NATURAL RESOURCES

INACTIVE AND ABANDONED MINE LANDS— United Copper Group Mines, Chewelah Mining District, Stevens County, Washington

by Fritz E. Wolff,
Donald T. McKay, Jr.,
and David K. Norman

WASHINGTON
DIVISION OF GEOLOGY
AND EARTH RESOURCES

Open File Report 2003-18
July 2003



WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

INACTIVE AND ABANDONED MINE LANDS— United Copper Group Mines, Chewelah Mining District, Stevens County, Washington

by Fritz E. Wolff,
Donald T. McKay, Jr.,
and David K. Norman

WASHINGTON
DIVISION OF GEOLOGY
AND EARTH RESOURCES

Open File Report 2003-18
July 2003



WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

DISCLAIMER

Neither the State of Washington, nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the State of Washington or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the State of Washington or any agency thereof.

WASHINGTON DEPARTMENT OF NATURAL RESOURCES

Doug Sutherland—*Commissioner of Public Lands*

DIVISION OF GEOLOGY AND EARTH RESOURCES

Ron Teissere—*State Geologist*
David K. Norman—*Assistant State Geologist*

Washington Department of Natural Resources
Division of Geology and Earth Resources
PO Box 47007
Olympia, WA 98504-7007
Phone: 360-902-1450
Fax: 360-902-1785
E-mail: geology@wadnr.gov
Website: http://www.dnr.wa.gov/geology/

Published in the United States of America

Contents

Introduction 1
Summary 1
Ownership 2
History 2
Geologic setting 3
Openings 4
Materials and structures 4
Water 4
Milling operations 4
Waste rock dumps 5
General information 5
Location and map information 6
Mine operations data 6
Physical attributes 7
Vegetation 8
Wildlife 8
Water quality 9
Acknowledgments 9
References cited 9
Appendix A 11
Photographic documentation 11
Methods 11
Field equipment 11
Appendix B: Water quality standards for hardness dependent metals 12

FIGURES

Figure 1. Site map of the United Copper Group mines 1
Figure 2. Photo showing site of the United Copper No. 2 main haulage tunnel adit 2
Figure 3. Photo showing collar of Amazon mine's vertical shaft 2
Figure 4. Photo showing site of the Copper King No. 1 adit and waste rock dump 3
Figure 5. Photo showing view inside the Copper King No. 1 adit 3
Figure 6. Photo showing Site of the Copper King No. 2 portal 4
Figure 7. Photo showing Circa-1090 ore storage bin at Copper King No. 2 portal 4
Figure 8. Photo showing water discharge from United Copper No. 2 adit 5
Figure 9. Photo showing retention pond at United Copper No. 2 tunnel site 5
Figure 10. Photo showing lower tailings disposal area of about 10 acres 5
Figure 11. Photo showing south bank of United Copper Co. lower mill tailings disposal site 6
Figure 12. Photo showing waste rock dump at United Copper No. 2 haulage tunnel 7
Figure 13. Photo showing waste rock dump near Amazon mine 7
Figure 14. Photo showing United Copper No. 1 access road washout 7

TABLES

Table 1. Mine statistics 8
Table 2. Mine features 8
Table 3. Soil analysis 8
Table 4. Model Toxics Cleanup Act, WAC 173-340-900 8
Table 5. Bat information 8

Table 6. Surface water field data 9
Table 7. Surface water analysis 9

Inactive and Abandoned Mine Lands—United Copper Group Mines, Chewelah Mining District, Stevens County, Washington

Fritz E. Wolff, Donald T. McKay, Jr., David K. Norman
Washington Division of Geology and Earth Resources
PO 47007; Olympia, WA 98504-7007

INTRODUCTION

Presently in Washington State there is no systematic database of inactive and abandoned metal mines (Norman, 2000). Previous work by the Department of Natural Resources (DNR) has had a distinctly commodity-oriented focus (Huntting, 1956; Derkey and others, 1990). The current goal is to build a single database and geographic information system (GIS) coverage of major mines in the state. Documentation will focus on physical characteristics and hazards (openings, structures, materials, and waste) and water-related issues (acid mine drainage and/or metals transport). Accurate location, current ownership, and land status information will be included. Acquisition of this information is a critical first step in any systematic approach to determine if remedial or reclamation activities are warranted. Open-File Reports (OFRs) will provide written documentation on mines or groups of mines within specific mining districts or counties.

Over 3800 mineral properties have been located in the state during the last 100 years (Huntting, 1956). Many are undeveloped prospects of little economic importance. Therefore, in considering the population to include in the Inactive and Abandoned Mine Land (IAML) inventory, we have identified approximately 60 sites that meet one of the following criteria: (a) more than 2000 feet of underground development, (b) more than 10,000 tons of production, (c) location of a known mill site or smelter. This subset of sites includes only metal mines no longer in operation.

We have chosen to use the term *inactive* in the project's title in addition to the term *abandoned* because it more precisely describes the land-use situation regarding mining and avoids any political or legal implications of surrendering an interest to a property that may re-open with changes in economics, technology, or commodity importance.

Creation of the state-managed IAML database is a cooperative effort between DNR, the U.S. Forest Service (USFS), the U.S. Bureau of Land Management (BLM), the U.S. Environmental Protection Agency (EPA), and the Washington Department of Ecology (DOE). DNR's Division of Geology and Earth Resources (DGER) is the lead agency. To date, USFS contracts have been the principal source of funding, with other contributions coming from DNR and EPA.

SUMMARY

The overwhelming tonnage mined from this group of mines, referred to as the United Copper Group, was generated from the United Copper mine itself. However, data on the Amazon, Copper King, Copper Queen, and Keystone mines are included. Because of shared openings, interconnections, and milling agreements, we consider them essentially one mine, specific ownership considerations notwithstanding. All have produced copper, silver, and minor gold values from a series of six primary traceable veins. The properties are located about 3.5 miles northeast of Chewelah, Wash., in secs. 29 and 32, T33N R41E (Fig. 1).

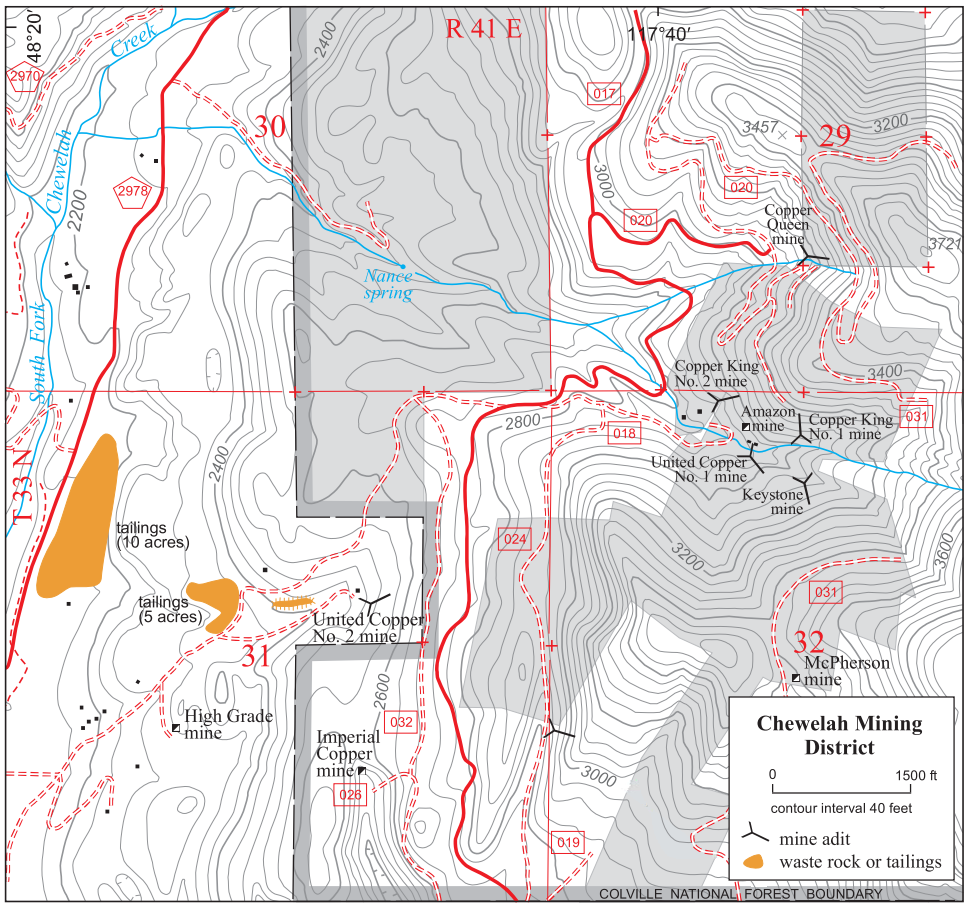


Figure 1. Site map of the United Copper Group mines. Light gray areas are non-National Forest lands within the National Forest boundary. Red pentagons indicate county roads; red rectangles are National Forest roads.

Ownership

All the lands formerly mined lie within the Colville National Forest, which is administered by the U.S. Forest Service. As detailed below, private parties hold the majority of the mineralized ground as patented claims. A map of claim surveys drawn in 1913, after the patenting process had taken place, indicates a tangle of overlapping claim boundaries and corners involving each of the five principal mines named above (Campbell, 1912). The question of who owned what, combined with the vexing geologic problem of six parallel veins, some of which branch and intersect one another, led to a legal confrontation in 1959 that appears to have been finally resolved in 1970: "To simplify the owner-operator record entries, a 20 percent share of the ownership was assigned to each of the [five] owners listed therein" (DGER Mine File). No unpatented claims were on active status in December 2002. DGER personnel performed field work at the site on Sept. 11, 2001,and May 8, 2002.



Figure 2. Site of the United Copper No. 2 main haulage tunnel adit. GPS unit (8 inches wide) in lower right for scale. View to northeast.

History

According to Bancroft (1914), the United Copper mine was acquired by Judge Shapler of Chewelah in 1891. Development work until 1906 consisted of surface exploration along the outcrop and sinking an exploratory shaft approximately 175 feet deep. This work indicated the presence of oxidized silver-copper mineralization transitioning to sulfides. A 300-foot long drift was driven under the deepest shaft elevation from a point next to the southwest corner of the Shamrock Fraction claim. These openings, and the significant future production emanating from stopes and sublevels on the adjacent Black Cat Lode claim, are referred to in this report as the United Copper No.1 mine (UC#1). The United Copper Co. was formed in 1906. In 1909, the company purchased land about one mile south of UC#1 in order to drive a 4222-foot crosscut, bearing N84E, to intersect the vein. The purpose of this tunnel was to gain depth on the vein for stoping, as opposed to sinking shaft in reportedly wet ground. This tunnel is referred to in the literature, maps, and elsewhere as United Copper mine No. 2 (UC#2). In reality, it is not a separate entity and served only as the main haulage and drainage tunnel for the upper workings. It was completed in 1914. A little known aspect of this work was the discovery of an additional ore-bearing structure during the drive (Wolfle, 1942): "We might also mention that [at about] 3000 feet in from the portal of No.2 tunnel . . . a very promising vein, 8 feet [wide] was found showing a good character of ore. There [was] no work done on this vein as the company did not own the ground. So [it] was solidly timbered up . . ." This discovery is believed to have been the downward extension of the Keystone vein.

United Copper Co. produced over 9 million pounds of copper and 1.6 million ounces of silver during the period from 1906 to 1920 (Fulkerson and Kingston, 1958). The last year of any significant production was 1920. At that time, the price of both metals dropped below the expected return from shipping and smelting the mine's concentrate, and the property was placed on watchman status. The United Copper mine ultimately consisted of seven sublevels below the surface shaft (400, 500, 600, 1000, 1100, 1200, 1300, and 1400 foot levels), two internal vertical shafts, and numerous raises and ore chutes (Patty, 1921). At cessation of mining in 1931, work on the vein extended almost to a connection with the Copper King mine.



Figure 3. Collar of Amazon mine's vertical shaft. View to north.

In 1952, Chewelah Copper Co. (CCC) reopened the UC#2 tunnel and purchased leases on the Keystone, Amazon, Copper

King, and Copper Queen mines. Several years effort was expended retimbering and dewatering the UC#2 tunnel and arranging for purchase of the Bonanza flotation mill at Palmer Siding north of Colville. The first shipment of concentrates from this activity was delivered to the Tacoma smelter in April 1955. CCC also hauled ore through the Copper King No. 2 (CK#2) tunnel from drifts and stopes on the Amazon vein (DGER mine file). A $63,000 Defense Minerals Exploration Act (DMEA) loan was obtained in 1955 for diamond drilling the Keystone vein. It is unclear whether the drilling program was actually carried out, and if so, what the results were. A Philip Skok of Colville purchased the "United Copper holdings" for delinquent taxes in March 1961. The Delles and Sullivan Mining and Milling Co. optioned the property in November 1962 (DGER mine file). We could discover no additional information relative to post-1962 activity.



Figure 4. Site of the Copper King No. 1 adit and waste rock dump. View to north.

The Copper King vein was opened at two different elevations and locations, owing to separate business entities at the time of discovery. At some point during the 1950s, connections were made between the two levels and to the Amazon vein. The Amazon, Copper King, and Keystone mines lie within an 800-foot radius of the UC#1 adit. The Copper Queen mine is located approximately 0.5 miles north of the other properties on two patented claims and 80 acres of deeded land.

Fulkerson and Kingston (1958) reported the combined production from the four properties adjacent to United Copper at approximately 18,000 tons, or 5 percent of the output from United Copper itself. The only known mine maps are contained in Patty (1921) and Clark and Miller (1968).

Geologic Setting

Six prominent mineralized veins have been identified and developed within the United Copper Group. The sulfide mineralization in these veins consists primarily of chalcopyrite, tetrahedrite-freibergite, and pyrite. Quartz is the primary gangue mineral, with subordinate siderite and calcite. The veins follow nearly vertical zones of shearing and partial replacement along the bedding and jointing planes in schist and argillite of the Precambrian Belt series (Wallace Formation). The mineralization is believed by Clark and Miller (1968) to be related to the upper Mesozoic Flowery Trail granodiorite batholith, which crops out 2 miles southeast of the mine workings along the Thompson Creek valley. Exploration below the United Copper 1400 level may have been restricted due to a belief by early investigators that Eagle Mountain was underlain by a nearly horizontal post-mineralization thrust fault. Later geologic mapping indicates that this fault may not actually exist (Miller and Clark, 1975). "It was found that in many mines little exploration had been attempted below adit level and that the plane of an underlying thrust fault that appears to have been the control for ore deposition has not been tested." A narrow (2–12 in. wide) ore shoot encountered in the lower United Copper workings assayed from 70 to 300 ounces of silver per ton. Patty (1921) theorized that the shoot was introduced during later stage mineralization, since it exhibited both a sharp line of contact with the surrounding lower grade vein material and because it consisted almost exclusively of freibergite—a silver-rich variety of tetrahedrite.

Veins exposed in the workings are composed of milky quartz and carbonate minerals, but contain small horses of argillite wall rock. Sulfides are sparsely disseminated but locally concentrated.



Figure 5. View inside the Copper King No. 1 adit. Plank crosses the vertical shaft, which is caved at 10 feet. View to north.

Conway (1915) carried out a rigorous sampling program on the UC#1 500-foot and 1000-foot levels. The average tenor of ore reported for 150 samples was 2.1 percent copper and 5.02 ounces silver per ton. The figure for silver content does not take into account a high standard deviation in the samples: sigma = 14, meaning 99 percent of the assays vary by approximately 42 ounces per ton. A preponderance of values in the 0.2 to 0.8 ounce per ton range were adjacent to occasional paystreaks of

30 to 101 ounces per ton. Gold content ranged from trace to 0.04 ounces per ton (Conway, 1915).

Openings

The UC#1 and UC#2 (Fig. 2) adits are caved. Clark and Miller (1968) reported them inaccessible in 1964. We did not find the UC#1 vertical shaft. The Amazon shaft is collapsed, unfenced, and filled with collar timbers (Fig. 3). Its original depth was 195 feet. It appeared to be blocked at an estimated depth of 50 feet in May 2002. The (upper) CK#1 adit is open (Fig. 4). A vertical shaft of unknown depth lies immediately inside this portal (Fig. 5). Someone had placed a 2 x 10-inch plank across the shaft to gain access to a horizontal drift that continues northerly to the CK vein. The CK#2 (lower) adit is caved (Fig. 6). The Keystone adit is caved. The CK#1 and Amazon shaft openings are dangerous, as is the highwall surrounding CK#2 portal. The Copper Queen adit is open, but caved 20 feet inside the portal. It has a bearing of N85E. A USFS land marker stands on the dump surface.



Figure 6. Site of the Copper King No. 2 portal. Note highwall subsidence and tree fall.

Materials and Structures

The original mill and camp structures have disappeared, with the exception of the log CK#2 ore bin. This structure is intact but rapidly succumbing to climatic degradation (Fig. 7). A photo of the structure taken circa 1910 appears in Bancroft (1914, p.75). Mine rails extend across the CK#2 waste rock dump.



Figure 7. Circa-1890 ore storage bin at Copper King No. 2 portal. View to east.

Water

Water emanated from three mine openings: from the UC#2 adit (Fig. 8), from a 1-inch plastic pipe extending from the caved adit of CK#2, and from the Copper Queen adit. Samples taken at these widely separated localities exhibited very similar field qualities: a basic or non-acidic mine drainage (pH ~8.0) and conductivity readings of 614, 730, and 422 μS/cm, respectively. These readings are elevated but typical for sulfide/sulfate-containing ore deposits. Analyses for heavy metals met both Washington State standards shown in Table 7. Drainage from UC#2 of approximately 20 gpm flows into a collection pond several hundred feet west of the portal area. The pond shows signs of heavy use by all-terrain vehicles (ATV) and off-road vehicles (ORV)(Fig. 9). The UC#2 tunnel is synonymous with the "1000 level" nomenclature found on mine maps (Patty, 1921). An unpublished report indicates the mine is flooded below this elevation (DGER mine file). We do not know if water is impounded behind the collapsed portal, but some potential exists for a hydraulic blowout because of the tunnel's 4220-foot length

Water at the Copper Queen adit consisted of 120 cubic feet of standing water inside the portal from which a discharge of approximately 0.25 gallon per minute was observed.

Milling Operations

United Copper Co. operated a 125 ton per day mill near the portal of UC#2 from 1913 until the mid-1920s. The original mill used Frue vanners and Wilfley tables for gravity concentration. The gravity tailings were reground and reprocessed after flotation technology was introduced circa 1918 (Weaver, 1920). Concentrates were shipped to the Granby smelter at Grand Forks, Montana, and later to Trail, B.C., and Tacoma. A material balance calculation based on the total output of the United Copper Group of claims (~373,000 tons) would have generated about 240,000 cubic yards of dry sand tailings. Based on field



Figure 8. *(top)* Water discharge from United Copper No. 2 adit (arrow points to opening). View to northeast.

Figure 9. *(middle)* Retention pond at United Copper No. 2 tunnel site. Portal behind trees in upper right of photo. Note ATV tracks (arrow). View to northeast.

Figure 10. *(bottom)* Lower tailings disposal area of about 10 acres. View to north.

observations of thickness, we estimate that the 5-acre upper tailings site contains 64,500 cubic yards of material (Fig. 10), and the 10-acre lower site about 117,500 cubic yards (Fig. 11). The two sites are separated by 900 feet of forest through which tailings have been dumped or spilled. We estimate the thickness in this 13-acre area to be 1 to 2 feet, adding an additional 1600 cubic yards of material. Each tailings disposal area exhibits signs of heavy ATV, ORV, and dirt-bike usage.

Samples taken at the upper and lower sites exhibit remarkably similar copper and arsenic content, both of which exceed levels listed in Model Toxics Control Act for Unrestricted Land Use (Tables 2, 3). Erosion has begun to compromise embankments at both sites, forming long narrow gullies. We were unable to pinpoint the exact site of the United Copper mill. We suspect from historic photos that it was located near the present road, several hundred yards west of UC#2 portal. Milling operations during a brief period of activity in the mid-1950s took place at the Bonanza mill near Colville (DGER mine file).

Waste Rock Dumps

The major waste rock dump in terms of volume is located near the portal of UC#2 (Fig. 12). It is partly shotrock from the tunnel (quartz-mica schist) and partly unmineralized run-of-mine material. Dumps 30 to 40 feet high were observed at CK#1, CK#2 and in the general vicinity of the Amazon shaft (Fig. 13). All exceed 500 cubic yards in volume. None of the dumps exhibit staining or other indication of high toxic metal content. No samples were taken. The Copper Queen dump is approximately 100 feet wide by 100 feet long with a slope length of 40 feet.

GENERAL INFORMATION

Name	Alternate Name	MAS/MILS sequence number
United Copper	United Silver Copper	530650095
Amazon		none
Copper King		0530650456
Copper Queen		0530650033
Keystone		none
Chinto	Banner	0530650458

Access: jeep road and hiking trail; no gates as of May 2002

Status of mining activity: none

Claim status: The ORMC number is the BLM designation for mining claims in Oregon and Washington. Per the Mining Law of 1872, lode mining claims fall in two categories:

1. *Unpatented claims* require a minimum annual expenditure of $100 assessment work per claim. A $100 maintenance fee may be paid in lieu of performing assessment work. Unpatented claims are classified as *active* or c*losed*. *Active* denotes a valid, up-to-date claim. *Closed* denotes that the maintenance fee, assessment work, or other requirements have not been met, and that the claim is no longer valid. The following table contains information on active claims only.
2. *Patented claims* are owned in fee simple by the discoverer and their assigns. A mineral survey is performed as part of the patent application process, prior to the issuance of a patent. Some lode claims initially mined underground may at a later date turn into an open pit operation. If this occurs, a Surface Mining Permit is required, which contains certain stipulations regarding reclamation.

United Copper Group. No unpatented lode claims are listed as active as of November 2002 according to the BLM LR2000 database

Name of patented claims	Mineral survey no.	Tax parcel no.
New Home mine	952	435750
Hester mine	952	435750
Widow's Mite mine	952	435750
Mint mine	937	435500/435400
Independence mine	937	435500/435400
Gray Copper Fraction mine	952	435750
White Cat mine	1068–1171	435300
Sunset Fraction mine	1107	435200
Jappo mine	1068–1171	435300
Nellie mine	1075	435600
Coin mine	937	435500/435400
Keystone Fraction mine	937	435500/435400
Black Cat mine	952	435700
Half Diamond Fraction mine	952	435700
United Copper Fraction mine	952	435800
Hidden Treasure mine	952	435800
Jappo Fraction mine	1068–1171	435300
Amazon Fraction mine	1028	435100
Wild Goose mine	1028	435100
Copper King mill site	981	435000
Shamrock Fraction mine	981	435000
Banner mine	981	435000
Copper King mine	981	435000
Amazon mine	1028	435100

Current ownership of lands formerly mined: The Copper Queen property of 80 acres is part of the Colville National Forest administered by U.S. Forest Service. Forty acres of deeded land surrounding the UC#2 portal are under private ownership. Contact the Stevens County Assessor's Office for information.

Surrounding Land Status: Colville National Forest

Location and Map Information

Mine name	County	Location	Decimal longitude	Decimal latitude	1:24,000 map	1:100,000 map
United Copper Group	Stevens	secs. 29, 31, and 32, T33N R41E	117.679075	48.317097	Chewelah	Colville

Directions: Proceed north from Chewelah city limits on the Lambert Grade Road, paralleling the east bank of South Fork Chewelah Creek. At approximately 2.6 miles, a dirt road takes off to the right heading east. Follow this road 0.7 miles to a wye. This is the approximate site of the United Copper mill as evidenced by ~5 acres of tailings. The right branch of the track at this point leads past a long narrow waste rock dump composed of a quartz-mica schist known locally as 'silver shale'. The United Copper No. 2 (UC#2) tunnel portal is located just above this dump. The patented claims and all the known mineralization associated with the United Copper group of mines lie in a tight valley approximately one mile northeast of this portal. The spiderweb of roads in the area render it impossible to describe a precise route to the properties, but all are located within a 900 foot radius of one another along an unnamed drainage leading downstream to Nance Spring shown on the USGS Chewelah 7.5-minute quadrangle (Fig. 1). A single-lane track at elevation 2880 feet leads directly to the original United Copper No. 1 portal. It is washed out several hundred feet from the mine site (see Fig. 14).



Figure 11. South bank of United Copper Co. lower mill tailings disposal site (~10 acres). Shovel for scale. View to north.

Mine Operations Data

Type of mine: underground

Commodities mined: copper, silver, gold

Geologic setting: The mines developed along a series of roughly parallel, near-vertical veins that strike north to northeast. The United Copper vein is 5 to 20 feet wide and averages 8 feet. Ore is localized in a second-stage mineralization of silver-rich tetrahedrite (freibergite) 2 to 12 inches wide (Huntting, 1956). The Copper King and Amazon mines contained similar paystreaks in veins approximately 5 feet wide. Data on the Key-

Figure 12. Waste rock dump at United Copper No. 2 haulage tunnel. View to northeast.

Figure 13. Waste-rock dump near Amazon mine. Sheet flow in foreground from spring to east of photo. View to north.

Figure 14. United Copper No. 1 access road washout.







stone property is not available. All the veins occur as fracture filling in Precambrian argillite, quartzite, and quartz-mica schist of the Wallace Formation.

Ore minerals: chalcopyrite ($CuFeS_2$), tetrahedrite var. freibergite ($(Ag,Cu)_{12}(Sb,As)_4S_{13}$), malachite ($Cu_2(CO_3)(OH)_2$) (Derkey, 1990)

Non-ore minerals: quartz (SiO_2), calcite ($CaCO_3$), siderite ($FeCO_3$), pyrite (FeS_2), arsenopyrite (FeAsS)

Host rock: argillite, quartzite, and quartz-mica schist of the Wallace Formation on the east side of the north-trending shear zone and Edna Dolomite of the Deer Trail Group on the west side of the shear zone (Clark and Miller, 1968)

Period of production: 1906 to 1931 and 1955 to 1959

Development: ~12,000 feet of stopes, drifts, and crosscuts; the UC#2 tunnel is 4220 feet long

Production: 10.5 million pounds copper, 1.7 million ounces silver, and 1400 ounces gold

Mill Data: The original mill built in 1913 was located near the UC#2 tunnel portal. A flotation circuit was added circa 1918 to process fines and gravity tails. The mill eventually had a 350-tons/day capacity and contained the most advanced equipment of the day: jaw crusher, Simmonds gyratory crusher, ball mills, classifiers, filters and dewatering equipment (Patty, 1921). We found no evidence of the mill's exact location; no equipment or structures have survived.

PHYSICAL ATTRIBUTES

Features: see Table 1

Materials: none

Machinery: A bright yellow, heavy-duty wheeled vehicle sits a few hundred feet east of the Amazon shaft. A winch-like mechanism, which may have been used as a hoist, is welded to the frame.

Structures: The log ore bin adjacent to the Copper King No.2 portal still stands. It is collapsing and dangerous.

Waste rock dumps, tailings, impoundments, highwalls, or pit walls: Sandy unconsolidated material has sloughed around the entrances of the United Copper No. 1 and Copper King No. 2 adits. The slope angle at both sites is about 73 degrees. The highwall relief is 100 feet in places. Trees continue to slide off the highwall lip.

Table 1. Mine features. – – –, no data; *, data from DGER mine map file; **, numbered photos online at http://www.dnr.wa.gov/geology/iaml/03-18/

Description	Condition	Fenced (yes/no)	Length (feet)	Width (feet)	Height/ depth (feet)	True bearing	Elev. (feet)	Decimal longitude	Decimal latitude	Digital photo**
United Copper No. 2 adit (1000-foot level)	caved	no	4220	~6*	~7*	N84E	2480	117.6798	48.31725	DSCN2160
United Copper No. 1 adit (400-foot level)	caved	no	1000	~6*	~7*	S10E	2960	117.6638	48.32107	DSCN2788
Copper King No. 2	caved	no	950	~6*	~7*	N70E	2920	117.6658	48.3229	DSCN2789
Copper King No.1	open	no	1000	~6	~7	N15E	3040	117.6617	48.32155	DSCN2797
Amazon shaft	collar timbers and supports litter the opening	no		~8 x 8	192*	N/A	2960	117.6646	48.32204	P5080095
Keystone adit	caved	no	300*	– – –	– – –	S10W	3040	117.6618	48.32053	DSCN2790
Copper Queen adit	open, but caved 20 feet from portal	no	600*	– – –	– – –	N85E	3200	117.66136	48.32666	– – –

The upper 5-acre tailings disposal site is 10 feet thick at its western limit and approximately 3 feet thick closest to the suspected mill site. It shows obvious signs of ATV usage, possibly as a race-track. The arsenic and copper content of the dust generated by these activities may pose a human health hazard. (See Tables 2, 3.) The elevation of this site is 2330 feet. We estimate that this site contains 64,500 cubic yards of material.

The lower (elevation 2160) tailings disposal site of 10 acres shows similar signs of public use. The entrance is ungated. We estimate the average thickness to be 11 feet or a total volume of approximately 177,500 cubic yards of material. The western margin of the tailings and the area between Lambert Grade Road and the tailings is experiencing residential development. An electric utility trench 3 feet deep had been excavated in tailings slough at the southwest margin of this site at the time of DGER visitation. Tailings have also free-flowed over much of the 13 acres in between the two sites discussed above. We estimate the total volume in this area at approximately 1600 cubic yards.

Analysis of tailings and dumps: see Table 2

Waste rock, tailings, or dumps in excess of 500 cubic yards: yes

Reclamation activity: none

Table 2. Soil Analysis. Metal concentrations are mg/kg – – –, no data. Numbers in parentheses indicate factor by which analysis exceeds standards shown in Table 3

Sample location	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc	Gold
5-acre upper tailings sample #1	91.3 (4X)	<0.946	– – –	– – –	7.21	– – –	81.5	– – –
5-acre upper tailings sample #2	70.3 (3X)	0.448	4200 (420X)	32200	5.3	– – –	68.5	– – –
10-acre lower tailings sample #1	179 (9X)	<0.871	4950 (500X)	57900	5.84	– – –	61.4	– – –
10-acre lower tailings sample #2	134 (7X)	0.341	– – –	– – –	4.68	– – –	53.2	– – –

Table 3. WAC 173-340-900, Model Toxics Control Act. Table 749-2: Priority contaminants of ecological concern for sites that qualify for the simplified terrestrial ecological evaluation procedure (partial data). Concentrations are mg/kg. Levels shown for unrestricted land use. Levels for silver, gold, and iron are not specified

Metals	Arsenic III	Cadmium	Copper	Lead	Mercury	Zinc
mg/Kg	20	25	100	220	9	270

Table 4. Bat information

Opening	Aspect	Air temp. at portal	Air flow: exhaust	Air flow: intake	Multiple interconnected openings	Bats or bat evidence
Copper King No. 1	SE	47–62°F May–Sept	yes	no	unknown	no

Table 5. Benthic macroinvertebrates: number of taxa found

Sample location	Flat-worms	Beetles	Caddis-flies	Flies	May-flies	Moths	Stone-flies	Segmented worms
United Copper No. 2 adit	5	0	0	1	4	0	0	0
Nance Spring drainage below Copper King No. 2	0	1	0	1	0	0	0	1

VEGETATION

Grasses, clover, knapweed and aquatic plants at United Copper No. 2 portal. Fir, birch, aspen, and cottonwood trees growing at most mine adit sites. Vegetation did not appear stressed. The upper and lower tailings impoundments do not support any plant life to speak of. The 13 acre area between the upper and lower tailings typically supports a sparse stand of lodgepole pine and brush; the vegetation appears stressed and unhealthy.

WILDLIFE

A breeding pair of red-naped sapsuckers (*Sphyrapicus nuchalis*) was observed on May 8, 2002, in trees adjacent to the UC#2 tunnel portal. Black bear prints were observed adjacent to the UC#1 portal. White tailed deer were observed. Data for the one opening suspected of providing bat habitat are given in Table 4.

Data on benthic macroinvertebrates are given in Table 5. These data are indicative of lesser water quality (Marc Hayes,

Table 6. Surface water field data: – – –, no data; *, data collected by Robert L. Raforth, Washington Department of Ecology, Water Quality Division; low flow, Oct. 2002 (Raforth and others, 2002); **, numbered photos online at http://www.dnr.wa.gov/geology/iaml/03-18/.

Sample location	Description	Flow (gpm)	Conductivity (μS/cm)	pH	Bed color	Temp. (°F)	Elev. (feet)	Decimal longitude	Decimal latitude	Digital photo**
United Copper No.2 portal	discharge	20	614	7.79*	natural	44	2480	117.6812	48.31747	DSCN2162
Copper King No. 2 (1-inch pipe from adit)	discharge	1	730	8.00*	natural	47	2920	117.6658	48.3229	P5080098
Copper Queen adit*	discharge*	0.25*	422*	8.33*	– – –	47*	3200*	117.66136*	48.32666*	– – –

Table 7. Surface water analysis. Metal concentrations are μg/L; Hardness is in mg/L. ≤ indicates metal was not detected; the number following is the practical quantitation limit above which results are accurate for the particular analysis method—the metal could be present in any concentration up to that limit and not be detected; – – – no data; *, data collected by Robert L. Raforth, Washington Department of Ecology, Water Quality Division; low flow, Oct. 2002 (Raforth and others, 2002). ** Standards for these metals are hardness dependent. Conversion formulae are shown in http://www.ecy.wa.gov/pubs/wac173201a.pdf. Standards calculated for hardness values specific to Part 1 below, are shown in Appendix B

PART 1: ANALYSIS BY USEPA METHOD 6010, INDUCTIVELY COUPLED PLASMA

Sample location	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc	Hardness
United Copper No. 2 adit	≤10	≤5	≤10	≤100	≤0.5	≤0.2	≤10	– – –
Copper King No. 2 adit	≤10	≤5	33.4	103	≤0.5	≤0.2	≤10	– – –

PART 2: ANALYSIS BY USEPA METHOD 6020, INDUCTIVELY COUPLED PLASMA/MASS SPECTROMETRY

Sample location	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc	Hardness
Copper King No. 2 adit (low flow)*	6.16	0.058	29.9	55	≤0.02	0.0061	6.6	437
Keystone mine (low flow)*	≤0.01	≤0.02	0.19	44	≤0.02	≤0.02	19.2	– – –
Nance Springs (low flow)*	0.75	≤0.02	1.47	27	≤0.02	≤0.02	1.8	187

PART 3: APPLICABLE WASHINGTON STATE WATER QUALITY STANDARDS

Type of standards (applicable Washington Administrative Code)	Arsenic	Cadmium	Copper	Iron	Lead	Mercury	Zinc	Hardness
Surface water standards (WAC 173-201A, Standard for aquatic life in surface freshwater, chronic level maximums at 100 mg/L hardness)	190	**	**	none	**	0.012	**	100
Ground water standards (WAC 246-290, Washington State Department of Health, standards for ground water, domestic consumption)	50.0	none	1300	300 (cosmetic only)	15	2.0	5000	– – –

DNR Habitat biologist, written commun., 2002). The UC#2 sample site was at the portal. The CK#2 sample site was at a road culvert a few hundred feet west of the portal.

WATER QUALITY

Surface waters observed: headwaters of Nance Spring drainage

Proximity to surface waters: 0 feet

Domestic use: livestock

Acid mine drainage or staining: none

Water field data: see Tables 6 and 7

Surface Water Migration: Water discharging from the UC#2 haulage tunnel migrates to the pond shown in Fig. 10. We believe a standpipe or culvert has been installed at some time in the dike at the southwest end of the pond to prevent breaching of the earth-fill dam. ATV tracks running across the pond bottom and through the culvert area indicate that whatever is there to prevent overfill of the pond may not be functional. Seepage occurs on the downstream side of the impoundment.

Water flowing through the UC#1 yard area does not come from the suspected adit location. It appears to originate from springs in a brush-covered gully to the east of the mine portal. It continues downslope past the Amazon and Copper King No. 2 waste rock dumps, the access road, and finally discharges in a stream of approximately 100-gpm flow at a logging-road culvert west of the Copper King ore bin described above. Water discharging from the 1-inch pipe at the CK#2 adit infiltrates the waste rock dump.

ACKNOWLEDGMENTS

The authors thank our editor Jari Roloff for helpful suggestions on the layout and content of this report. Additional appreciation goes to USFS Region 6 for funding this project, Bob Raforth, and the Washington State Department of Ecology.

REFERENCES CITED

Bancroft, Howland; Lindgren, Waldemar, 1914, The ore deposits of northeastern Washington, including a section on the Republic mining district: U.S. Geological Survey Bulletin 550, 215 p.

Campbell, C. M., 1913, "United Copper mine," Stevens Co., Wash.: Granby Consolidated Mining, Smelting and Power Company Limited, 11 p., 1 plate.

Clark, L. D.; Miller, F. K., 1968, Geology of the Chewelah Mountain quadrangle, Stevens County, Washington: Washington Division of Mines and Geology Geologic Map GM-5, 2 sheets, scale 1:62,500, with 6 p. text.

Conway, E. J., 1915, Report on the "United Copper," Chewelah, Wash.: Granby Consolidated Mining, Smelting and Power Company Limited, 20 p.

Derkey, R.E.; Joseph, N.L.; Lasmanis, Raymond, 1990, Metal mines of Washington—Preliminary report: Washington Division of Geology and Earth Resources Open File Report 90-18, 577 p.

Fulkerson, F. B.; Kingston, G. A., 1958, Mine production of gold, silver, copper, lead, and zinc in Pend Oreille and Stevens Counties, Wash., 1902–56; Annual totals by mines, districts, and counties: U.S. Bureau of Mines Information Circular 7872, 51 p.

Huntting, M. T., 1956, Inventory of Washington minerals; Part II—Metallic minerals: Washington Division of Mines and Geology Bulletin 37, Part II, 2 v.

Miller, F. K.; Clark, L. D., 1975, Geology of the Chewelah–Loon Lake area, Stevens and Spokane Counties, Washington, with a section on potassium-argon ages of the plutonic rocks, by J. C. Engels: U.S. Geological Survey Professional Paper 806, 74 p., 2 plates.

Norman, D. K., 2000, Washington's inactive and abandoned metal mine inventory and database: Washington Geology, v. 28, no. 1/2, p. 16-18.

Patty, E. N., 1921, The metal mines of Washington: Washington Geological Survey Bulletin 23, 366 p.

Raforth, R L.; Norman, D. K.; Johnson, Art, 2002, Second screening investigation of water and sediment quality of creeks in ten Washington mining districts, with emphasis on metals: Washington Department of Ecology Publication 02-03-024, 126 p.

Weaver, C. E., 1920, The mineral resources of Stevens County: Washington Geological Survey Bulletin 20, 350 p., 1 plate.

Wolfle, Conrad, 1942, History of the United Copper mine Chewelah, Washington: [Privately published by the author], 3 p. ■

Appendix A

PHOTOGRAPHIC DOCUMENTATION

Photos (JPEG format) listed in tables may be found on our website at http://www.dnr.wa.gov/geology/iaml/03-18/.

METHODS

We recorded observations and measurements in the field. Longitude and latitude were recorded in NAD83 decimal degree format. Literature research provided data on underground development, which was verified in the field when possible.

All water samples were collected as simple grab samples in pre-cleaned 500 mL HDPE bottles with preservative and kept on ice for transport to Sound Analytical Services, Inc. (SAS). Soil samples from dumps or tailings were taken from subsurface material and double bagged in polyethylene. Chain of custody was maintained.

Water and soil samples were analyzed for arsenic, cadmium, copper, iron, lead, and zinc by inductively coupled plasma/mass spectrometry (ICP/MS) following USEPA Method 6010. Samples were analyzed for mercury by cold vapor atomic absorption (CVAA), USEPA Method 7470 (water), and Method 7471 (soil).

Holding times for the metals of interest were observed (28 days for mercury, 180 days for other metals). Instrument calibration was performed before each analytical run and checked by standards and blanks. Matrix spike and matrix spike duplicates were performed with each set.

FIELD EQUIPMENT

barometric altimeter
binoculars
digital camera
flashlight
Garmin GPS III+, handheld GPS unit
Hanna Instruments DiST WP-3 digital conductivity meter and calibration solution
litmus paper, range 0–14, and 4–7
Oakton digital pH meter
Oakton digital electrical conductivity meter
Taylor model 9841 digital thermometer

Appendix B

WATER QUALITY STANDARDS FOR HARDNESS DEPENDENT METALS

WAC 173-201A Chronic standard (μg/l). *, hardness data from Raforth and others (2002); – – –, no data

Sample location	Hardness (mg/l)	Cd (μg/l))	Cu (μg/l)	Pb (μg/l)	Zn (μg/l)
Copper King No. 2	437	3.07	39.70	12.00	364.9
Keystone mine	– – –	– – –	– – –	– – –	– – –
Nance Springs	187	1.63	19.29	4.91	176.81