NATURAL RESOURCES

INACTIVE AND ABANDONED MINE LANDS— Iroquois Mine, Leadpoint 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 2004-17
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site location

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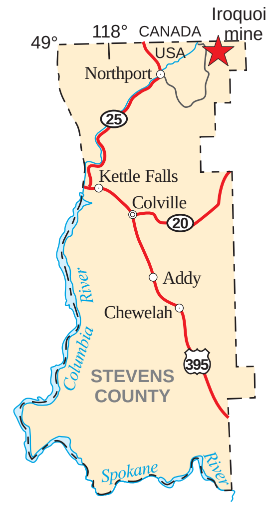

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INTRODUCTION

The Washington State Department of Natural Resources (DNR), Division of Geology and Earth Resources (DGER) has compiled a database and geographic information system (GIS) coverage of major mines in the state. Site characterization was initiated in 1999 (Norman, 2000). Work was funded through interagency grants from the U.S. Forest Service, Region 6. Other agencies sharing in the project are the U.S. Bureau of Land Management (BLM), the U.S. Environmental Protection Agency (EPA), and the Washington Department of Ecology (DOE).

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.

The IAML database focuses on physical characteristics and hazards (openings, structures, materials, and waste) and water-quality-related issues (acid mine drainage and/or metals transport). Accurate location, current ownership, and land status information are also included. Acquisition of this information is a critical first step in any systematic approach to determine if remedial or reclamation activities are warranted at a particular mine. Open-File Reports (OFRs), such as this one, provide documentation on mines or groups of mines within specific mining districts or counties. The IAML database may be obtained with assistance from DGER personnel. IAML OFRs are posted online at http://www.dnr.wa.gov/geology/pubs/.

SUMMARY

The mine property (Fig. 1) included 26 unpatented lode claims and roughly 65 acres of deeded land as

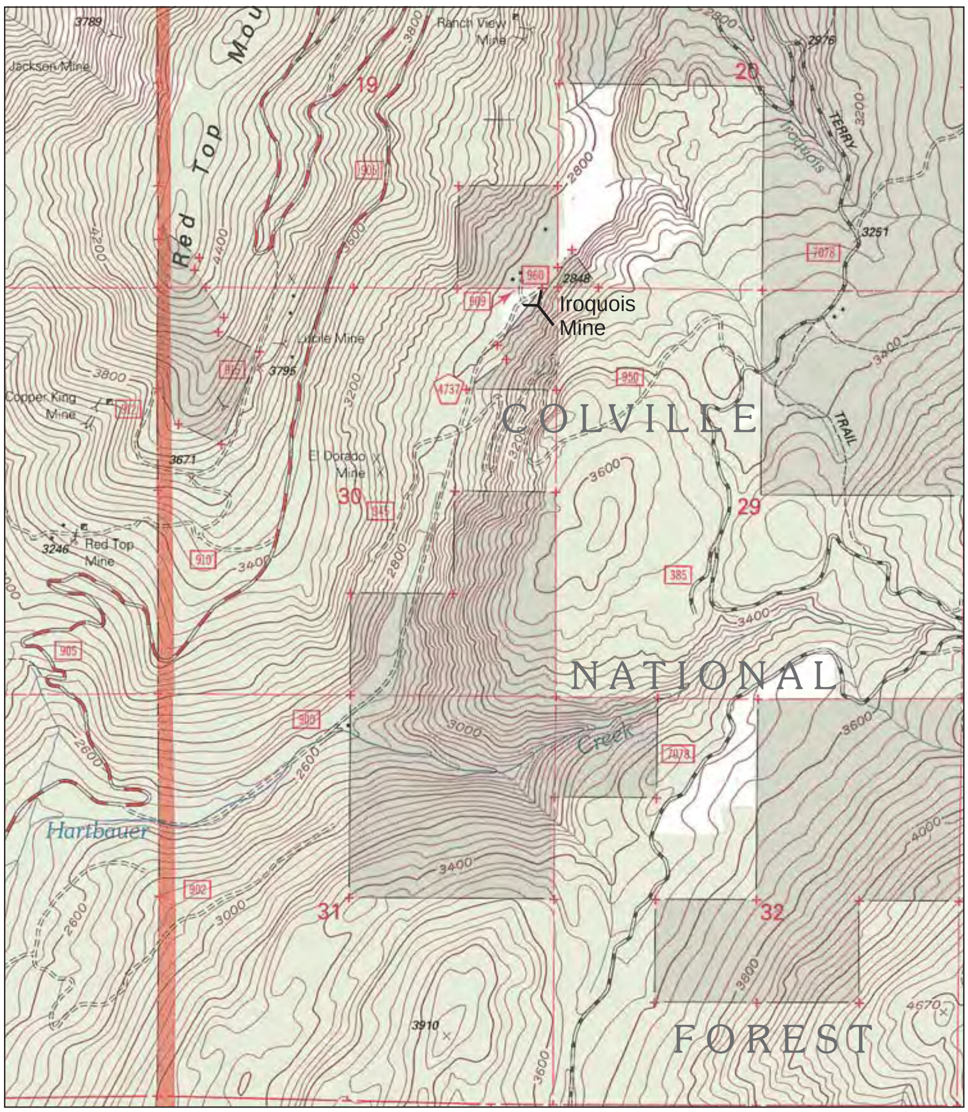

Figure 1. Map showing location of the Iroquois mine in Stevens County *(top)* and a more detailed map of the mine area *(bottom)*. Red section lines are 1 mile apart.

late as 1976. At present, the unpatented claims have been closed (BLM, written commun., 2004). Mines Management, Inc. (MMI) of Spokane has owned the deeded land since 1948. The property is an inholding in the Colville National Forest. The principal area of interest lies in the NE¼ of sec. 30 and SE¼ sec. 19, T40N R42E.

The first discovery of mineralization leading to the development of this property was made in 1893. However, Fulkerson and Kingston (1958) show 1917 as the first year of recorded production during which only 22 tons of ore were produced. The mine lay idle until 1949, at which time MMI carried out a significant underground exploration program by extending the main adit and driving several crosscuts. Production during 1949 and 1950 totaled about 6000 tons of ore averaging 3.3 percent zinc, 0.4 percent lead and less than 1 ounce of silver per ton. In 1951 the company entered into a core drilling program with the U.S. Bureau of Mines under a contract sponsored by the Defense Minerals Exploration Administration (DMEA). The program's final report calculated 502,000 tons of indicated ore averaging 3.88 percent combined lead and zinc and 454,000 tons of inferred ore averaging 4.52 percent combined lead and zinc (DMEA file no. 432, 1952). The overall ratio of zinc to lead in 162 assayed samples closely approximated 3 to 1. Sulfide mineralization at the Iroquois is finely disseminated sphalerite and galena occurring as discontinuous lenses within a brecciated dolomitic unit of the Metaline Limestone. Declining base metal prices in the late 1950s precluded further production activity by MMI, but the information generated during the DMEA program led to a lease by the Bunker Hill Company in 1964 to test targets established by geochemistry and geophysical methods. Cominco American Exploration applied the same techniques in 1974. The results of this exploration were reported to be favorable, but production plans failed to materialize, again due to poor market conditions (DGER mine file). An overview photo of the mine area is shown in Figure 2, and a map of underground development is shown in Figure 3.

The principal physical feature is a caved adit 780 feet long bearing S45E (Figs. 4 and 5). In addition, 880 feet of drifts and 1350 feet of crosscuts were driven, plus a 350-foot raise to the surface. Very little stoping was done. The adit discharges 50 to 200 gallons/minute, depending on the season, onto a grassy marsh below the waste rock dump (Fig. 6). This discharge is clear, has a pH of 8.2, and meets the Washington State ground water standards (WAC 246-290) for lead and zinc. The zinc content exceeds the chronic standard (WAC 173-201) for surface fresh water supporting aquatic life. Water standards are shown in Table 5 and Appendix B. DGER personnel collected field data on site during September 2001 and June 2004.

OWNERSHIP

Mines Management, Inc., of Spokane owns deeded land encompassing the adit and mine yard buildings and 40 contiguous acres in sec. 19 (Stevens Co. Assessor, written commun., 2004). A number of historic unpatented mining claims adjacent to the deeded land are closed and those claims, including the area explored during the DMEA contract, have reverted to the Colville National Forest (BLM, LR2000 database, 2004).

Figure 2. Iroquois mine site. View to the southwest.

HISTORY

The initial discovery took place in mineralization cropping out in dolomitic limestone bluffs 300 feet above the present adit. A few tons of ore were taken from surface excavations and short drifts at this point. Jenkins (1924) indicates that at the time of his examination the upper workings were abandoned and an adit had been extended 770 feet S45°E from a point just above the valley floor at elevation 2810 feet to intercept a downward extension of mineralization from the discovery. Patches of galena and sphalerite were found as disseminations and veinlets in the dolomitic limestone along the tunnel but not in significant quantities.

Mines Management, Inc., of Spokane reactivated the property in 1949, driving an average of 13 feet advance per shift of 7 by 9 foot exploration drifts and crosscuts (Mining World, 1952). This work disclosed additional lead-zinc mineralization along a 240-foot portion of a NE–SW trending crosscut and a somewhat confusing picture of local geology containing a lamprophyre dike and one or more major faults. Drifts continuing to the southeast at right angles to the crosscut were mostly barren. At this point the company applied for and received a DMEA exploration loan to conduct an underground core-drilling program. The $24,000 program consisted of 18 holes totaling 3056 feet and took place from May 1951 through January 1952. Core recovery averaged about 52 percent due in part to the brecciated nature of the dolomite. Failure to collect sludge samples made accurate grade and tonnage calculations problematic. Kirkemo (DMEA file no. 432, 1952) made two ore reserve calculations. The first, based on a very conservative interpretation of the work, indicated: ". . . a gross reserve of 188,962 tons of ore averaging 4.01 percent zinc and 1.67 percent lead. This reserve lies above and below the tunnel level . . . and only one ore reserve block has been tested by any vertical development other than diamond drilling. The reserve, therefore, is mainly indicated ore for which the tonnage and grade was computed from specific measurements and samples obtained from drifts, one raise, and the drill cores."

The second calculation included lower grade intercepts and yielded approximately 502,000 tons of indicated ore averaging 3.88 percent combined lead and zinc and 454,000 tons of inferred ore averaging 4.52 percent combined lead and zinc (DMEA file no. 432, 1952). Files for this program are stored in the Spokane Office of the U.S. Geological Survey. It does not appear that any further underground work was carried out after 1952.

Records indicate that the Bunker Hill Company leased the property in 1964 and drilled a number of holes to test targets established by geochemistry and geophysics. Cominco American applied the same techniques again in 1974. Cominco dropped the property in 1975. Although the results of Cominco's investigation were reported to have been favorable, the decision to discontinue development was primarily the result of declining markets, and negative economic conditions (DGER mine files).

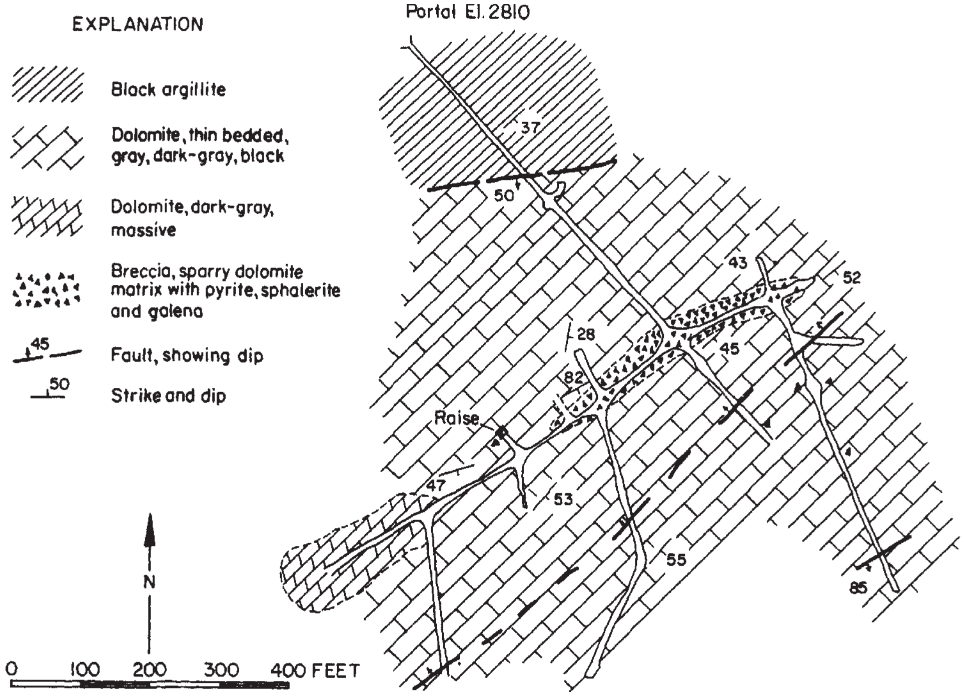

Figure 3. Geologic map of the mine workings of the Iroquois mine, Leadpoint mining district. (Reprinted from Mills, 1977.)

GEOLOGIC SETTING

The Metaline Limestone, which is the principal host for lead-zinc mineralization in northeastern Washington, overlies the Cambrian Maitlen Phyllite and is in turn overlain by the Ordovician Ledbetter Slate. Yates (1964) places the Iroquois mineralization in the Middle Cambrian Metaline Limestone, which contains some highly dolomitic units. Locally this host rock forms an apparent transitional unit between the same formation to the east in the Pend Oreille district and to the west in the Northport district. Yates assigned the term "intraformational breccia" to the rocks hosting sulfide mineralization, due to the presence of sharp, angular fragments characteristic of solution-collapse brecciation. The first 250 feet along the main adit is in black argillite of the Ledbetter Slate. "For the next 10 feet the adit cuts through intensely sheared and distorted argillite and dolomite marking the position of the steeply dipping Russian Creek fault" (Mills, 1977). The remainder of the adit and associated drifts and crosscuts follow bedding planes in the dolomite that appear to have been a controlling factor in the deposition of sulfides.

Figure 4. Main haulage adit.

The brecciated rock has been recemented and partially replaced by crystalline calcite and dolomite, followed by deposition of quartz, sphalerite, galena and minor chalcopyrite. The presence of ore-bearing brecciation in the Metaline Limestone is repeated at the following mines in the Leadpoint district: Anderson/Calhoun, Admiral Consolidated, Advance, and Big Chief. The predominant ore mineral is fine-grained sphalerite accompanied by lesser quantities of galena and chalcopyrite. Pyrite is locally abundant. Silver, usually associated with lead-zinc mineralization, is not present in commercial quantities (~.025 ounce per ton). Mills also stated that, "The [sulfides] seem not to bear any relation to fractures, fault zones or stratigraphic position." A number of altered lamprophyre dikes are associated with the ore body; however, their influence, if any, on the development of mineralization is unknown.

A review of the Mines Management, Inc., circa-1950 geologic map indicates a discontinuous, seemingly random distribution of sphalerite and galena throughout the portion of the property explored by drifts or crosscuts (DGER map file). For this reason the original application for a production loan from DMEA was deferred in favor of an exploration program. The DMEA diamond drilling delineated " three zones that contain mineralized bands or lenses alternating with barren or very low grade material." (DMEA file no. 432, 1952) The Main zone is crossed in the tunnel between 560 and 640 feet from the portal. It is approximately 80 feet wide and 150 feet high. The Southwest zone is 12 feet wide and 135 feet high. The Southeast zone is 3 to 8 feet wide and 75 to 100 feet high. A profusion of steeply dipping post-ore faults, probably affected by proximity to the Russian Creek fault passing through the property, complicates interpretation of the mine's structural geology and the effect of these faults on ore control.

OPENINGS

Underground development at the Iroquois mine consists of the southeast-bearing main adit, which is 780 feet long, accessory drifts and crosscuts, and a 350-foot raise from the main adit to the surface. The main adit bisects a major crosscut at a right angle 560 feet from the portal. The crosscut served as access to four parallel exploration drifts (DGER map file). Total development is approximately 3380 feet (Mills, 1977). We were not able to locate the former surface excavation reported to be 50 feet deep near the overlying bluff (Jenkins, 1924) or the surface breakout of the raise.

Drift timbers supporting the main adit have collapsed about 20 feet inside the portal. The condition of the adit after this point is unknown.

MATERIALS AND STRUCTURES

Two buildings occupy the landing next to the main adit portal. One, a Quonset-type that originally housed the machine shop, dry house, and air compressor is partly collapsed (Fig. 7). A sheet metal/frame building, presumably the mine operations office, is still intact (Fig. 8).

WATER

A 6-inch pipe running from the adit to the edge of the waste rock dump discharges approximately 200 gallons/minute during the spring runoff and 50 gallons/minute in the fall. The water has a pH of 8.2. Lead and zinc analyses of a sample taken from the pipe met the Washington State ground water standards for domestic consumption (WAC 246-290). The zinc content exceeded the hardness-based standard (WAC 173-201) for aquatic life in surface fresh water, chronic level. (See Table 5 and Appendix B.) The flow is clear and the bed sediment unstained.

The discharge flows down a gully in the waste rock dump onto a marshy field approximately 1250 feet long by 250 feet wide. Color aerial photos taken in August 2000 (Flight NE-C-2000) show this field inundated with water a foot or two deep. The inundation may be intermittent since the field was relatively dry at the time of DGER site visits in 2001 and 2004.

The field occupies a saddle between two drainages, and no apparent streams empty into it. Therefore, it appears that the adit discharge has been the main source of water for this marsh. Joe Creek starts at the field's north margin, flows into an unnamed pond at elevation 2571 feet, and thence into Cedar Creek.

MILLING OPERATIONS

No milling operations were conducted on the Iroquois property *per se*. Mines Management, Inc., apparently built a 50-ton/day mill near Northport in 1952 at an estimated cost of $58,000 (DMEA file no. 432, 1952). Its exact location is unknown.

Figure 5. *(top)* Condition of adit inside portal.

Figure 6. *(bottom)* Adit discharge at margin of waste rock dump.

Development and stoping material mined during and prior to 1952 was processed at the nearby Sierra Zinc mill operated by Goldfields Consolidated, Inc.

WASTE ROCK DUMPS

An estimated 2000 cubic yards of unmineralized dolomite and argillite waste rock occupy areas adjacent to the adit and down a slope to the northeast.

GENERAL INFORMATION

Name(s): Iroquois, Flannigan

MAS/MILS sequence number: 0530650420

Access: two-wheel drive

Status of mining activity: none

Claim status: two parcels of deeded land as indicated in Figure 2; no unpatented or patented lode claims

Current ownership: Mines Management, Inc., of Spokane, Wash.

Surrounding Land Status: Colville National Forest

Location and map information: see Table 1

Directions: The mine is located about 9 airline miles due east of Northport. From Northport, follow the paved Aladdin Road about 10 miles to an intersection at the settlement of Spirit. At Spirit, turn left onto Deep Lake–Boundary Road and proceed north 8 miles to an intersection with the Hartbauer Road. Turn right and proceed northeast 1.3 miles to a wye. Turn right onto Forest Service Road 900 for approximately 1.7 miles to a grassy field. The Iroquois mine dump is clearly visible on the east side.

MINE OPERATIONS DATA

Type of mine: underground and glory hole

Commodities mined: lead, zinc, silver

Geologic setting: brecciated dolomite unit of the Middle Cambrian Metaline Limestone

Ore minerals: sphalerite, galena, chalcopyrite

Non-ore minerals: quartz, pyrite

Period of production: 1917–1918, 1949–1952

Development: 3380 feet of underground workings; 5089 feet of core drilling, including DMEA contract and pre-1952 company-sponsored drilling (Huntting, 1956).

Production: 6000 tons plus

Mill data: None on site. Production from 1949 to 1952 taken to the Sierra Zinc mill 10 miles south of Leadpoint.

Figure 7. Machine shop, dry house, and compressor building.

Figure 8. Mine office with main haulage adit to the left of center.

Table 1. Location and map information

Mine	County	Location	Decimal latitude	Decimal longitude	1:24,000 quad.	1:100,000 quad.
Iroquois	Stevens	portions of secs. 19, 20, 29, 30, T40N R42E	48.95171	117.54043	Leadpoint	Colville

PHYSICAL ATTRIBUTES

Features: see Table 2

Materials: none

Machinery: none

Structures: Quonset hut and a 20 x 30 sheet metal frame building

Waste rock dumps, tailings, impoundments, highwalls, or pit walls: waste rock dump

Analysis of tailings and dumps: none

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

Reclamation activity: none

VEGETATION

The site has thick fir and larch, willows and grass. The waste rock dump is barren.

Table 2. Mine features

Description	Condition	Fenced (yes/no)	Length (feet)	Width (feet)	Height/depth (feet)	True bearing	Elev. (feet)	Decimal latitude	Decimal longitude
main adit	timbers crushed; back caved in ~20 feet from portal	no	780*	7	9	S45E	2840	48.95171	117.5432

WILDLIFE

See Table 3 for bat habitat information.

Table 3. Bat habitat information

Opening	Aspect	Air temp. (°F) at portal	Air flow: exhaust	Air flow: intake	Multiple interconnected openings	Bats or bat evidence
main adit portal	NW	70	none	none	yes	none

WATER QUALITY

Surface waters observed: marshy field

Proximity to surface waters: 0 feet

Domestic use: cattle grazing

Acid mine drainage or staining: none

Water field data: see Tables 4and 5

Surface Water Migration: adit discharge flows down side of waste rock dump onto a marshy field

Table 4. Surface water field data

Description	Flow (gpm)	Conductivity (μS/cm)	pH	Bed color	Temp. (°F)	Elev. (feet)
main adit portal discharge	50–200	559	8.2	natural	47	2810

ACKNOWLEDGMENTS

The authors thank our editors Jari Roloff and Karen Meyers for helpful suggestions on the layout and content of this report. Additional appreciation goes to U.S. Forest Service Region 6 personnel Bob Fujimoto and Dick Sawaya.

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Table 5. 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; **, 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. Numbers in bold indicate analyses that 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
main adit portal	– – –	≤5	– – –	– – –	≤10	– – –	**668**	318

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, Standards 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	– – –

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 (μg/l); *, no measurable amount detected in sample

Sample location	Hardness (mg/l)	Cd (μg/l)	Pb (μg/l)	Zn (μg/l)
main adit discharge	318	*	*	278

Appendix C. Ore reserve nomenclature

Proven ore: Ore for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed mapping. The sites for inspection, sampling, and measurement are so closely spaced and the geologic character is so well defined that the size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits that are stated and no such limit is judged to differ from the computed tonnage or grade by more than 20 per cent.

Indicated ore: Ore for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to outline the ore completely or to establish its grade throughout.

Inferred ore: Ore for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposits and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition for which there is geologic evidence; this evidence may include comparison with deposits of similar type.