NATURAL RESOURCES

INACTIVE AND ABANDONED MINE LANDS— Apex Mine, Money Creek Mining District, King County, Washington

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

WASHINGTON
DIVISION OF GEOLOGY
AND EARTH RESOURCES

Open File Report 2001-2
December 2001

Site location

WASHINGTON STATE DEPARTMENT OF
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INTRODUCTION

Presently the Washington Division of Geology and Earth Resources is developing a systematic database of inactive and abandoned metal mines (Norman, 2000). Previous work by the Division has had a distinctly commodity-oriented focus (Huntting, 1956; Derkey, 1990). Our current goal is to build a single database and geographic information system (GIS) characterizing the largest of the state's inactive and abandoned mines. Documentation will focus on physical characteristics, possible 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 (OFR) will provide written documentation on mines or groups of mines within specific mining districts or counties.

Over 3,800 mineral properties have been located in the state during the last 100 years (Huntting, 1956; McFaul and others, 2000). Many are undeveloped prospects of little economic importance. Therefore, we have selected approximately 60 sites for site characterization. These sites meet one of the following criteria: (a) more than 2,000 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 the Washington State Department of Natural Resources (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 Apex mine lies in a glacial cirque at an elevation of 3800 feet, one-half mile south of the Money Creek Road in the SW¼SW¼ sec. 34, T26N R10E (Fig. 1). Gold was the principal commodity mined. Data in DGER mine files suggest this precious metal was found predominately in solid solution with arsenopyrite. Lenses of galena and sphalerite mineralization yielded significant amounts of lead and silver. Orebodies occur

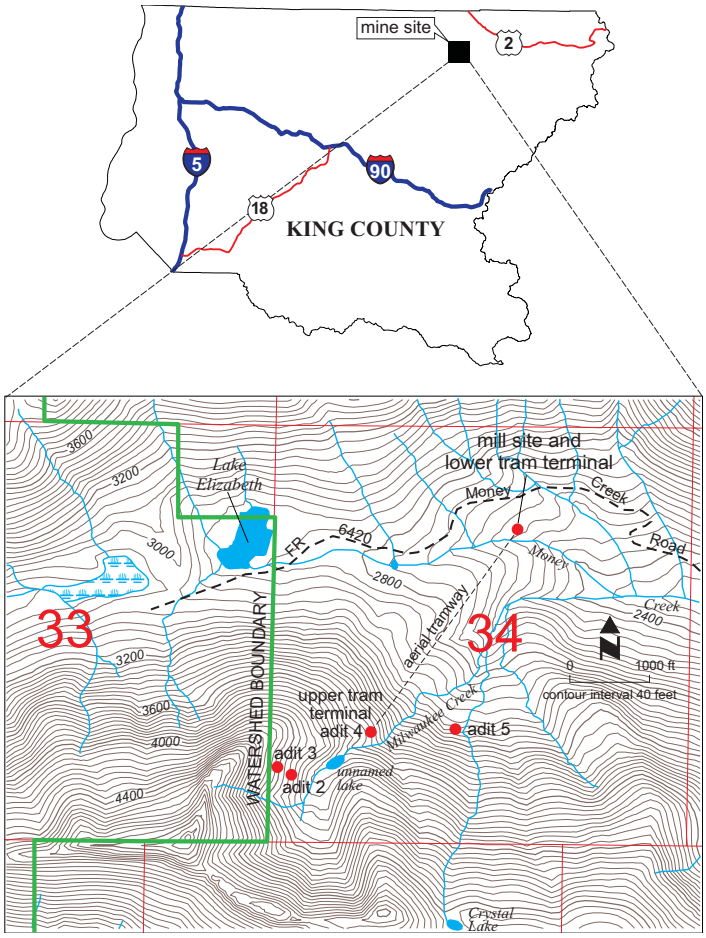

Figure 1. Map showing the location of the Money Creek Mining District and a site map of the Apex Mine.

in a quartz vein 2 to 6 feet wide and more than 1000 feet long that follows a persistent fissure in granodiorite of the Snoqualmie batholith (Huntting, 1956).

Apex Gold Mines Inc., the last major producer, was dissolved in 1943. Joe B. Cashman (*dba* Cleopatra Mining Co. Inc.), presently holds the property under possessory title. Ten lode claims were on active status at the date of publication (BLM Land and Mineral Records LR2000 database). The claims lie in the Mount Baker–Snoqualmie National Forest administered by the U.S. Forest Service.

The mine has a checkered history of production owing to periods of changing ownership and its isolated location in mountainous country. Accumulations of 6 to 9 feet of winter snow and demanding trail access to the mine, contouring around steep cliffs, mandated construction of an aerial tramway to facilitate production. The 3200-foot jig-back aerial tramway connected adit 4 to a lower tram terminal and millsite on Money Creek. From there, four-ton cars were lowered over narrow-gage rail to a point on the Miller River for shipment to American Smelting and Refining Company's Tacoma smelter. A 1650-foot wood-stave flume, 22 inches in diameter, carried water from Lake Elizabeth to a Pelton wheel for electrical power generation. The

Figure 2. *(top)* View from adit 2 looking northeast. White arrow points to former location of higher camp.

Figure 3. *(middle)* Site of lower tram terminal and mill. The diesel engine is in the top left corner of the photo.

Figure 4. *(bottom)* Site of the upper tram terminal and bunkhouse (in culvert). Note the scrap haulage track at the far right center.

company constructed a rock house, snow shed, and bunkhouse for 30 men at the upper tram terminal (DGER mine file). Another, higher, camp was located on the west shore of a small lake (unnamed) in a basin below adits 2 and 3 (Fig. 2).

In 1936, W. J. Priestly, manager of the property from 1915 to 1943, conducted a comprehensive sampling of the vein material exposed in adits 2, 3, and 4. Ninety-one samples averaged 1.2 ounces of gold per ton and 7 ounces of silver per ton (Livingston, 1971). Smelter returns from 1920 through 1934 show similar amounts of gold and silver in addition to sporadic lead content up to 6 percent and arsenic in the range 21 to 38 percent. A total of 2950 feet of haulage tunnel was developed through five adits. Adit 4 yielded most of the tonnage produced. Development footage in stopes and raises is estimated at an additional 5000 feet (DGER mine map file).[1]

Initially, the mill used water-washed tables to concentrate ore, but a 75-ton flotation unit was added in 1938. Government funds made it possible to complete a mine-to-market road in 1940, replacing the light rail line on Money Creek. From its discovery in 1889 until closure in 1941 under War Production Board order L-208, the mine produced about $300,000 at historic metal prices (DGER mine file).

We visited the site on 29 June 2001. All the structures described above have burned or collapsed due to decay and snow load. A stationary diesel engine remains upright at the lower tram terminal amidst cast iron housings from electrical power equipment and miscellaneous scrap iron (Fig. 3). Mining-related machinery/equipment remaining on site is limited to a steel culvert that had been used as a bunkhouse and salvaged rail at the portal of adit 4 (Fig. 4).

Adit 2, the highest mine working investigated, is open and appears sound. It is located directly on the vein centerline at an elevation of 3940 feet. Water from a ravine pours into the tunnel from an opening 25 feet inside the portal, creating a pool of standing water on the floor. There was no discharge to the surface at the time of site visitation. A 55-gallon drum of unknown material stands just inside the adit (Fig. 5). Adit 3, at 3800-foot elevation, is partially caved. Adit 4 is located in the vertical-walled canyon of Milwaukee Creek, which is the outlet of the unnamed lake. The original portal to adit 4 lies to the left of a snowfield, directly above cribbing holding the

[1] Add correction of +400 feet to elevations on historic Apex mine maps to reflect current USGS datum.

landing in place (Fig. 6). The steel culvert in the photo lies at the same elevation, in front of a snub-tunnel, circa 1980, driven into the right-hand side of the canyon for 20 feet. It appears to double back to the southeast to intersect the original tunnel.

Granitic wall rock is the principal constituent of waste dumps adjacent to adits described above. Some iron staining is present. No discernible tailings accumulation was found at the mill site. The mill's flotation circuit appears to have been used only during parts of 1938 and 1940 prior to cessation of operations at the outset of World War II (DGER mine file). A veneer of crushed rock covers the footprint of the mill/lower tramway terminal. The immediate surroundings are reforested (Fig. 3).

Water samples collected in or near the mine openings contained concentrations of arsenic, lead, and zinc that exceeded the standards set by the Washington Administrative Code (WAC 173-201A and WAC 246-290) (Table 5). Milwaukee Creek flows through both the mine workings and the vein itself, which is mineralized and largely unexcavated on the surface. The vein is softer than the surrounding granodiorite and affords a convenient stream channel. Since the vein lies partly in the bed of Milwaukee Creek, it is difficult to determine what fraction of metals transport originates from naturally occurring background solubility in the creek bed and what fraction originates from the mine workings themselves. The high arsenic load is unsurprising given the presence of its sulfide (arsenopyrite) and its oxide (arsenolite). The latter is reported to have accumulated on the footwall between adits 3 and 4 in terraces as much as a foot thick (Coats, 1932). At water sample locations, bed staining was minimal to non-existent; electrical conductivity and hardness values were low, and pH measured 5.0. The standing water sampled in adits 2 and 4 migrated directly to ground water through cracks in the floor. No water emanated from the adit itself.

Water emanating from adit 3 migrated across the dump landing by sheet flow and infiltrated the ground prior to reaching the dump toe. The tributary relationship of the surface waters in this area is as follows: Milwaukee Creek flows northeast into Money Creek, which flows east into Miller River, which flows north into the Skykomish River. A water sample taken at the lowest elevation of Milwaukee Creek, at its confluence with Money Creek, showed undetectable concentrations of lead and zinc and 15 micrograms per liter of arsenic. Concentrations of analytes in this sample are below permissible levels listed in applicable Washington State Water Quality Standards (Table 5, Part 2).

A granite slab overlying the portal of the snub-tunnel near adit 4 has crushed the culvert insert. Detritus overlying the portal of adit 3 is supported by two-inch lagging of questionable strength (Fig. 7). Conditions underground are unknown, but considered hazardous by default. The area surrounding the mine is precipitous mountain terrain, especially the chasm formed by Milwaukee Creek below the lake. Traverses demand appropriate attention and care.

GENERAL INFORMATION

Names: Apex (also known as Bondholder's Syndicate)

MAS/MILS sequence number: 0530330084

Access: We recommend a four-wheel-drive vehicle to negotiate the gravel logging road leading to the parking area described below. Access to the mine elevation is by trail.

Status of mining activity: *Inactive*, meaning there is no production activity, but annual assessment work or maintenance fee payments were current on the date noted below in the BLM LR 2000 database.

Claim status: The ORMC number is the BLM designation for mining claims in Oregon and Washington. 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.

ORMC no.	Unpatented	Active	No. of patented claims	Mineral survey no.	Surface Mining permit no.	Source of data (date)
22680–22682	yes	yes	none	– – –	– – –	BLM (09/20/01)
22689-22690	yes	yes	none	– – –	– – –	BLM (09/20/01)
22676	yes	yes	none	– – –	– – –	BLM (09/20/01)
22687–22690	yes	yes	none	– – –	– – –	BLM (09/20/01)

Figure 5. Adit 2 entrance, elevation 3940 feet. Note the rusted barrel and the standing water on the floor.

Current Ownership

Joe B. Cashman; PO Box 56; Baring, WA 98224 (*dba* Cleopatra Mining Co., Washington State Uniform Business Identifier (UBI) 601539263)

Surrounding land ownership: Mount Baker–Snoqualmie National Forest (USFS)

Location and Map Information

Mine name	County	Mine location	1:24,000 map	1:100,000 map	Decimal longitude	Decimal latitude
Apex	King	NE¼SW¼SW¼ sec. 34, T26N R10E	Mount Phelps	Skykomish River	121.5122	47.6950

Directions

From the town of Snohomish, drive east 41.5 miles on US 2 to the intersection of Miller River Road at the Money Creek campground. Cross the bridge and drive about 1 mile to the settlement of Miller River and turn west onto Money Creek Road. At about 5 miles, two sharp switchbacks occur, one to the right and one to the left. The mine access trail begins at a wide spot in the road approximately three-quarters of a mile past the last switchback, near milepost 6 (Northwest Underground Explorations, 1997). An obscure trail heads south (toward Money Creek) from a pile of debris logs. The remains of the lower tram terminal and mill lie on the north bank of Money Creek, approximately 100 yards from the road. Directly across the creek, a way-trail leads steeply upslope to a cedar puncheon road. Follow this road south about one-half mile to the site of an intermediate tram station. Here the trail heads southwest, switchbacking steeply uphill, below cliff bands to a point (elevation 3800 feet) overlooking a small cirque lake. Adit 3 dump is visible from this vantage point against a cliff, 100 yards to the southwest. Adit 2 lies in a narrow cleft, 140 feet vertically above adit 3 (Fig. 8). Adit 4 and the upper tramway terminal are located north of and about 200 feet beneath the lake's outlet, Milwaukee Creek (Fig. 9). To visit these features, climb northeasterly over the top of the intervening hill adjacent to the lake's west shore and proceed down a talus slope to a point where the dump and ruins become visible. Total trail-time from Money Creek Road is over 2 hours. The trail is obscure from certain vantage points, requiring some route-finding capability. Dumps at adits 3 and 4 may provide suitable landing sites for access by helicopter.

Mine Operations Data

Type of mine: underground with mill (DGER mine file)

Commodities mined: gold; some lead, zinc and silver

Geologic setting: The mine is in Tertiary granitic rocks of the Snoqualmie batholith. Mineralization is concentrated in discontinuous ore shoots along the strike of a fissure vein traceable for 1000 feet on the surface. The vein varies in width from a few inches to 6 feet (Derkey, 1990). The strike is S65°W and dip is 45 to 65 degrees southeast. In 1939, W. J. Priestly conducted a comprehensive sampling program at intervals across the width of the vein in adit 4. Ninety-one samples averaged 1.2 ounces/ton gold and 7 ounces/ton silver (Livingston, 1971). When these assays are compared with mineralization at the point of sampling, the gold values exhibit a high degree of correlation with arsenopyrite concentrations; the silver values with galena concentrations. Further evidence is provided by a smelter return reporting high gold values in a shipment containing 38 percent arsenic (DGER mine file). The mineral arsenopyrite contains 46 percent elemental arsenic. Arsenic trioxide was widely used as an orchard insecticide prior to 1950.

Figure 6. Area of adit 4 showing original opening location (left arrow) and portal of snub tunnel (right arrow). Milwaukee Creek (outlet) flows through photo.

Figure 7. DGER geologist at portal of adit 3, elevation 3800 feet.

Ore minerals: arsenopyrite (FeAsS), galena (PbS), chalcopyrite ($CuFeS_2$), sphalerite (ZnS)

Non-ore minerals: quartz (SiO_2), calcite ($CaCO_3$), pyrite (FeS_2), tourmaline (complex borosilicate), arsenolite (As_2O_3)

Host rock: granodiorite

Period of production: 1889–1943 (intermittent)

Development: Five adits totaling 2950 feet of haulage tunnel, plus an estimated 5000 feet of development in stopes and (13) raises. Adit 1, 100 feet long, cannot be seen on the surface. Adit 2, 117 feet long, is open for an undetermined distance. The portal of adit 3 is partly caved. The original portal of adit 4 lies in a vertical wall 10 feet southeast of a waterfall in Milwaukee Creek. It is caved. A circa-1980s snub tunnel was driven into the right-hand side of the canyon at the same elevation for a distance of 20 feet. It turns 90 degrees to the southeast to pass beneath the creek bed and intersect the former opening (Northwest Underground Explorations, 1997). No determination was made of its condition underground. Adit 5 was driven prior to 1925 in an unsuccessful attempt to locate the vein. It terminates at a point roughly underneath the aerial tramway, several hundred feet north of a point at the same elevation where an intersection of the vein's downward projection might be expected. Its portal was 550 feet lower in elevation and 1100 feet N85°E of the upper tram terminal (DGER mine map file).

Production: The bulk of production came from an area about 500 feet long and 500 feet high along adit 4. Ore was hand-sorted underground. The lower-grade material was used to backfill stopes, and the higher-grade material was hauled to the aerial tramway for shipment (Patty, 1921). The total value of production was about $300,000 at historic metal prices. The mine closed in 1941 as a result of War Production Board order L-208 "Nonessential Industry". Two 7-foot-diameter steel culverts were flown to the site during the 1980s spike in gold prices (J. Cashman, landowner, oral commun., 2001). One served as a camp shelter; the other collared the aforementioned snub-tunnel. No production figures have been reported since 1941.

Figure 8. Looking south toward adits 2 (upper arrow) and 3 (lower arrow), elevation 3800 feet.

Mill data: From the mine's discovery until 1936, smelter shipments consisted of hand-sorted ore. In 1936, (Wilfley) concentrating tables were installed in a mill at or near the lower tram terminal. A Fahrenwald flotation circuit was added in 1938. Reports indicate the mill processed fewer than 100 tons of ore prior to shutdown in 1941 (DGER mine file). No tailings or waste material from the mill were observed during the field visitation, and the structure has been burned.

Figure 9. Looking north at the unnamed lake in the basin below adits 2 and 3. Adit 4 lies 200 feet beneath the outlet (white arrow).

PHYSICAL ATTRIBUTES

Features: see Table 1

Materials: A rusted 55-gallon drum stands in 10 inches of water on the floor of adit 2 at the portal. Its contents are unknown (online photo 1599).

Machinery: A 150-horsepower diesel engine stands on footings at the lower tram terminal. It is rusted and stripped of component parts (online photo 1596). A generator housing, Pelton water wheel, and assorted cast iron relics lay scattered around the engine (Fig. 3, online photo 1595).

Structures: see Table 2

Presence of unstable slopes, walls, waste rock, tailings or impoundments: Approximately 10 feet of the access pathway leading to adit 4 has slipped into the chasm of Milwaukee Creek.

Table 1. Mine features. – – –, no data; **, data from DGER mine map file; *, numbered photos online at http://www.wa.gov/dnr/htdocs/ger/iaml/01-2/

Description	Condition	Fenced (yes/no)	Length (feet)	Width (feet)	Height/depth (feet)	True bearing	Elev. (feet)	Decimal longitude	Decimal latitude	Digital photo*
adit 3	caved, partly open	no	500**	6	7	N63W**	3800	121.51628	47.69406	1598 (Fig 7)
adit 2	open, intact, wet	no	150**	6	7	S73W	3940	121.51699	47.69431	1599 (Fig.5)
adit 4	open, intact	no	1550**	10	8	S55W	3540	121.51224	47.69556	1609-1611*; 1612 (Fig.6)
adit 5	not visited	– – –	1200**	– – –	– – –	– – –	3000**	– – –	– – –	– – –

Analysis of tailings and dumps: no samples taken

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

Reclamation activity: No planned reclamation activity has taken place on the mine lands.

Table 2. Mine structures. – – –, no data; *, numbered photos online at http://www.wa.gov/dnr/htdocs/ger/iaml/01-2/

Description	Decimal longitude	Decimal latitude	Elevation (feet)	Condition	Photo no.
lower tramway terminal and mill site	121.50485	47.70265	2550	charred ruins	1593-1596*
intermediate tramway station	121.50801	47.69965	2800	collapsed ruins	– – –
upper tramway station/ and temporary camp setup in steel culvert	121.51224	47.69556	3540	collapsed charred ruins/deteriorated	1609 (Fig.4)

VEGETATION

The mine dumps are barren of vegetation, the one exception being material from adit 2 at elevation 3940. It supports a thick stand of bracken fern, and isolated clumps of mountain ash (Fig. 10). Flora on the remaining mine land resembles typical Cascade Montane Forest Zone assemblage of wildflowers and plants—slide alder, low bush blueberry, alpine fir, Douglas fir, red cedar, western hemlock; avalanche lily, bleeding heart, buttercup, fringe gentian, paint brush, fan-leaf cinquefoil, and green false hellebore.

WILDLIFE

We observed no bats or bat evidence. We detected no air flow at any opening.

WATER QUALITY

Surface waters observed: Milwaukee Creek (local name), Money Creek, Miller River, and an unnamed lake, meltwater, and associated alpine wetlands in a glacial cirque.

Figure 10. DGER geologist stands on the adit 2 dump, which is covered with bracken fern and mountain ash.

Proximity to surface waters: 0.0 mile from unnamed lake and Milwaukee Creek, 0.8 mile from Money Creek, and 5.5 miles from Miller River.

Domestic use: none

Acid mine drainage or staining: none

Water sample data: see Table 3

Table 3. Surface water field data. – – –, no data; *, numbered photos online at http://www.wa.gov/dnr/htdocs/ger/iaml/01-2/

Sample location	Discharge (gpm)	Conductivity (μS/cm)	pH	Bed color	Temp (°F)	Elev. (feet)	Decimal longitude	Decimal latitude	Digital photo*
discharge from adit 3 on dump	~2	007	5.0	natural	42	3800	121.51628	47.69406	– – –
standing water in adit 2; no discharge	~15; influx from ravine above adit	007	5.0	natural	42	3920	121.51699	47.69431	1599 (Fig.5)
standing water in adit 4; no discharge	none	– – –	5.0	natural	– – –	3540	121.51224	47.69969	– – –
Milwaukee Creek, 0.8 miles downstream from mine	~100	– – –	5.0	natural	52	2360	121.5 (estimate)	47.7 (estimate)	– – –

Water sample results: see Table 4

Surface water migration: Discharge from adit 3 infiltrates ground water before reaching the dump toe. Standing water in adit 2 infiltrates via cracks in tunnel floor. Standing water in adit 4 does not discharge.

Table 4. Surface water analysis. Metal concentrations are in μg/L, uncorrected for hardness; 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

PART 1: ANALYSIS BY USEPA METHOD 6010, INDUCTIVELY COUPLED PLASMA					
Sample location	**Arsenic**	**Copper**	**Lead**	**Zinc**	**Hardness**
discharge from adit 3 on dump	1000	≤2000	330	520	4
standing water in adit 2	≤100	≤2000	≤100	460	5
standing water in adit 4	530	≤2000	220	810	110
Milwaukee Creek 0.8 miles downstream from mine	15	– – –	≤10	≤10	14
PART 2: APPLICABLE WASHINGTON STATE WATER QUALITY STANDARDS					
Type of standards (applicable Washington Administrative Code)	**Arsenic**	**Copper**	**Lead**	**Zinc**	**Hardness**
Surface water standards (WAC 173-201A, Standard for aquatic life in surface freshwater, chronic level maximums at 100 mg/L hardness)	190	11.4	2.5	104	100
Ground water standards (WAC 246-290, Washington State Department of Health, standards for ground water, domestic consumption)	50.0	1300	15	5000	– – –

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Appendix

PHOTOGRAPHIC DOCUMENTATION

Photos (JPEG format) listed in tables and photo log may be found on our website at http://www.wa.gov/dnr/htdocs/ger/iaml/01-2/.

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

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