous studies of the geology and mineral resources of the Wood River and adjacent areas have been made. Geologic studies have been conducted to investigate mineral deposits (Lindgren, 1900

& 1933; Umpleby et al, 1930; Anderson and Wagner, 1946; Anderson et al, 1950; Hall et al, 1978; Wavra and Hall, 1989; Link and Worl, 2001; Worl and Lewis, 2001); individual formations and units (Hall et al, 1974; Sandberg et al, 1975; Wavra and Hall, 1986; Worl and Johnson, 1995); quadrangles (Batchelder and Hall, 1978; Mitchell et al, 1991; Kiislgaard et al, 2001) and to compile regional information (Rember and Bennett, 1979). Preliminary and environmental assessment investigations have been conducted to assess current and potential impacts from historic mining in the region (Mitchell and Gillerman, 2005; IDEQ, 2002 & 2006; IDEQ & USEPA, 2006 & 2007). Link and Worl (2001) reviewed previous geologic and historic information relating to stratigraphy and mineralization relationships in the Mineral Hill district, including Red Elephant Gulch.

Fryklund (1950, pp. 65-66) noted the following in regards to the structure of the rocks:

> *The most obvious and significant structural features of the area are the major faults or fault zones which divide the area into a number of distinct blocks...The age of the oldest faults are to be placed as pre-intrusive and possibly all the major faulting is pre-intrusive...All of the major faults are probably pre-mineral as well as pre-intrusive.*

Section 7 Current and Potential Future Land Uses

Current land uses in the area include biking, hiking, hunting, horseback riding and off-road vehicle touring. The Red Cloud Mine is accessible from the Wolftone Creek Road and from Narrow Gauge Gulch on ORV trails. Additional ORV trails come into this local trail system from the Bullion Gulch and Red Elephant Gulch roads.

Fish Species Observed

Fish presence/absence studies have not been conducted in Wolftone Gulch to confirm any fish species that may reside in this stream. However, visual observations in Deer Creek and Wolftone Creek confirm the presence of brook trout [Salvelinus foninalis]. Redband rainbow trout [*Oncorhynchhus mykiss* gairdneri], mountain white fish [Prosopium williamsoni], wood river sculpin [Cottus leiopomus], and brook trout [Salvelinus foninalis] are present within the Big Wood River (IDFG, 2000). These are the closest official observations of fish to the mine site. Commercial or subsistence fishing does not occur within the 15-mile downstream distance, but sport fishing does.

Apparent Wetlands

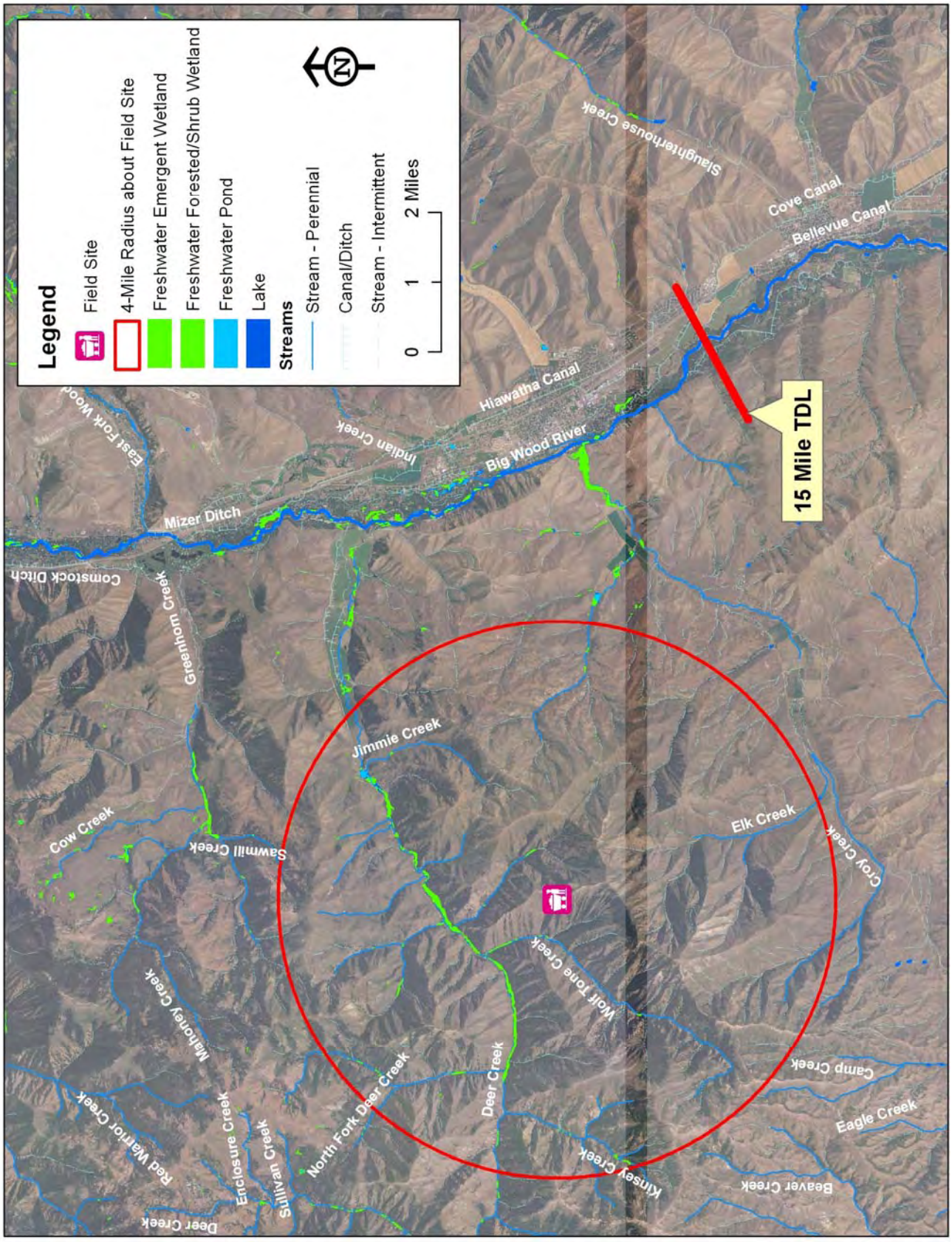
Wetland surveys near the site were reviewed (USFWS, 2007) along with aerial photographs. These indicate that the nearest wetlands are in both Wolftone Creek at the mouth of Red Cloud Gulch, and in Deer Creek. Overland transportation of mine and mill waste entering Wolftone Creek may occur seasonally, but deposits of jig tails were not traced all the way from RC Waste Dump #10 to Wolftone Creek.

Future Land Use

Future land use could potentially include some year-round and/or seasonal homes on the private parcels of property in the sub-basin, owing to its close proximity to Hailey.

It is likely that recreational use of the site will increase as the local populations and recreation industry expands.

The site will also likely continue to provide grazing values to livestock and wildlife.


Legend
Field Site
4-Mile Radius about Field Site
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Streams
Stream - Perennial
Canal/Ditch
Stream - Intermittent
0
1
2 Miles
15 Mile TDL
Slaughterhouse Creek
Cove Canal
Bellevue Canal
Hiawatha Canal
Indian Creek
Big Wood River
East Fork Wood
Mizer Ditch
Comstock Ditch
Greenhorn Creek
Jimmie Creek
Cow Creek
Sawmill Creek
Elk Creek
Croy Creek
Wolf Tone Creek
Mahoney Creek
Red Warrior Creek
Deer Creek
Enclosure Creek
Sullivan Creek
North Fork Deer Creek
Deer Creek
Kinsey Creek
Camp Creek
Eagle Creek
Beaver Creek

Section 8 Waste Sampling and Characterization

Sample Collection

Waste

Only one soils/waste sample (RCWD10SS-1) was collected at the Red Cloud Mine. However, four background soil samples (UNGBG-1, LJBGSS-1, LLJJTBG-1 and LJJTBGSS-2) were collected for background analysis of soils. Although the locations for the background samples were dispersed, it was believe they were of sufficient quality to be used in the comparative analysis for the jig tailings sample. There were no identified Probable Points of Entry (PPEs) at the site.

Each soil sample collected was, initially approximately ten (10) pounds in size. Each sample location (except stream sediment samples) was excavated several inches with the material discarded. Then the sample hole was excavated approximately 6" more to extract a sample. Waste dumps and tailings had at least three locations within a few square yards sampled and composited. Samples were placed in a large sterile plastic bowl from which coarse (+1") rock and woody debris were hand picked an disposed. The samples were then screened over a 10 mesh sieve and placed in a sterile plastic zip lock bag. The bag was appropriately marked with the sample identification, location description, date and samplers. It was then placed in a cloth sample bag which was marked exactly the same way. Sample descriptions were entered into field log books for this analysis. The samples were logged on a standard chain-of custody lab submittal form and placed on ice in a cooler. Once samples were taken to IDEQ's field office at the end of the day they were placed in secure storage to await shipping.

Water

No water was observed flowing at the site. Therefore, no water samples were collected.

Soil Sample Description

Soils

Sample **RCWD10SS-1** was collected in jig tailings (<1,000 cubic yards) at the toe of the RC Waste Dump #10. The sample was from jig tailings which were mixed with some mine waste rock. The sample contained some coarse fragments greater than 3". After hand sorting to dispose of the plus 1" material the dump sample was still coarse with <50% passing the 10 mesh screen and about 50% being between ¼" and 1" in size. The sample was generally brown or buff colored, but there was clear evidence of altered sulfides in the mix.

Sample **LJBGSS-1** was collected just up hill from the Libby Jane Tunnel and road to the Red Cloud Mine. The sample was brown or buff colored and appeared to be very weathered fine grain shale. Approximately 75% of the sample passed the 10 mesh sieve, and less than 10% was plus 1" rock and large woody debris.

Sample **LLJJTBG-1** was collected on the southwestern slope of Red loud Gulch approximately 50 feet in elevation above the tailings area. The location for the sample was in heavy forest with a thick blanket of organic matter. This matter was clear away from the sample location until very little organics were observed. The sample location was then excavated approximately 6 more inches in very coarse rock and soil. The sample was brown or buff colored and appeared to be very weathered fine grain shale. Approximately 50% of the sample passed the 10 mesh sieve, and more than 50% was plus 1" rock with very little woody debris.

Sample **LJJTBGSS-2** was collected below the high water mark in the Wolftone Creek stream channel approximately 1,000 feet upstream of the mouth of Red Cloud Gulch and the western edge of the M.G. Smith Jig Tails. The sample was taken in a poorly sorted colluvium that contained all sizes and shapes of sediment from sand and silt fractions to gravel, cobbles and boulders. The colluvium contained all types of detritus from silty limestones and shales to quartz diorite. The location of the sample contained very little organic detritus. Because the colluvium was well mixed by fluvial actions the sample location was not excavated to depth.

Sample **UNGBGSS-1** was collected on the north facing slope of the ridgeline separating Narrow Gauge Gulch and Bullion Gulch. This sample site location is just above the upper workings of the Pass Group, which is described in "Narrow Gauge Gulch Preliminary Assessment" (IDEQ 2008). The location for the sample was in heavy forest with a thick blanket of organic matter. This matter was cleared away from the sample location until very little organics were observed. The sample location was then excavated approximately 6 more inches in very coarse rock and soil. The sample was brown or buff colored and appeared to be very weathered fine grain shale. Approximately 50% of the sample passed the 10 mesh sieve, and more than 50% was plus 1" rock with very little woody debris.

Sample Analysis

Generally speaking soils analysis indicates that the heavy metals of concern for the site are arsenic (11,500 ppm) and lead (41,300 ppm), which far exceed IDTLs, EPA Region Six's Human Health Screening levels and back ground conditions. Furthermore they exceed most removal criteria at sites such as the Triumph mine site and the Minnie Moore tailings impoundment near Hailey, Idaho.

Soils

Background sample **LJBGSS-1,** which was collected above the Red Cloud Mine site, had heavy metals concentrations of total Arsenic, total Cadmium, total Chromium, total Mercury and total Silver which exceeded IDTLs. However, only total Arsenic in the sample exceeded HHSLs. None of these concentrations would trigger any level of concern for this remote area.

Background sample **LLJJTBG-1**, which was collected above the valley floor on the western slopes of Red Cloud Gulch, had heavy metals concentrations of total Arsenic, total Cadmium, total Chromium, total Mercury and total Silver which exceeded IDTLs. None of the

concentrations exceeded HHSLs, and none of these concentrations would trigger any levels of concern for this remote area.

Red Cloud Mine and Local Background Soil Samples

Description	IDEQ Initial Default Threshold Level (IDTL) values	EPA Region 6 Human Health Screening Criteria	Libby Jane Background Soil Sample above Tunnel	Lower M. G. Smith Jig Tailings Background Soil Sample W side of Red Cloud Gulch	Lower M.G. Smith Jig Tailings Background Soil Sample in Wolftone Gulch	Upper Narrow Gauge Gulch Background sample	Jig Tailings below Red Cloud Waste Dump #10
			LJBGSS-1	LLJJTBG-1	LLJJTBGSS-2	UNGBGSS-1	RC WD10 JT
Arsenic	0.391	**23**	27.2	17.7	12.2	54	**11500**
Barium	896	**1600**	106	110	29.2	191	22.9
Cadmium	1.35	**39**	2.56	3	1.34	9.79	22.9
Chromium	7.9	**210**	37.6	54.2	10.4	31.9	12.5
Copper	921	**2900**	20.1	11.4	7.8	38.6	1360
Iron		**55000**	16000	12700	10600		
Lead	49.6	**400**	30.8	39.4	30	357	**41300**
Mercury	0.00509	**23**	0.072	0.035	<0.033	0.09	16.3
Selenium	2.03	**390**	<4	<4	<4	<4	9.0
Silver	0.189	**390**	0.91	<0.50	<0.50	4.04	161
Zinc	886	**23000**	92.2	148	87.6	1010	4970
XXXXX	At or Exceeds IDTLs						
XXXXXX	At or Exceeds Background Levels						
XXXXX	At or exceeds EPA region 6 HHSLs						

Background sample **LJJTBGSS-2,** which was collected in the Wolftone stream channel above the M.G. Smith mill site, had heavy metals concentrations that were far below the other two back ground sample concentrations, but total Arsenic, total Cadmium, total Chromium, total Mercury and total Silver which exceeded IDTLs. None of the concentrations exceeded HHSLs.

Background sample **UNGBGSS-1** was collected above the Pass Group near the ridgeline between Bullion and Narrow Gauge Gulch(s). Although concentrations of total arsenic, Cadmium, Chromium, Lead, Mercury, and zinc exceeded IDTLs, these concentrations were relatively unremarkable due to the remoteness of the area.

Sample **RCWD10SS-1** was a composite sample of jig tails at the toe of RC Waste Dump #10. Concentrations of heavy metals of total arsenic (11,500 ppm) and total lead (41,300 ppm) exceed

IDTLs, HHSLs, and Background sample concentrations by several orders of magnitude. Although this volume of these jig tailings is small (<1,000 cubic yards), these concentrations indicate that the dump warrants some level of risk management, whether that is site restriction or tailings removal.

Section 9 Pathway and Environmental Hazard Assessment

Pathway and environmental hazards were assessed for groundwater, surface water, and soil/air exposure. The findings from these assessments are presented in the following.

Ground Water

Ground water flow is expected to be controlled structurally within faults and brecciated zones in the country rock and be expressed at the surface as springs. However, the high flows from the Red Cloud Mine, which exit the underground workings from the Libby Jane Tunnel over 1,000 feet to the west of the RC Waste Dump #10, which indicates that the extensive underground workings of the Red Cloud Mine have a major influence ground water flows. Other than those adit discharges no other springs were noted or mapped in the area of the mine.

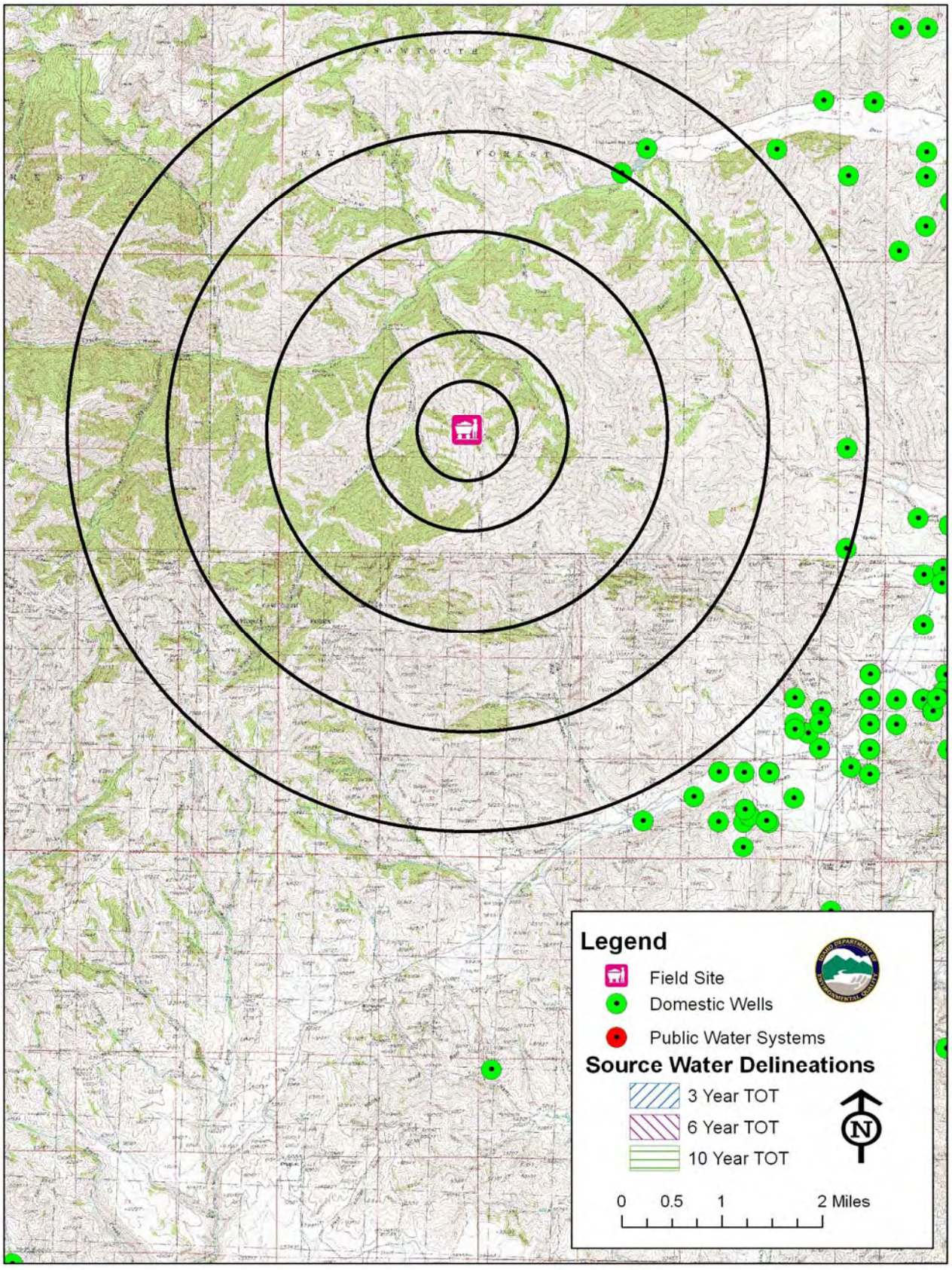
Shallow ground water and surface waters are inextricably related in Red loud Gulch, Wolftone Gulch and further down in Deer Creek, as both are bounded by densely crystalline bedrock and flow through or on top of the valley fill colluvium. The amount of recharge of regional aquifers by surface and ground water in the Red Cloud Gulch area is unknown.

According to Idaho Department of Water Resources July 2002 records, only 4 private drinking water wells are located within a 4-mile radius of the site. However two of the locations are on the other side of Kelly Mountain from Red Cloud Gulch, and these were identified by IDEQ staff as live stock watering tanks, not domestic wells. The domestic wells are located within the Deer Creek drainage almost six miles down gradient of the site. No wells were sampled.

During the cleanup activities of the nearby mines, such as Triumph and the Minnie Moore Mill site, the first concerns were related to potential human health risks as a result of contamination of public and private drinking water supplies. Generally speaking, contamination of drinking water systems was thought likely to occur from two types of sources (ore bodies and waste dumps) and along three pathways, as illustrated by the following three scenarios. First, heavy metals are leached from mine waste dumps, enter ephemeral or perennial drains and then contaminate the area's shallow ground water system. Second, heavy metals leach from the local ore bodies and are transported through the geologic structure to the shallow ground water. Third, heavy metals could leach out of the ore bodies, and be discharged from the underground workings as adit water, that is then conveyed through ephemeral and perennial drains to the shallow ground water systems.

For the purposes of completing Preliminary Assessments, Source Water Assessments (completed for local public drinking water supplies) were used to identify any known affects to those systems. Although IDEQ's Source Water Assessments were used to evaluate potential affects of this mine on public drinking water supplies no inferences can be made about the affects that this and adjoining mines have on local private wells.

.


Legend
Field Site
Domestic Wells
Public Water Systems
Source Water Delineations
3 Year TOT
6 Year TOT
10 Year TOT
N
0
0.5
1
2 Miles

Source water assessments provide information on the potential contaminant threats to public drinking water sources. In the Big Wood River Valley Idaho, most of those sources (>95%) are ground water (IDEQ 2000). Each source water assessment:

- Defines the zone of contribution, which is that portion of the watershed or subsurface area contributing water to the well or surface water intake (source area delineation).
- Identifies the significant potential sources of drinking water contamination in those areas (contaminant source inventory).
- Determines the likelihood that the water supply will become contaminated (susceptibility analysis**).**

Each assessment is summarized in a report that describes the above information and provides maps of the location of the public water system, the source area delineation, and the locations of potential contaminant sources. Idaho began developing source water assessments in 1999, and in May 2003 met its obligation under the amendments of the Safe Drinking Water Act by completing delineations for all 2100+ public water systems that were active in Idaho as of August 1999 (IDEQ 2000). Source water assessments for new public drinking water systems are being developed as those systems come online. Each public water system is provided with two copies of its final assessment report. Four source water assessments for drinking water supplies have been used in this Preliminary Assessment Process to evaluate the potential impacts to both public and private drinking water supplies in and around Sun Valley, Ketchum, Hailey and Bellevue.

The information extrapolated from these reports is based on data that existed at the time of their writing, and the professional judgment of IDEQ staff. Although reasonable efforts were made to present accurate information, no guarantees, including expressed or implied warranties of any kind are made with respect to these reports or this Preliminary Assessment by the State of Idaho or any of its agents who also assume no legal responsibility for accuracy of presentation, comments or other information in these publications or this Preliminary Assessment report. The results should not be used as an absolute measure of risk, and they should not be used to undermine public confidence in public drinking water systems.

The Source Area delineation process establishes the physical area around a well or surface water intake that becomes the focal point of the source water assessment. The process includes mapping the boundaries of the zone of contribution (the area contributing water to the well or to the surface water intake) into time of travel zones (TOT) indicating the number of years necessary for a particle of water to reach a well or surface water intake (IDEQ 2000). The size and shape of the source water assessment area depend on the delineation method used, local hydrogeology, and volume of water pumped from the well or surface water intake.

IDEQ used a refined computer model approved by EPA to determine the 3-year (Zone 1B), 6-year (Zone 2), and 10 year (Zone 3) time of travel associated with the Big Wood River Aquifer and its sources (IDEQ 2000). This information is illustrated in Figure 4.

This process involves collecting, recording, and mapping existing data and geographical information system (GIS) coverage to determine potential contaminant sources (e.g., gas stations) within the delineated source water assessment area. The potential contaminant source inventory is one of three factors used in the susceptibility analysis to evaluate the overall

potential risk to the drinking water supply (IDEQ 2000). The inventory process goal is to locate and describe those facilities, land uses, and environmental conditions that are potential sources of ground water or surface water contamination.

This susceptibility analytical process determines the susceptibility of each public water system well or surface water intake to potential contamination within the delineated source water assessment area. It considers hydrogeologic characteristics, land use characteristics, potentially significant contaminant sources, and the physical integrity of the well or surface water intake. The outcome of the process is a relative ranking into one of three susceptibility categories: high, moderate, and low. The rankings can be used to set priorities for drinking water protection efforts (IDEQ 2000).

There are numerous public and private drinking water supplies in the Big Wood River Basin. The Sun Valley Water and Sewer District operates and maintains nine wells in two groupings (IDEQ 2000). The City of Ketchum drinking water system consists of seven wells in two groupings. The City of Hailey's drinking water system consists of six wells and a spring (IDEQ 2000).The City of Bellevue drinking water system consists of two wells and three springs (IDEQ 2000).

Generally speaking, public drinking water systems in the Big Wood River Valley are rated as moderate to high (IDEQ 2000). Multiple factors affect the likelihood of movement of contaminants from the sources to the aquifer, which led to this moderate to high score. Soils in the area are poorly to moderately drained. The vadose zone is predominantly gravel, which increases the score. On the valley floors the average depth to ground water is twenty to fifty feet.

To date, routine water quality monitoring of public drinking water indicates that there are no significant volumes of heavy metals migrating through the regional or localized ground water systems. There is no current, long term or recurring water chemistry problems in the City of Ketchum's drinking water sources. Arsenic, nickel, antimony, barium, selenium, chromium, cyanide and nitrate have been detected in Ketchum's wells, but all were well below MCLs (IDEQ 2000). There is no long term or recurring water chemistry problems in the City of Hailey's drinking water sources. Manganese, zinc, chromium, and mercury have been detected in Hailey's wells, but all were well below MCLs (IDEQ 2001). Currently, there are no data that indicate that any metal concentrations have exceeded MCLs in the Bellevue drinking water systems (IDEQ 2000).

Surface Water

There were no observed surface water flows at the Red Cloud Mine, except those discussed from the Libby Jane Tunnel. The mine water discharge from the Libby Jane Tunnel into Red Cloud Gulch approximately 1,000 feet west of the Red Cloud Waste Dump #10, has been discussed and evaluated in the Libby Jane Tunnel, Florence Mine and M.G Smith Mill Site Preliminary Assessment Report (DEQ 2008). Essentially, chemical analysis of the mine water discharge, which is voluminous, indicates that the effluent contains unremarkable concentrations of metals.

Red Cloud Gulch drains northward towards the northeast flowing Wolftone Creek which then enters the large Deer Creek approximately 1 mile from the site. Overland flow across or in the vicinity of the waste piles delivers sediment to Red Cloud Gulch before disappearing into the porous colluvium and mill wastes. Red Cloud Gulch is not currently listed on the EPA CWA

§303(d) list of impaired streams. The nearest EPA CWA §303(d) listed stream is the Big Wood River approximately 8 miles downstream from the site.

Commercial or subsistence fishing does not occur within the 15-mile downstream distance, but sport fishing does. Redband rainbow trout [*Oncorhynchhus mykiss* gairdneri], mountain whitefish [Prosopium williamsoni], wood river sculpin [Cottus leiopomus], and brook trout [Salvelinus foninalis] are, however, present within the Big Wood River (IDFG, 2000).

There are no surface water intakes for drinking water or any type of industry within the 15-mile TDL. Two drinking water wells are located within the 4-mile radius of the site and are discussed further in the Groundwater Pathway section.

Soil Exposure and Air

Access to the mine site is unrestricted from the Wolftone Gulch Road (FS 111). Human and ecological receptors may be exposed to soils and mine waste by inhalation, dermal contact and ingestion. As with most of the mine sites in the Big Wood River area, strong winds on hot summer afternoons suspends fugitive dust in the air, which may be inhaled. Visitors may also have direct contact with heavy metals in wastes while exploring the site.

Potential Receptors

Potential receptors include hikers, hunters, anglers, cattlemen, and trail riders (motorized and non-motorized). Sheep graze the surrounding area, but their presence within the mine site is minimal. Outdoor enthusiasts remain the highest percentage of human receptors, as they frequent the area for a number of recreational activities. The land within a two (2) mile radius of the site is primarily public land administered by the USDA Forest Service.

Schools, Day-Care Facilities, Private Residences

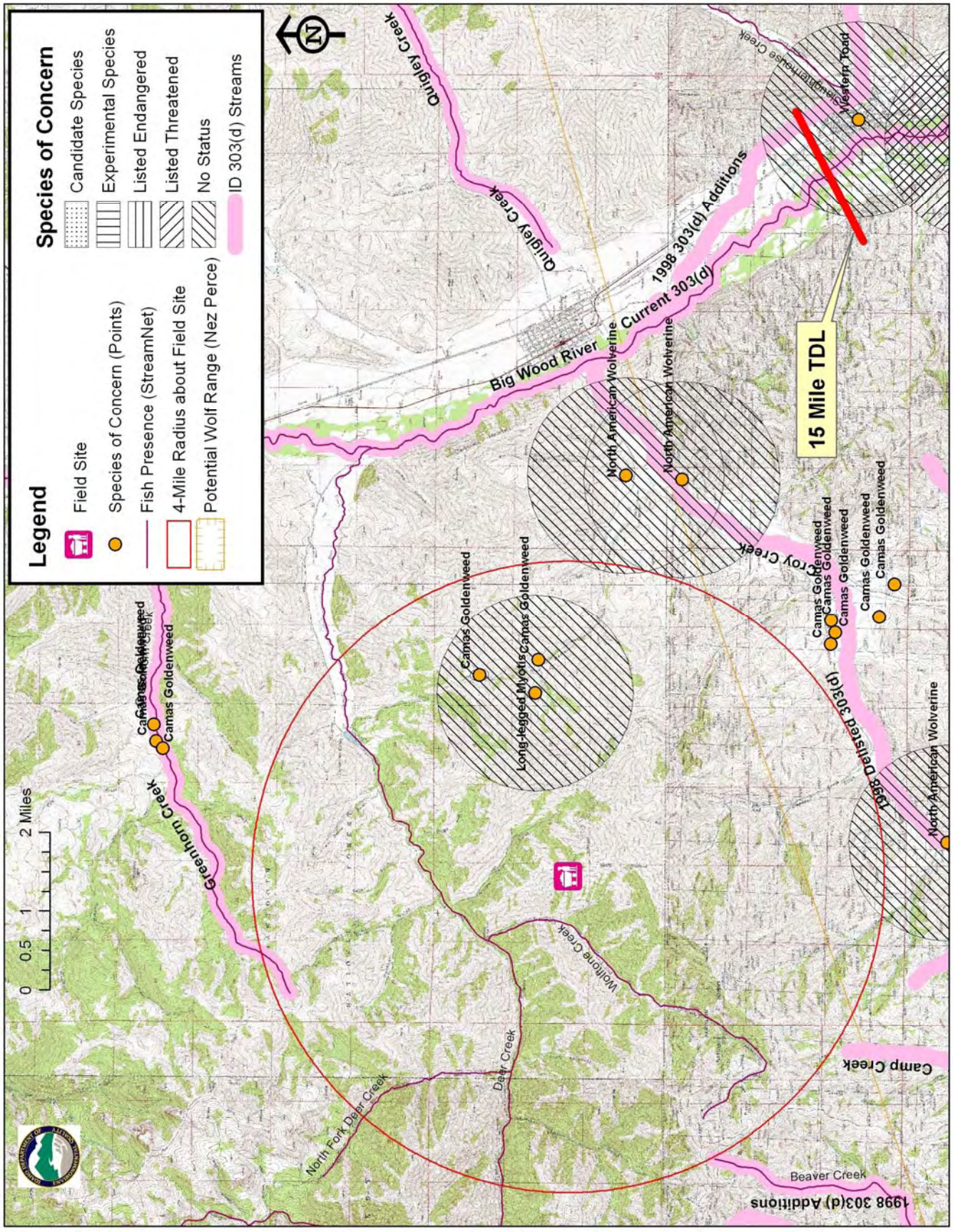
There are no schools, day-care facilities, or private residences within 200 feet of the site, however, BLM or Forest Service workers, in addition to the outdoor recreation enthusiasts, may occasionally be within 200 feet of the site.

Plant and Animal Species of Concern

Camas Goldenweed and Long legged Myotis were the only IDF&G listed species of concern (F&G, 2002) within a 4-mile radius of the mining site. Gray Wolves and North American Wolverines may also range in this area. Due to the much greater area of range for these animals compared to the size of the waste dumps, it is unlikely that individual animals would experience sufficient doses to be at risk.

Soil Sample Concentrations

Frequent exposure to heavy metals at the site for all receptors exists. Risks due to these exposures may be high particularly exposures to arsenic, cadmium and lead.


Legend
Field Site
Species of Concern (Points)
Fish Presence (StreamNet)
4-Mile Radius about Field Site
Potential Wolf Range (Nez Perce)
Species of Concern
Candidate Species
Experimental Species
Listed Endangered
Listed Threatened
No Status
ID 303(d) Streams
0 0.5 1 2 Miles
Quigley Creek
Big Wood River
Current 303(d)
1998 303(d) Additions
15 Mile TDL
Greenhorn Creek
Camas Goldenweed
Long-legged Myotis
North American Wolverine
Western Toad
Deer Creek
North Fork Deer Creek
Wolftone Creek
Camp Creek
Beaver Creek

Section 10 Summary, Conclusions and Recommendations

Although heavy metals concentrations in the mine and mill wastes warrant some risk management, it is doubtful that there is sufficient volumes of waste to trigger extensive remedial action. Based on the remoteness of the site, minimal area of exposure and few receptors, IDEQ is recommending to EPA that there is no calculation of a Hazard Ranking Score for the Red Cloud Mine and that No Remedial Action is Planned for the site. However, IDEQ is also recommending to the owner, that all six mine openings are closed as these are very dangerous hazards particularly since each is directly on a frequently used ORV trail.

Presence of Wetlands

Official wetland surveys and aerial photographs of the area, wetlands exist on the site. Based observations and available wetlands data, existing wetlands in Wolftone Creek and downstream are probably not significantly impacted by this site.

Impacts on Water Quality

No overland connections were observed between seasonal runoff and nearby surface or ground water systems. Furthermore, source water assessments indicate that there are no adverse impacts to public or private drinking water supplies from mining in the area. If future development encroaches on the site, new wells drilled at the site would not be likely impacted by heavy metals from the site.

Potential Exposure for Wildlife, Livestock, and Vegetation

Potential exposure from the tailings pile to wildlife and vegetation from the site is present. Native plant species may bio-accumulate high concentrations of metals that may be consumed by the local wildlife or livestock. Livestock and wildlife may be exposed at the site, particularly to elevated lead and silver concentrations, but relative to the extensive range of the livestock and wildlife, compared to the area of the dumps, it is unlikely that significant exposures to heavy metals occurs.

Potential Exposure for Humans

Human activity around the site is high due to the recreational values of the area. This site is frequently visited by mountain bikers, hikers, hunters, snowmobile operators, off-road four wheeling, and various other outdoor recreation enthusiasts. Humans may receive very small doses of heavy metals, especially arsenic, cadmium, chromium, lead, mercury, silver and zinc. Fugitive dust or direct contact with the waste piles appears to be the most significant route of exposure to humans for elevated constituents. Considering the site access is very easy, these exposure levels are likely and probably should be addressed.

References

Bureau of Land Management, 2006, *Land Patent Details* – BLM GLO Records. http://www.glorecords.blm.gov/PatentSearch/Detail.asp?Accession=IDIDAA+046037&Index=1&QryID=41620.75&DetailTab=1

Idaho Department of Water Resources (IDWR), 2006. http://www.idwr.idaho.gov/water/well/search.htm

Anderson, A.L., Kiislgaard, T.H., and Fryklund, V.C., Jr., 1950, *Detailed geology of certain areas in the Mineral Hill and Warms Springs mining districts, Blaine County, Idaho;* Idaho Bureau of Mines and Geology, Pamphlet No. 90, 37 p.

Blaine County, 2006, Blaine County Treasurer-Tax Collections, Hailey, Idaho

Bureau of Land Management, 2006, *Land Patent Details* – BLM GLO Records. http://www.glorecords.blm.gov/PatentSearch/Detail.asp?Accession=IDIDAA+046037&Index=1&QryID=41620.75&DetailTab=1

Environmental Protection Agency (EPA), 2002. Preliminary Remediation Goals. http://www.epa.gov/region9/waste/sfund/prg/index.htm

Idaho Department of Fish and Game (IDF&G), 2002. http://www2.state.id.us/fishgame/info/cdc/plants/vasc_plants&status_n-r.htm

Idaho Department of Fish and Game (IDF&G), 2000. Redband Trout Distribution.

Idaho Department of Environmental Quality (DEQ), 2006. Safe Drinking Water Information System (SDWIS).

Idaho Department of Environmental Quality (DEQ), 2000. 1998 303(d) list.

Idaho Department of Water Resources (IDWR), 1997. COVERAGE IDOWN -- Idaho Surface Ownership.

IDWR^2, 2002. GIS shapefile of well database.

Kiislgaard, T.H., Lewis, R.S., and Bennett, E.H., 2001, *Plutonic and Hypabyssal Rocks of the Hailey 1ºx2º Quadrangle, Idaho*, USGS Bulletin 2064-U, 18 p.

Link, P.K. and Worl, R.G., 2001, *Geology and Mineral Deposits of the Minnie Moore and Bullion Mineralized Areas, Blaine County, Idaho*, USGS Bulletin 2064-Y, 22 p.

Mitchell, V.E., and V.S. Gillerman, 2005, Site Inspection Report for the Abandoned and Inactive Mines in Idaho on U.S. Bureau of Land Management Property in the Hailey-Bellevue Area: Red Elephant Gulch, Blaine County, Idaho; Idaho Geological Survey, 66 p.

Umpleby, J.B., Westgate, L.G., and Ross, C.P., 1930, Geology and ore deposits of the Wood River region, Idaho, with a description of the Minnie Moore and nearby mines by Hewett, USGS Bulletin 814, 250 p.

United States Geological Survey (USGS), 1991. Digital map file of major land uses in the United States.

Western Regional Climate Center (WRCC), 2006. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?idhail