NATURAL RESOURCES

INACTIVE AND ABANDONED MINE LANDS— Cleveland Mine, Springdale Mining District, Stevens County, Washington

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

WASHINGTON
DIVISION OF GEOLOGY
AND EARTH RESOURCES
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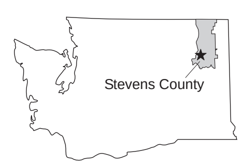

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INTRODUCTION

The Department of Natural Resources (DNR), Division of Geology and Earth Resources (DGER), has created a database (Access software) and a series of written open file reports (OFRs) documenting present-day characteristics of selected Inactive and Abandoned Mine Lands (IAML) in the state. This program of site characterization was initiated in 1999 (Norman, 2000). The continuing body of work was accomplished through interagency grants awarded by the U.S. Forest Service (USFS), Region 6. Documentation focuses 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 is included. Acquiring this information is a critical first step in determining if remedial or reclamation activities are warranted and also serves to update information on many properties last characterized during or before the 1970s. The IAML database may be viewed by contacting Fritz Wolff (360-902-1468). The OFRs are online at http://www.wa.gov/dnr/htdocs/ger/iaml.

More than 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 Lands (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.

Other agencies sharing information in cooperation with DGER are the U.S. Bureau of Land Management (BLM), the U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (DOE).

SUMMARY

The Cleveland mine is located on Huckleberry Mountain nine miles east of Hunters, Wash., in Stevens County (Fig. 1). Although some of the ten patented claims spill over into sec. 4, mining has been confined to two claims in the center of

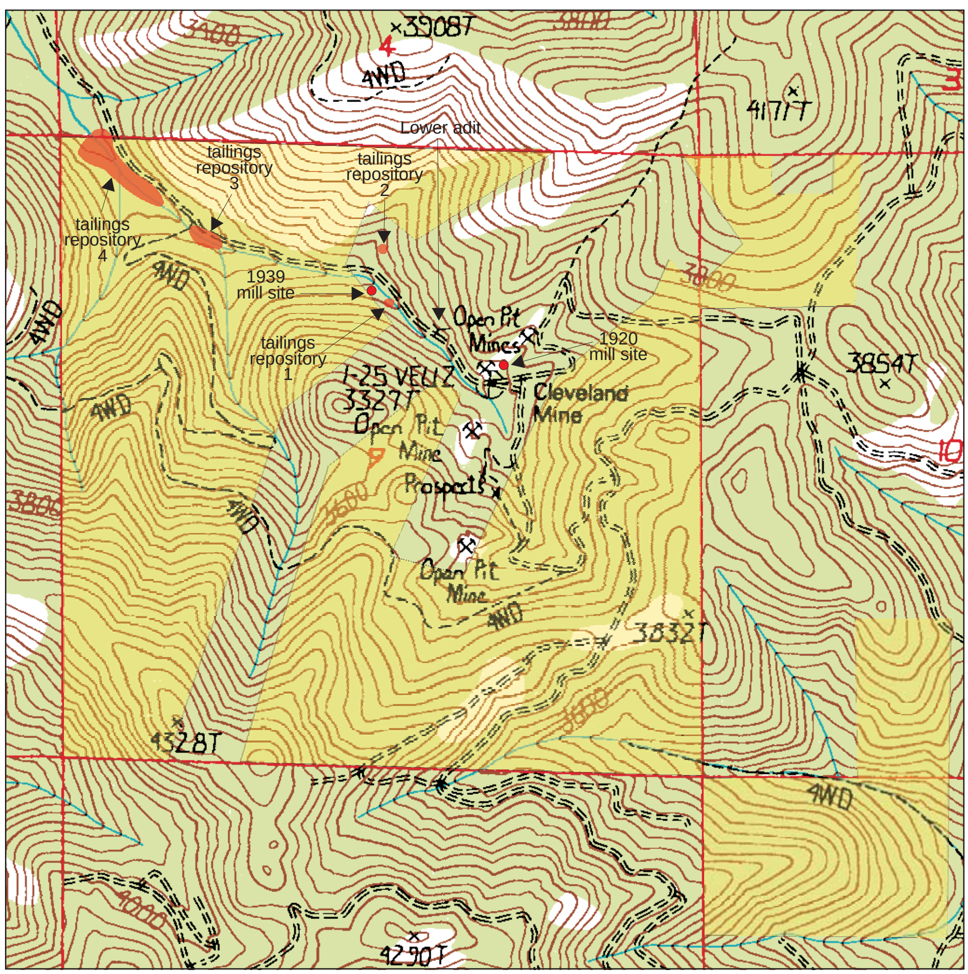

Figure 1. Map showing the location of the Cleveland mine in Stevens County (top) and a more detailed map of the mine site (bottom). Yellow shaded area is BLM land. Section lines are about 1 mile apart.

sec. 9, T30N R38E. BLM owns all of sec. 9 outside the private inholdings. DGER personnel performed field work at the site September of 2001 and May of 2002.

The mine has undergone several changes in ownership since its discovery in 1892. The greatest development took place during the years 1918 to 1926 under the direction of Santa Rita Mining Co. Various attempts were made to open the mine after Santa Rita's withdrawal. Zenith Mines, Inc., put the mine in production during World War II, followed by Base Metals, Inc., from 1947 to 1952. Cleveland Silver Mines, Inc., removed a large tonnage of ore from the surface directly over and to the north and south of the historic underground workings from 1966 to 1970. That is the last known operation to date. A partial overview of the site is shown in Figure 2. Production figures from the surface mining are not available, but the activity cut into and excised some underground development on the upper level, leaving hazardous vertical openings in the pit floor. The north open pit terminates at a structurally unstable vertical wall.

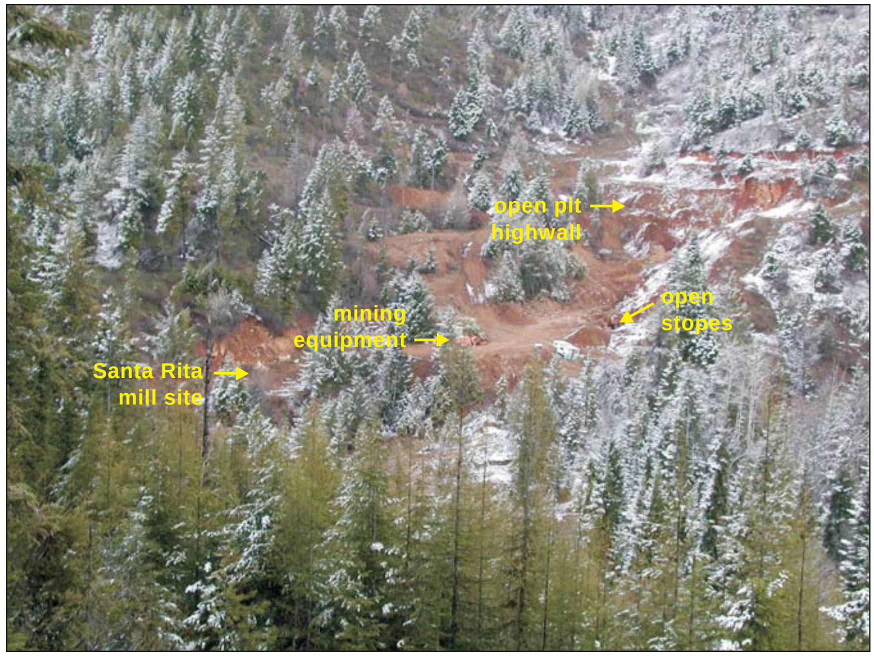

Figure 2. Partial overview of the Cleveland mine site. The Lower Level portal, tailings, and access road are off the photo at the far left center. View to the northwest.

Smelter returns from 1903 through 1948 indicate that the mine produced 2.7 million pounds of lead, 0.5 million pounds of zinc, and 100,000 ounces of silver from 27,000 tons of raw ore. Most of this production came from an underground glory hole measuring 50 feet long by 20 feet wide at one point. It extended from the surface to the lowest level, a distance of approximately 200 feet. At times, ore rich in the antimony mineral boulangerite was stockpiled and shipped to specialty metal reduction works.

Mineralization at the Cleveland mine contained lead and zinc sulfide minerals, most of their oxides and carbonates, and in addition, assayed as much as 8 percent antimony. This assemblage is significantly different from the lead-zinc mineralization found in later dolomites and limestones in northern Stevens County. Arsenic is present in the form of arsenopyrite and mimetite. It forms one of the major contaminants of the tailings and creek sediments.

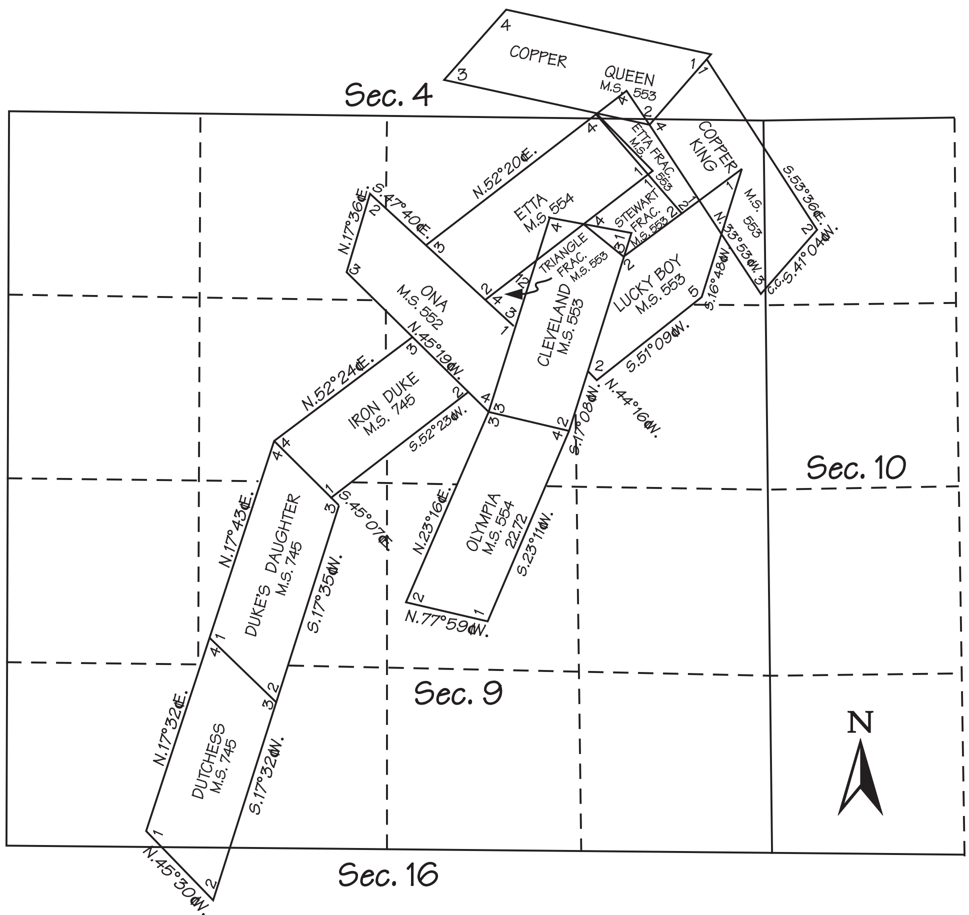

Figure 3. Patented claim map. *(After BLM records.)*

Two mills were constructed on the property. We believe that Santa Rita put the first mill in operation circa-1920. The flow sheet indicates screened and classified material feeding flotation cells and Wilfley shaking tables (DGER mine map file). The remains of this structure's rock and mortar foundation can be seen at the northwest edge of the open pit (Fig. 2). A second mill was built in 1939 just below the Lower level portal on an unnamed tributary of North Fork Hunters Creek. The tailings from both mills discharged into the tributary and collected behind earthfill and log-crib dams at four different locations downgradient from the mine (see Fig. 10). The Lower level waste rock dump covers part of the tailings.

In 2000, BLM undertook a voluntary reclamation on BLM-managed lands in sec. 9. The Washington State Department of Ecology (DOE) cooperated in the reclamation. This work focused on isolating the tailings on public land from the stream, armoring the stream bed and banks, and removing tailings that had inundated the mine access road. The mine openings and mill locations on private holdings were not involved, which limited the scope of work. Several pre-reclamation studies determined that the watercourse was contaminated with concentrations of cadmium, lead, zinc, and arsenic that exceeded certain EPA and State standards for surface waters and stream sediment. A water sample taken by DGER at the Lower level portal exceeded one or more of the State standards for arsenic, lead, and zinc shown in Table 9.

Figure 4. Underground opening excised by surface mining. View to the southeast.

OWNERSHIP

The mine property consists of ten full-sized patented lode claims and three patented fractions (Fig. 3). Stephen Gaylord *aka* Judge Mining Co. LLC, Colorado Springs, Colo., owns three claims surveyed under Mineral Survey 745. B & B Equipment, Spirit Lake, Idaho, holds title to the remaining claims and fractions in sec. 9 under Mineral Surveys 553 and 554. Portions of the Copper King, Copper Queen, and Etta Fraction that overlap into sec. 4 are held by the Guenther Living Trust, Hunters, Wash. (Stevens Co. Assessor, written commun, 2005). (See Table 1.)

HISTORY

Santa Rita Mining Co. developed three levels and sank two inclined shafts between 1918 and 1926. The company built a 50-tpd concentrator whose original purpose was to concentrate oxidized ore left in waste rock dumps by previous operators. The mill was subsequently modified to treat newly mined sulfide ores (Weaver, 1920). Santa Rita's development and stope maps indicate that the company drilled more than 4000 feet of exploratory core holes to the south, north, west, and east from a station on the Intermediate level (DGER mine map file). The holes were drilled at declinations of 30 to 40 degrees and varied in length from 140 feet to 250 feet. No core logs are available to assess the outcome of that effort. The company mined approximately 12,000 tons of ore from a chimney of high-grade mineralization discovered by drifting on one branch of a major fault. Title to the mine is unclear from the cessation of Santa Rita's operation until 1939 when the *Mining Journal* (Dec. 30, 1939) reported that a Kellogg, Idaho, consortium had equipped a newly constructed 20-tpd mill for operation.

Zenith Mines, Inc., operated the Cleveland property from 1942 through 1946, producing 7729 tons and completing 2100 feet of drifts and raises. In addition to lead and silver returns, this production yielded 314,000 pounds of zinc.

Base Metals, Inc., operated the mine from 1947 to 1952. They produced 5160 tons of ore and performed 250 feet of diamond drilling (Fulkerson and Kingston, 1958). Spokane–Idaho Mining Co. leased the property in 1952. Their exploration drilling targeted an area 50 feet below the Lower level and intersected a vein of lead-zinc ore 30 feet wide that contained no antimony (Purdy, 1951). Production by Spokane–Idaho, if any, is unknown.

Cleveland Silver Mines, Inc., registered as a corporation with the state in 1966. It is unknown if the firm held title to the mine or held a lease and option. An article in the *Wallace Miner* (Nov. 12, 1970) stated that as a result of exploration and development activities initiated in 1966, Cleveland Silver had discovered additional surface mineralization 12 to 40 feet wide, containing galena, sphalerite, and boulangerite, that continued

Figure 5. Caved stope. Open-pit excavation in the background. View to the north.

north of the discovery outcrop and south across the tributary gulch. Surface mining began in 1970 with the removal of 100,000 cubic yards of overburden to reach ore approximately 30 feet below the then surface. This activity resulted in the excising of historic underground workings, which now present a significant physical hazard (Figs. 4 and 5). The highwall (Fig. 6) of the north pit terminates in a vertical face of quartzite approximately 75 feet high that appears to be the footwall of an east-striking, steeply dipping fault. It is not apparent if the Santa Rita flotation mill was intact at the time of Cleveland Silver's operation. Since the *Wallace Miner* article mentions stockpiled antimony ore being trucked to Northwest Magnesite at Chewelah, it is most probable that the mill was inoperable. Cleveland Silver deregistered with the state in 1981.

Cominco, Ltd., conducted surface drilling and geophysical exploration in 1997 on the patented claims.

Figure 6. North pit highwall. View to the north.

GEOLOGIC SETTING

Rocks at and within 1000 feet of the Cleveland mine are phyllite, quartzite, and dolomite metasedimentary facies of the Stensgar Dolomite of Proterozoic age (Campbell and Raup, 1964). Ore occurs in lenses and a brecciated chimney within a narrow band of dolomite. Metamorphosed diabase dikes and sills cut the Precambrian rocks. The most obvious structural feature is a near-vertical normal fault that strikes N45E and splits into two branches (Jenkins, 1924). It cuts the dolomite host rock 800 feet from the portal of the Lower level. The right-hand branch led to the discovery of a brecciated chimney containing lead, zinc, and antimony sulfides. The left branch was largely barren. Santa Rita's detailed geologic maps show dozens of low-displacement faults, none of which were found to contain mineralization. The antimony content (boulangerite and stibnite) found at the Cleveland deposit is a significant departure from the mineral suite found at lead-zinc mines located farther north in the county, such as the Deep Creek, Sierra Zinc, and Van Stone mines.

Diabase dikes cut through the dolomite in places. Jenkins (1924) traced one 25-foot-wide dike for more than a mile on the surface. The role played by the dikes or the faulting in ore deposition, if any, has not been studied in detail. Jenkins stated, "In no place were dikes found cutting the ore body, nor in any place was an ore body found cutting a dike."

Purdy (1951) reported ". . . the ore minerals within 200 feet of the surface consist of sphalerite, boulangerite, chalcopyrite, tetrahedrite, and minor galena. Boulangerite and sphalerite are the predominant sulfides. Below 200-feet the ore is chiefly sphalerite and galena. This transition is remarkably abrupt, taking place within a few tens of feet. Mill heads from ore in the winze extending 55 feet below the main haulage level ran about 10% Pb and 3% Zn. This winze . . . is the deepest working in the mine and still shows a thickness of 20 feet in the bottom." Purdy's extensively detailed field notes from 1948 were taken at a time when the underground workings were still accessible (DGER mine file). The primary gangue minerals are quartz, pyrite, and arsenopyrite. Near-surface ore mined prior to 1920 contained a wide variety of oxides and carbonates: cerussite, anglesite, bindheimite, mimetite, and valentinite (Derkey and others, 1990). (See "Ore Minerals" below for chemical formulas.)

Figure 7. Remains of the 1939 mill on the west bank of the tributary.

OPENINGS

Development at the Cleveland mine included two open pits and approximately 3500 feet of drifts, raises, shafts, and stopes. Aside from the surface mining, it is difficult to say in what sequence the development took place, but indications are that the first work undertaken was the sinking of two inclined shafts on or near the discovery outcrop. Altogether, four levels were developed: the "60" level at elevation 3400, the Upper level at elevation 3380, an Intermediate level at elevation 3320, and the Lower level (also referred to as the main haulage level), which daylights at elevation 3260 in the east bank of an unnamed tributary of Hunters Creek (see Fig. 11).

As discussed above, mine maps show a dead-end winze driven 55 feet below the Lower level. Therefore, from the original outcrop to the lowest development, the mine is approximately 255 feet in vertical extent. Our observations place the elevation of the current open pit floor at about 3340 feet indicating that the "60" and Upper levels have been removed by surface mining and that the vertical openings in the pit floor are excised development slightly above the Intermediate level. The mine is flooded up to the Lower level, and the interior of the mine reportedly collapsed in 1973 (Johnson, 2000).

Figure 8. Heavy equipment and storage container. View to the west.

The Lower level strikes S65E for 800 feet to a point of intersection with the aforementioned fault. Here it changes direction abruptly to the northeast and follows the fault, which splits in two about 120 feet from the intersection. Exploration drifts were driven along both branches. The right branch encountered a pipe-like elliptical orebody averaging about 20 feet in width. Drifting on the Upper and Intermediate levels subsequently discovered this orebody's upward extension. The resulting stope between the three levels was 160 feet high, creating in essence an unsupported underground glory hole. A cursory glance at Santa Rita's plan map for each level attests to a "now you see it, now you don't" dispersion of mineralization within the host rock. Blind drifts and "dog holes" run off in every direction from the main levels in seemingly random fashion, and the levels themselves meander across the subsurface landscape.

MATERIALS AND STRUCTURES

The foundation of the flotation mill built by Santa Rita in the 1920s can still be observed near the entry to the north open pit. One wall of the 20-tpd mill built in 1939 was found in the tributary drainage (Fig. 7). Two recreational buildings are located on the Olympia claim across the gulch to the south of the mine. A track-mounted Ingersoll-Rand pneumatic drill, compressor, and Euclid bulldozer were parked on the floor of the open pit near a locked storage container (Fig. 8). The equipment appeared to be in operable condition.

WATER

The primary source of flow in the tributary emanates from two mine-related openings. One is a blind adit south of and upland from two recreational structures. Discharge from this adit flows north, then west-northwest just south of the mine road across patented claims, and then onto BLM property. The second opening discharging water is the Lower level portal.

Water discharged from the Lower portal in May of 2002 at the rate of 300 gpm. Discharge from the same portal in August 1999 was 72 gpm (Johnson, 2000). This difference in volume has a marked influence on dissolved metals analyses. Our 2002 sample results compared favorably with BLM data from the same month 8 years prior, while DOE samples taken in August 1999 show toxic metal concentrations reduced by factors of 10 to 20 (Johnson, 2000). Our data indicate that water flowing from the Lower level portal exceeds one or more state standards for

Figure 9. Water discharge at the Lower level adit. Note the iron staining on the wall to a height of about 36 inches.

lead, zinc, and arsenic during periods of high flow (see Table 9). Although iron standards have not been adopted by the state, the analysis of 31,700 mg/l exceeds the level proposed by the EPA for chronic effects to aquatic life of 1000 mg/l (Ecology and Environment, Inc., 2001). The discharge observed by DGER was light yellow with a neutral to slightly basic pH, and the streambed was iron-stained.

Johnson (2000) sampled tributary sediments downgradient from the Lower portal to the confluence of North Fork Hunters Creek, a distance of 1.5 miles. He concluded: "Sediments in all parts of the Cleveland Mine drainage stream are highly contaminated with iron, zinc, lead, arsenic, cadmium, silver, and antimony due to the presence of tailings and discharges from the Lower portal. The concentrations observed would be expected to have a severe adverse effect on benthic organisms." DGER attempted to find benthic macroinvertebrates (BMI) with a kick-net in a 100-yard-long stretch of the tributary at a point 0.3 mile below tailings repository 4, but none were found. However, we also sampled North Fork Hunters Creek at a bridge crossing the Springdale–Hunters Road, approximately 3 miles downstream from the Lower portal. Here we found a wide variety of BMI indicative of good water quality. Marc Hayes (DNR, written commun., 2002) found "the North Fork Hunters Creek sample was rich in species (11) and a significant number of individuals (23)."

Iron staining on the walls of the Lower level portal indicates that a water column was impounded behind the portal at some time in the past (Fig. 9). Miners using a backhoe to remove the portal blockage released a calculated 125,000 gallons of water (Jake Jakabosky, BLM, written commun., 2005). Such a release helps explain why the road below the portal is undercut to a depth of 3 feet. The present discharge flows approximately 250 feet downgradient across the road and spreads out on a marshy area where tailings are impounded behind a log-crib dam (Fig. 10). At this point the adit discharge flows into the tributary.

In 1994, private owners diverted the main stem of the unnamed tributary into a channel that skirts the Lower level's waste rock dump (Jakabosky, written commun., 2005)(Fig. 11).

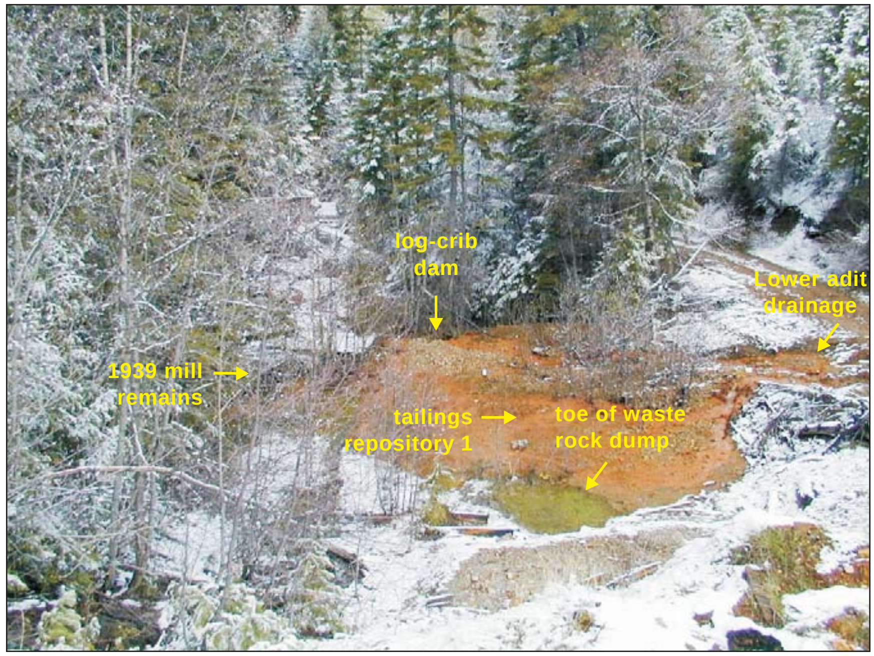

Figure 10. Drainage from Lower level adit. View to the northwest and downstream. Mine access road at far right center. Note the log-crib dam and tailings.

Figure 11. Diversion channel carrying tributary. Flow downgradient from center to far bottom right. Access road at left. Pickup for scale. View to the southeast.

MILLING OPERATIONS

Two mills were constructed at various times on the Cleveland site. The first, of 50-tpd capacity, utilized gravity and flotation machinery. It was completed by Santa Rita circa-1920 on a site near the entrance to the current open pit. Its original purpose was to treat refractory (oxide) ores left in dumps by former operators, but it was subsequently used to concentrate newly mined ore until 1926 (Weaver, 1920). The photo from Weaver's report shows the mill and pre-1920 dumps (Fig. 12). Fused glass and charcoal are scattered around the stone foundation.

A second mill of 20-tpd capacity (Fig. 7) was built in 1939 on the tributary just below the Lower level portal. The remains of both mills were burned by a private owner in fall of 1994.

WASTE ROCK DUMPS AND TAILINGS

Tailings from both mills discharged into the aforementioned tributary of North Fork Hunters Creek forming a total of four tailings repositories, listed in the following discussion as numbers 1 through 4, in order of highest to lowest elevation (Fig. 1). Repositories 1 and 2 are on patented (private) land; numbers 3 and 4 are located on BLM-administered public lands.

Figure 12. *(top)* Overview of Cleveland mine circa 1920 (Weaver, 1920). Santa Rita Mining Co. mill at left. Tributary to Hunters Creek (hidden in foreground) flows downgradient right to left. View to the north.

Figure 13. *(middle)* Log-crib dam at tailings repository 1. Tailings are about 3 feet thick. View to the west.

Figure 14. *(bottom)* Tailings repository 2 and log landing. Mine access road in upper lefthand corner. View to the southeast. BLM photo taken October 2001.

Repository 1 is located in the tributary just below the Lower adit on the Ona claim. It is impounded behind a log-crib dam (Fig. 13), and partially buried by the adit's waste rock dump (Fig. 10). Repository 2 is located on the same claim on the north side of and adjacent to the mine access road (Fig. 14). It is not directly in the tributary and has been used as a log landing.

Repository 3 is 0.4 acres in surface area and roughly triangular in shape. Prior to BLM reclamation work in the year 2000, the tributary had incised the tailings to a depth of 5 feet after breaching the log-crib dam (Fig. 15). Repository 4, approximately 2.2 acres in area, lies 375 feet downstream from repository 3. Prior to the reclamation work, it was impounded behind an earthfill dam (Fig. 16). The failure of both dams in the past has allowed tailings to wash downstream onto private land in secs. 4 and 5 and beyond (Jakabosky, written commun., 2005).

Arsenic, lead, and zinc analyses from soil samples taken by BLM in 1997 at repositories 3 and 4 exceed Model Toxics Control Act standards for unrestricted land use (see Tables 4 and 5). Samples taken from repositories 1 and 2 on one of the upstream patented claims under START-2 (Superfund Technical Assessment and Response Team) by Ecology and Environment, Inc., (E&E) identified significant concentrations of antimony, cadmium, copper, iron, manganese, mercury, and silver in addition to arsenic, lead, and zinc (E&E, 2001).

The major waste rock dump is located adjacent to the portal of the Lower level. It is triangular in shape, approximately 200 feet long by 90 feet at the base and 30 feet thick in two lifts. It partially covers tailings repository 1 and contains an estimated 10,000 to 15,000 tons of argillite and dolomite shot rock. A sample collected at the interface between native soil and the waste rock identified significant concentrations of the same metals found in the tailings (E&E, 2001).

RECLAMATION

In 2000, the BLM undertook a voluntary reclamation of mine-affected lands lying outside the patented claims in conjunction with the Washington State Department of Ecology (DOE). The focus of this work was on tailings repositories 3 and 4 and the tributary, which had meandered through both tailings piles for more than 80 years and released toxic metals into the stream and streambed. Preliminary site studies were conducted in 1997 along with cost analyses of various alternative actions. A complete reclamation of the site wasn't possible at the time because the mine openings, which continue to discharge water-borne contaminants of concern, and a portion of the tailings-filled streambed are located on private land.

The reclamation work accomplished the following key elements (Jakabosky, written commun., 2005): Repository 3 was consolidated and moved to the north bank so that the stream bypassed the tailings. Repository 4 was consolidated and isolated from contact with the stream by construction of a bypass channel. A geotextile capillary break was installed on top of both tailings repositories to prevent infiltration of surface water. Topsoil spread on top of the break was seeded with grass (Fig. 17). Tailings in the streambed between the two sites were removed in 2001, and the stream channel was armored with cabled concrete blocks to prevent further erosion and undercutting (Fig. 18). Tailings that had inundated the mine access road were removed in 2001 and placed on the north side of repository 4. Figures 19 and 20 show principal elements of this work.

Figure 15. Tailings repository 3. Note failed log-crib dam and cut bank. Tributary flows through foreground left to right. View to the south. BLM photo taken October 1997.

GENERAL INFORMATION

Names: Cleveland, Santa Rita

MAS/MILS sequence number: 05306500235

Access: four-wheel-drive road to mine and mill sites; gates open May 2002

Status of mining activity: none

Claim status: 13 patented claims, including fractions

Current ownership: see Table 1 (Stevens Co. Assessor, written commun., 2005)

Location and map information: see Table 2

Directions: Follow the Springdale–Hunters Road (State Route 292) 5 miles east of Hunters to a left turn onto Lessig Road. Proceed northeast approximately 1 mile to a gate (usually open) and head due east and then southeast approximately 0.5 miles to a point in the bottom of Blackhorse Canyon where the Cleveland mine access road crosses North Fork Hunters Creek. The Cleveland mine is reached in about 1.5 miles at elevation 3320 feet.

MINE OPERATIONS DATA

Type of mine: underground and open pit

Commodities mined: copper, lead, zinc, antimony

Table 1. Ownership.

Owner	Claims	Mineral survey no.
B & B Equipment, Spirit Lake, Idaho	Ona, Etta, Olympia, Cleveland, Triangle Fraction, Lucky Boy, Stewart Fraction, Copper King, Etta Fraction, Copper Queen	552, 553, 554
Judge Mining Co. LLC, Colorado Springs, Colo.	Iron Duke, Duke's Daughter, Dutchess	745
Guenther Living Trust, Hunters, Wash.	Portions of the Copper Queen, Copper King, and Etta Fraction lying in sec. 4	553, 554

Table 2. Location and map information.

Mine property	County	Location	Decimal latitude	Decimal longitude	1:24,000 quad.	1:100,000 quad.
Cleveland	Stevens	sec. 9, T30N R38E	48.11673	118.02771	Adams Mt.	Nespelem

Table 3. Mine features. **, data from DGER mine map file; N/A, not applicable.

Description	Condition	Fenced (yes/no)	Length (feet)	Width (feet)	Height/ depth (feet)	True bearing	Elev. (feet)	Decimal latitude	Decimal longitude
Lower level portal	open, stable, discharging water	no	1200**	6	8	S65E	3260	48.11673	118.02771
open pit highwall	vertical, sloughing	no	N/A	~100	~75	N/A	N/A	48.1171	118.0241
tailings repository 4, upper end	reclaimed	yes	N/A	N/A	N/A	N/A	N/A	48.12037	118.03869
tailings repository 3, lower end	reclaimed	yes	N/A	N/A	N/A	N/A	N/A	48.11866	118.03688
Santa Rita mill foundation	burned	no	N/A	N/A	N/A	N/A	N/A	48.11581	118.02658
1939 mill	collapsed	no	N/A	N/A	N/A	N/A	N/A	48.11723	118.02914

Geologic setting: dolomite, argillite and phyllite, metasediments of Proterozoic age in the Deer Trail Group (Campbell and Raup, 1964)

Ore minerals: sphalerite (ZnS), galena (PbS), chalcopyrite ($CuFeS_2$), boulangerite ($5PbS.2SbS_3$), tetrahedrite ($3Cu_2S.Sb_2S_3$), stibnite (Sb_2S_3), cerussite ($PbCO_3$), anglesite ($PbSO_4$), mimetite ($3Pb_3As_2O_8.PbCl_2$), valentinite (Sb_2O_3)(Johnson, 2000)

Non-ore minerals: pyrite (FeS_2), arsenopyrite ($FeAsS$)

Period of production: 1918–1926, 1937–1948 (Fulkerson and Kingston, 1958), 1966–1970

Development: two shafts, four levels, stopes and crosscuts totaling 3500 feet (Purdy, 1951), and two open pits, the northernmost of which is approximately 1500 feet long by 300 feet wide

Production: approximately 27,000 tons up to 1958 yielding 551,000 pounds zinc, 2,700,000 pounds lead, 7400 pounds copper, 99,000 ounces silver, 90 ounces gold; estimated 20,000 tons from open pit operations, chiefly antimony ores

Mill data: 50-tpd Santa Rita mill utilized two Wilfley shaking tables plus flotation cells in combination with classifiers; technology used in the 20-tpd 1939 mill is unknown

PHYSICAL ATTRIBUTES

Features: see Table 3

Materials: storage vault, contents unknown

Machinery: Ingersoll-Rand track drill, Euclid bulldozer, air compressor

Structures: two recreational-use dwellings

Table 4. Soil analysis. Metal concentrations are mg/kg; the data below are representative of results obtained during BLM sampling of the tailings prior to reclamation (USBLM, 1998).

Tailings area	Date	Sample number	Arsenic	Lead	Zinc
repository 3	November 1997	CMT-TP-1A (one of ten)	2281	8321	7545
repository 4	November 1997	CMT-TP-1B (one of nine)	1047	13015	8527

Table 5. 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.

Metals	Arsenic III	Lead	Zinc
Level, mg/L	20	220	270

Table 6. Bat habitat information.

Opening	Aspect	Air temp. (°F) at portal	Air flow: exhaust	Air flow: intake	Multiple interconnected openings	Bats or bat evidence
Lower level portal	NW	53	yes		yes	no

Table 7. Benthic macroinvertebrates.

Location	Date	Riffle beetles	Caddisflies	Flies	Mayflies	Stoneflies	Segmented worms
0.3 mile downstream from tailings repository 4	05/07/02	0	0	0	0	0	0
3 miles downstream at intersection of Springdale–Hunters Road and North Fork Hunters Creek	05/07/02	5	1	1	11	2	3

Table 8. Surface water field data.

Location	Flow (gpm)	Conductivity (µS/cm)	pH	Bed color	Water color	Temp (°F)
Lower level portal	300 (May 2002)	576	7.0–8.3	orange	pale yellow	46

Table 9. Surface water analysis. Metal concentrations are in micrograms/liter (µg/L); hardness is in milligrams/liter (mg/L); USEPA, U.S. Environmental Protection Agency; – – –, no data; **, standards for these metals are hardness dependent; ≤ 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. 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. Numbers in bold indicate analyses which exceed one or more of the water standards shown in Part 2 below.

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

Sample location	Arsenic	Cadmium**	Copper**	Iron	Lead**	Mercury	Zinc**	Hardness
Lower level portal	**174**	≤5	11	31,700	**13**	– – –	**1290**	239

PART 2: 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	– – –

Figure 16. *(top)* Tailings repository 4. Note earthfill dam, tributary, and exposed decant pipe. Tributary flows through foreground left to right. View to the north. BLM photo taken April1999.

Figure 17. *(middle)* Tailings repository 4 after BLM reclamation. Note grass seeding, settling basin, and armored banks. Tributary flows right to left. View to the northeast

Figure 18. *(bottom)* Woody debris and concrete block armoring in place, post reclamation, on tailings repository 4. View downgradient to the northwest.

Waste rock dumps, tailings impoundments, highwalls, or pit walls: The waste rock dump adjacent to the Lower level contains an estimated 10,000 to 15,000 tons. The upper and lower tailings impoundments have been reclaimed as described above. The highwall in the northernmost open pit is vertical and approximately 75 feet high. Faults run through the face at various angles, and large blocks have slumped to the pit floor. The underground openings exposed by the open pit present an extreme physical hazard. The open pit and underground openings are on patented (privately held) ground.

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

Analysis of tailings and dumps: see Tables 4 and 5

Reclamation activity: see above

VEGETATION

The area around the mine is heavily forested. Douglas fir is the dominant tree species, in addition to western red cedar, ponderosa pine, and western larch, which are found around the perimeter of the tailings areas. Water birch, alder, and maple grow in profusion around the stream in wet, saturated areas. Although the open pit walls and floor are largely barren rock, Douglas fir and alder saplings to ten feet high are re-establishing a presence. Grass applied to the tailings surface(s) during reclamation is thriving.

WILDLIFE

See Tables 6 and 7.

WATER QUALITY

Surface waters observed: unnamed tributary, North Fork Hunters Creek

Proximity to surface waters: concurrent with mine workings

Domestic use: recreational-use buildings

Acid mine drainage or staining: pH of Lower level discharge is neutral to basic; significant orange staining in bed

Surface water field data: see Table 8

Surface water sample analysis: see Table 9

Surface water migration: Water discharging from the Lower level portal joins the tributary stream downgradient.

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Figure 19. Excavation of tailings from mine access road on public land. View to the west. BLM photo taken October 2001.

Figure 20. Roadside tailings placed in new cell adjacent to tailings repository 4. View to the southwest. BLM photo taken October 2001.

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Appendix A. Methods and field equipment

METHODS

We recorded observations and measurements in the field. Longitude and latitude were recorded with a global positioning system (GPS) unit in NAD83 decimal degree format. Literature research provided data on underground development, which was verified in the field when possible.

Soil samples from dumps or tailings were taken from subsurface material and double bagged in polyethylene. Chain of custody was maintained.

Soil samples were analyzed for the metals listed in this report by inductively coupled plasma/mass spectrometry (ICP/MS) following USEPA Method 6010. Holding times for the metals of interest were observed.

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

Conversion formulae are given in WAC 173-201A at http://www.ecy.wa.gov/pubs/wac173201a.pdf.
Chronic standard in micrograms/liter (µg/L)\

Sample Location	Hardness (mg/l)	Cd (µg/l)	Cu (µg/l)	Pb (µg/l)	Zn (µg/l)
Lower level portal	239	2.0	23.9	6.4	218.6