INACTIVE AND ABANDONED MINE LANDS—Queen Seal Mine, Cedar Canyon Mining District, Stevens County, Washington

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

The Washington State Department of Natural Resources (DNR), Division of Geology and Earth Resources (DGER), is building a database and geographic information system (GIS) coverage of major mines in the state. Site characterization was initiated in 1999 (Norman, 2000). Work is funded through interagency grants from the U.S. Forest Service (USFS), 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 (Hunting, 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-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. Reports such as this one provide documentation on mines or groups of mines within specific mining districts or counties. The IAML database may be viewed by contacting Fritz Wolff (360-902-1468). IAML reports are posted online at http://www.dnr.wa.gov/geology/pubs/.

SUMMARY

The Queen Seal mine is located approximately 10 miles east of Fruitland, Wash. The property is situated in W½ SW¼ sec. 11, T29N R37E (Fig. 1). The name of the mine as currently recognized is a composite of two different claims—the Silver Queen and the Silver Seal—operated by separate companies until approximately 1908, at which time it appears the properties consolidated. From 1902 to the present, the total reported production from the combined properties was 285,700 ounces of silver from 2930 tons, averaging 97.53 ounces per ton (opt) silver (Moen, 1976). Actual production may have been higher due to a scarcity of production data prior to 1902. DGER visited the site in September 2002.

The original locations were made on the Silver Queen claim in 1895 and Silver Seal in 1899. The claims were never patented. Two unpatented lode claims located in 2003 by private parties cover most of the previous mine area situated on BLM property.

Figure 1. Map showing the location of the Queen Seal mine in Stevens County (top) and an air photo of the mine site (bottom). Photo downloaded Nov. 3, 2006, from DNR’s State Uplands Viewing Tool.
At least eight mining companies operated the mine in widely spaced periods of activity over the past century. The last production for all practical purposes occurred prior to World War II in the period from 1937 to 1940. The beginning of each production era required significant renovation of the drifts, adits, and shafts after being flooded during the intervening years.

Ore occurs as lenses of high-grade silver mineralization in a quartz fissure vein, 1 to 3 feet thick, striking N25°–35°E and dipping 75°NW. The mineralization includes silver sulfides, silver chloride, native silver, galena, sphalerite, tetrahedrite, and minor amounts of malachite and azurite. One smelter return assayed 0.15 percent WO₃.

The deposit occurs in the Deer Trail group of Precambrian metasediments, consisting of interbedded quartzite, argillite, dolomite, and limestone. It is probably genetically related to the almost identical mineralization at the Deer Trail mine by the right-lateral displacement of a postmineralization fault. The Loon Lake granitic batholith crops out ¼ mile on either side of the Queen Seal mine and is considered to be the source for ore deposition.

Water discharged from a 6-inch pipe into a sump southeast of the mine dump at the rate of about 5 gallons per minute (gpm) in 2002. A sample from this source exceeded standards for cadmium and lead shown in WAC 173-201A (surface water) and for lead shown in WAC 246-290 (ground water). We observed no water discharging anywhere else on the property.

Two vertical shafts were sunk in 1902—the Seal shaft was 300 feet deep and developed on five levels; the Queen shaft was 206 feet deep and developed on two levels. The site’s most hazardous opening, a “no-escape” depression about 40 feet in diameter and caved 50 feet below the collar, is probably the remains of the Seal shaft. This opening was backfilled to within a few feet of the surface by BLM in 2004 after the DGER site characterization (M. Sweeney, BLM, oral commun., 2006). The Seal shaft was located about 300 feet south of the Queen shaft along the vein’s strike. Two northwest-trending adits were caved at the portal. A third adit is open for an unknown distance and is considered hazardous. It is at the approximate location of the Queen prospect tunnel identified by Weaver (1920).

The only remaining structure during the 2002 site characterization was a dilapidated mill building built in 1937 by Queen Seal Mining Co. It was considered a hazard and burned by local fire authorities in 2004. Mill equipment stored on a flatbed trailer consisted of a jaw crusher, flotation cells, and a pile of white crystalline substance that we identified as sodium carbonate. BLM removed this equipment and material during 2004.

We did not observe a tailings impoundment per se or a definable layer of tailings, probably due to the small tonnage of ore (390 tons) put through the mill between 1937 and 1940. The gully below the mill site was hummocky, terraced terrain having the appearance of native earth with intermixed sand and gravel. Numerous small pits dug in the area indicate that it had been a subject of interest for sampling or rework. A grab sample was analyzed for cadmium, lead, silver, and zinc. The lead and zinc content exceeded the DOE levels established for industrial sites and unrestricted land use. There are no established levels for silver, however, the analysis of 125 parts per million equates to about 1.8 opt.

**OWNERSHIP**

Two active unpatented lode claims, Queen Seal-1 and -2, were staked in 2003. They are held under possessory title by M. Inman, Hunters, Wash. (BLM, LR2000 database, 2006). BLM manages the land on which the claims are located.
HISTORY

The Van Horn brothers and W. Johnson discovered high-grade silver mineralization at the Queen Seal site in 1895, shortly after the nearby Deer Trail claims were staked. Fulkerson and Kingston (1958) attribute most production from the Silver Seal Fraction claim to the Silver Seal Mining Co. and most production from the Queen claim to the Silver Basin Mining Co. It is unclear if these two companies combined operating agreements. As discussed below and in Appendix C, at least eight companies have been involved in the property since discovery to present time with various permutations of the name(s). The registration in 1908 of the Silver Seal and Queen Consolidated Mining Co. may mark the date at which the mines were operated as one entity.

Fulkerson and Kingston (1958) reported 1075 tons of ore averaging 210 opt silver from production at the Silver Seal Fraction between 1902 and 1908. No further production is reported from this claim until 1928 and 1929, at which time Commodore Mines Development Co. Inc. shipped a total of 65 tons of raw ore. The mine apparently made a considerable quantity of water, as repeated flooding is a recurrent theme in the literature: Weaver (1920) stated, “The other levels [of the Seal shaft] were inaccessible at the time of the examination as the shaft was flooded up to the tunnel level.” In December 1937, Queen Seal Mining reported, “The Seal shaft has been dewatered to the third level,” and that water in the shaft had regained a point below the second level four months later (Mining Journal, Dec. 30, 1937, and April 15, 1938). In June 1938, an article reported that the Seal shaft had been dewatered to the fifth level (Mining Journal, June 30, 1938). A. W. Tyler, President of Queen Seal Mining, reported that the work of reopening the mine many years after it had flooded involved transporting “... 900 ore cars of muck from 1500 feet of drifts” and clearing and retimbering parts of the shaft. He stated that mill feed at the time averaged 47.6 opt silver (Spokane Daily Chronicle, April 1938, date unknown).

Early production from the Queen claim in the years leading up to 1903 is unreported in USBM Minerals Yearbook statistics. However, Norman (1918) reported that by 1917, Silver Basin had shipped an estimated 7500 tons of raw ore, and that the physical plant included steam power for running a 3-ton hoist, air compressor, and pump. Fulkerson and Kingston (1958) reported production from 1917 to 1928 of only 367 tons of ore yielding 18,305 ounces silver at an average grade of 50 opt silver. In 1935, the Queen Seal Mining Co. acquired the consolidated properties and constructed the first mill—a 40 ton per day (tpd) flotation and gravity operation. The company milled 390 tons of ore between 1937 and 1938 yielding 5500 ounces of silver. In addition to silver, the concentrate averaged about 6 percent lead, 2 percent copper, and 0.15 percent tungsten oxide (Northwest Mining, Feb. 3, 1938).

The price of silver averaged about $1.00 per ounce during the mines’ production years up to 1940, making the combined value of production a minimum of ~$285,000, and it may range upwards of $500,000, depending on the accuracy of production figures. Moen (1976) reported a small-scale mining operation of “less than 100 tons” at the combined properties in 1960. Aside from the 2003 claim relocations, exploration and other activity at the Queen Seal since 1976 is unknown.

GEOLOGIC SETTING

The ore deposit at the Queen Seal mine is similar in many ways to hydrothermal mineralization at the Deer Trail mine and may...
be genetically related to it due to the right-lateral displacement of the post-mineralization Deer Trail fault (Fluet, 1985). Ore occurs as high-grade silver mineralization in a quartz fissure vein 1 to 3 feet thick striking N25°–35°E and dipping 75°NW. Reported ore minerals are: argentite, cerargyrite, native silver, galena, sphalerite, tetrahedrite, and minor amounts of malachite and azurite (Moen, 1976).

The host formation is the Deer Trail group of Precambrian Belt Supergroup metasediments. Locally, the deposit is located in the Edna Dolomite, consisting of interbedded quartzite, argillite, dolomite, and limestone (Fluet, 1985). Weaver (1920) reported that the vein’s hanging wall was persistent and very clearly defined in the dolomite, but was less well defined and exhibited less mineralization where it wandered east into contact with argillite. The dolomite within the mine is locally brecciated and silicified (Jenkins, 1924). Granitic rocks of the Loon Lake batholith crop out ¼ mile east and west of the mine, undoubtedly underlie the metasediments, and are considered the source for precious metal deposition.

OPENINGS

Most descriptions of the property are consistent in reporting two vertical shafts. The depth of the Seal shaft is 300 feet and that of the Queen shaft is 206 feet (Weaver, 1920). A 40-foot-wide and 50-foot-deep depression with vertical walls (Fig. 2) is the probable location of the Seal shaft because of the significant waste rock dump (Fig. 3) and reported development on five levels (DGER mine file). The bottom was bridged-over with wall slough. This opening was partially backfilled by BLM in 2004 after the DGER site characterization (M. Sweeney, BLM, oral commun., 2006). DGER was unable to locate the Queen shaft, which Weaver reported as situated 500 feet north along strike from the Seal shaft. The only reported development in the Queen shaft was one station cut on the 75-foot level. Both shafts are connected at the 75-foot level by a crosscut.

Four adits totaling about 1400 feet, according to Moen’s estimate, have been driven to intersect the vein at various points (Moen, 1976). We found three primary adits. The west adit is located about 200 feet southwest of the Seal shaft. It bears due west into the dolomite and has a large adjacent dump (Fig. 3). The south and north adits shown in Figure 1 are approximately 75 feet lower in elevation than the shaft collar and probably served as haulage ways and drainage tunnels. The north adit bears N45°W at the end of a long surface cut leading to the mill site (Figs. 4 and 5). Drifts and raises account for an additional 1500 feet of development (Moen, 1976). One additional tunnel discovered near the former mine camp area may be the “Queen prospect tunnel” identified by Weaver (1920) as striking N45°W for 125 feet. Conditions inside are unknown but the portal is open and should not be entered.

MATERIALS AND STRUCTURES

The original bunkhouse, office, blacksmith shop, steam power plant, and accessory buildings have been destroyed. All the equipment has been removed. In September 2002, a jaw crusher and flotation cells on a semi-truck trailer were discovered in a collapsed temporary shelter, probably dating to the 1960s (Fig. 6). We identified the white granular substance as sodium carbonate. This equipment was removed in a 2004 BLM action (M.
Sweeney, BLM, oral commun., 2006). Queen Seal Mining’s 1937 mill (Fig. 7) was burned by local fire authorities because of its hazardous condition.

WATER

A buried 6-inch plastic pipe discharged less than 5 gpm into a sump containing a hard-wired submersible pump. The pipe is in a direct line with the South adit and may serve as a drainage conduit (Fig. 8). The water was clear, and the unstained streambed contained aquatic plants. We analyzed a sample from this source for cadmium, lead, and zinc. A sample from this source exceeded standards for cadmium and lead shown in WAC 173-201A (surface water) and for lead shown in WAC 246-290 (ground water) (see Table 6). In October 2000, Dave Norman (DGER) and Robert Rafforth (DOE) observed a 35 to 40 gpm flow from this pipe and a seep emanating from the North adit (DGER mine file).

We detected no acid mine drainage. Field parameters for pH and conductivity ranged from 6.6 to 7.55 and 600 to 672 $\mu$ohm/cm respectively. These values agree with observations reported by Rafforth and others (2002).

MILLING OPERATIONS

Reports on the property prior to 1937 indicate that smelter shipments consisted of run-of-mine, hand-sorted ore. The Queen Seal Mining Co. took control of the combined properties in 1935 and placed a 40-tpd mill in operation on New Year’s Day 1937 (Northwest Mining, March 4, 1937). Later that year, an article in the Mining Journal (Dec. 30, 1937) reported: “The Queen Seal Mining Co. is now operating its concentration mill at the Queen and Seal mines near Fruitland, Wash. Crushing is done by ball mill and recovery is by flotation and Wilfley tables. Power is supplied by two 50 h.p. diesel engines.”

It is difficult to estimate the total volume of tailings this mill produced. Fulkerson and Kingston (1958) report only 390 tons of raw ore production from the mine at this time, but the start-up mill feed came from an unknown quantity of “... dump material left by early operators” (Mining Journal, March 30, 1937). There are no reports of the mill operating after the mine was acquired by a different group of investors in 1940, who mined a total of 12 tons.

WASTE ROCK DUMPS AND TAILINGS

We did not observe a defined tailings impoundment or any identifiable concentrations of tailings-appearing material. The gully below the mill site was hummocky, terraced terrain having the appearance of native earth with intermixed sand and gravel. Numerous small pits dug in the area indicate that it had been a subject of interest for reworking. A grab sample of sandy material was analyzed for cadmium, lead, silver, and zinc. The lead and zinc content (see Table 3) exceeded the DOE levels for industrial or commercial sites and for unrestricted land use (see Table 4). There are no established levels for silver, however, the analysis of 125 parts per million equates to about 1.8 opt.

The white dolomitic waste rock material adjacent to the Seal shaft appeared unmineralized and was not sampled.

GENERAL INFORMATION

Names: Queen Seal, Queen, Seal, Silver Queen, Silver Seal
MAS/MILS sequence number: 0530650365
Access: four-wheel drive
Status of mining activity: none
Claim status: two active claims—Queen Seal-1 and Queen Seal-2
Current ownership: M. Inman, Hunters, Wash.
Surrounding land status: Bureau of Land Management and private timberland
Location and map information: Table 1
Directions: The Queen Seal mine is located 2.2 airline miles southwest of the Deer Trail mill site. From Fruitland on State Route (SR) 25, take the paved “Valley Road” east to the settlement of Turk, a distance of approximately 5 miles. From Turk, follow a dirt road about 3.7 miles east and then south along South Fork Alder Creek past the Deer Trail mill site and tailings impoundments. Turn left where a road leading uphill enters at a sharp angle and continue due west across the ridge in the center of sec. 12, T29N R37E. Follow the road downhill approximately 1 mile from a four-way crossing at the headwaters of O-Ra-Pak-En Creek. The access road bisects the mine property. The waste rock dump and shafts are clearly visible west of the road. The location is well marked on the Adams Mountain USGS 7.5-minute quadrangle.
Table 2. Mine features. – – –, no data; **, data from DGER mine map file.

<table>
<thead>
<tr>
<th>Description</th>
<th>Condition</th>
<th>Fenced (yes/no)</th>
<th>Length (feet)</th>
<th>Width (feet)</th>
<th>Height/depth (feet)</th>
<th>True bearing</th>
<th>Elev. (feet)</th>
<th>Decimal latitude</th>
<th>Decimal longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-foot-deep depression (Seal shaft?)</td>
<td>caved</td>
<td>no</td>
<td>40</td>
<td>40</td>
<td>50 (original depth 300 feet)</td>
<td>N/A</td>
<td>3890</td>
<td>48.02621</td>
<td>118.12184</td>
</tr>
<tr>
<td>West adit</td>
<td>open</td>
<td>no</td>
<td>––</td>
<td>5</td>
<td>7</td>
<td>W</td>
<td>3860</td>
<td>48.02690</td>
<td>118.11930</td>
</tr>
<tr>
<td>South adit</td>
<td>caved</td>
<td>no</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td>N40°W</td>
<td>3815</td>
<td>48.02538</td>
<td>118.12156</td>
</tr>
<tr>
<td>North adit</td>
<td>caved</td>
<td>no</td>
<td>––</td>
<td>––</td>
<td>––</td>
<td>N35°W</td>
<td>3820</td>
<td>48.02592</td>
<td>118.12095</td>
</tr>
<tr>
<td>dozer prospect trench</td>
<td>open</td>
<td>no</td>
<td>150</td>
<td>40</td>
<td>20</td>
<td>N</td>
<td>4040</td>
<td>48.02715</td>
<td>118.12096</td>
</tr>
<tr>
<td>mill site</td>
<td>ruins</td>
<td>no</td>
<td>30</td>
<td>25</td>
<td>––</td>
<td>N/A</td>
<td>3800</td>
<td>48.02459</td>
<td>118.12031</td>
</tr>
<tr>
<td>Queen prospect tunnel</td>
<td>open</td>
<td>no</td>
<td>125**</td>
<td>5</td>
<td>7</td>
<td>N45°W</td>
<td>3890</td>
<td>48.02711</td>
<td>118.11876</td>
</tr>
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</table>

Table 3. Soil analysis. Metal concentrations are in milligrams/kilogram (mg/kg); – – –, no data. Analyses in bold indicate levels which exceed one or more standard shown in Table 4.

<table>
<thead>
<tr>
<th>Sample location</th>
<th>Arsenic</th>
<th>Cadmium</th>
<th>Copper</th>
<th>Lead</th>
<th>Zinc</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>mill site tailings</td>
<td>– – –</td>
<td>13</td>
<td>– – –</td>
<td>960</td>
<td>1240</td>
<td>125</td>
</tr>
</tbody>
</table>

Table 4. Soil quality standards for unrestricted land use. 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 in mg/kg. Levels for silver, gold, and iron are not specified.

<table>
<thead>
<tr>
<th>Metals</th>
<th>Arsenic III</th>
<th>Cadmium</th>
<th>Copper</th>
<th>Lead</th>
<th>Zinc</th>
<th>Silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>unrestricted land use</td>
<td>20</td>
<td>25</td>
<td>100</td>
<td>220</td>
<td>270</td>
<td>no std.</td>
</tr>
<tr>
<td>industrial or commercial use</td>
<td>20</td>
<td>36</td>
<td>550</td>
<td>220</td>
<td>570</td>
<td>no std.</td>
</tr>
</tbody>
</table>

Table 5. Surface water field data. *, data collected by Robert L. Raforth (low flow, Oct. 2000; Raforth and others, 2002).

<table>
<thead>
<tr>
<th>Description</th>
<th>Flow (gpm)</th>
<th>Conductivity (µS/cm)</th>
<th>Temp. (°F)</th>
<th>pH</th>
<th>Bed color</th>
<th>Water color</th>
</tr>
</thead>
<tbody>
<tr>
<td>sump</td>
<td>&lt;5</td>
<td>600</td>
<td>49</td>
<td>6.6</td>
<td>natural</td>
<td>clear</td>
</tr>
<tr>
<td>Queen Seal mill [sump] drainage, low flow*</td>
<td>30–40</td>
<td>607</td>
<td>45</td>
<td>7.55</td>
<td>natural</td>
<td>clear</td>
</tr>
<tr>
<td>Queen Seal adit drainage, low flow*</td>
<td>&lt;2</td>
<td>672</td>
<td>47</td>
<td>7.43</td>
<td>natural</td>
<td>clear</td>
</tr>
</tbody>
</table>

WILDLIFE
No bats observed. Deer, elk reported; pika observed.

WATER QUALITY
Surface waters observed: pipe-fed sump and spring
Proximity to surface waters: 0 feet to overflow from sump; 1500 feet to O-Ra-Pak-En Creek
Domestic use: none
Acid mine drainage or staining: none
Water field data: Tables 5 and 6
Surface water migration: none
### Acknowledgments

The authors thank our editors Jari Roloff and Karen Meyers for helpful suggestions on the layout and content of this report. Thomas M. Sweeney of the BLM provided helpful information on that agency’s remedial activity at the mine in 2004.

### References Cited


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### Table 6. 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. 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. Metals which exceed one or more of the standards in Part 2 are shown in bold.

#### Part 1: Analysis by USEPA Method 6020, Inductively Coupled Plasma/Mass Spectrometry

<table>
<thead>
<tr>
<th>Sample location</th>
<th>Arsenic</th>
<th>Cadmium**</th>
<th>Copper**</th>
<th>Iron</th>
<th>Lead**</th>
<th>Mercury</th>
<th>Zinc**</th>
<th>Hardness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queen Seal sump</td>
<td>5.54</td>
<td>7.06</td>
<td>– – –</td>
<td>– – –</td>
<td>60.3</td>
<td>– –</td>
<td>214</td>
<td>360</td>
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</table>

#### Part 2: Applicable Washington State Water Quality Standards

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

<table>
<thead>
<tr>
<th>Sample location</th>
<th>Hardness (mg/L)</th>
<th>Cd (µg/L)</th>
<th>Cu (µg/L)</th>
<th>Pb (µg/L)</th>
<th>Zn (µg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sump</td>
<td>360</td>
<td>2.65</td>
<td>56.9</td>
<td>9.8</td>
<td>338</td>
</tr>
</tbody>
</table>
## Appendix C. Mining companies associated with the Queen Seal mine

<table>
<thead>
<tr>
<th>Company</th>
<th>Registered in Washington?</th>
<th>Date registered with Sec. of State</th>
<th>Date stricken or dissolved</th>
<th>Comment</th>
<th>Place of business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver Basin Mining Co.*</td>
<td>yes</td>
<td>October 1896</td>
<td>July 1911 and July 1923</td>
<td>original filing by Van Horn brothers; reinstated by C. S. Turner, Jan. 1912; paid fees 1917</td>
<td>Davenport</td>
</tr>
<tr>
<td>Silver Queen Mines, Ltd.*</td>
<td>yes</td>
<td>May 1905</td>
<td>July 1923</td>
<td>no fees</td>
<td>Spokane</td>
</tr>
<tr>
<td>Silver Seal and Queen Consolidated Mining Co.**</td>
<td>yes</td>
<td>April 1908</td>
<td>no data</td>
<td>W. Scheck, president/ superintendent of Germania tungsten mines</td>
<td>Germania</td>
</tr>
<tr>
<td>Silver Queen Mining Co.*</td>
<td>yes</td>
<td>April 1915</td>
<td>July 1925</td>
<td>paid fees 1917–1923</td>
<td>Spokane</td>
</tr>
<tr>
<td>Commodore Mines Corporation*</td>
<td>yes</td>
<td>August 1928</td>
<td>July 1931</td>
<td>paid fees 1929</td>
<td>Spokane</td>
</tr>
<tr>
<td>Silver Glance Mines Development Co.*</td>
<td>yes</td>
<td>September 1929</td>
<td>July 1932</td>
<td>paid fees 1930</td>
<td>Spokane</td>
</tr>
<tr>
<td>Queen Seal Mining Co.*</td>
<td>yes</td>
<td>October 1935</td>
<td>July 1943</td>
<td>paid fees 1936–1940 A. W. Tyler, president</td>
<td>Spokane</td>
</tr>
<tr>
<td>Silver Basin Mine, Inc.*</td>
<td>yes</td>
<td>July 1938</td>
<td>July 1942</td>
<td>paid fees 1939 H. Johnson, president</td>
<td>Spokane</td>
</tr>
</tbody>
</table>

*, copies of archived corporate registration cards in DGER mine file

**, identified by Huntting (1956)