

FINAL VERSION
SITE HAZARD ASSESSMENT
WORKSHEET 1
Summary Score Sheet

SITE INFORMATION:

Antimony Queen Mine
Gold Creek District
Carlton, Okanogan County, WA 98814

Section/Township/Range: S11 - T31N - R21E
Latitude: 48.20109
Longitude: 120.18101

Ecology Facility Site ID No.: 1163525

Site scored/ranked for the February, 2011 update: September 22, 2010

SITE DESCRIPTION (management areas, substances of concern, and quantities):

The Antimony Queen Mine is located in undeveloped forest land southwest of Carlton, Washington, situated on the south bank of Gold Creek on land administered by the U.S. Forest Service. Although abandoned for many years, the mine once reportedly produced ore containing antimony, gold, lead, and arsenic. The mine was developed by three main adits and approximately 1,000 feet of tunnel. The site is characterized by extremely steep slopes, in excess of 80 percent, and the result is that most of the deposited waste rock from the tunneling operations appears to have slid to the creek and been moved downstream during high water events.



One main portal is still open, located about 50' above the creek.

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Lower waste rock pile extends from main portal to the bank of Gold Creek.



Upper waste rock slope has little accumulation, due to the steepness of the slope.



Upper portal is located high on the slope above the creek, and has collapsed.

The site was visited by Michael Huchton, of the Okanogan County Health District, on June 13th, 1995. During this visit, a composite soil sample was created from the lower waste rock pile. This sample was analyzed for Total Metals, as summarized in the table below. Results in bold print indicate contaminants that were present in concentrations exceeding established cleanup levels.

Analyte	Waste Rock Concentrations (mg/kg)	Cleanup Level (mg/kg)
Antimony*	89.3	32.0
Arsenic	4532	20
Beryllium	5.6	--
Cadmium	2.1	2.0
Chromium	<1.0	2000
Lead	32.7	250
Mercury	0.13	2.0
Selenium	0.52	--
Silver	1.9	--
Copper	113	--
Zinc	177.3	--
Nickel	6.2	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Soil Cleanup Levels for Unrestricted Land Uses.

*Cleanup level value for Antimony reflects Model Toxics Control Act (MTCA) Ground Water Method B, Non-carcinogenic, Standard Formula Value.

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At the time of this inspection, standing water was observed in the portal of the lowest adit. A water sample was collected and was tested for Total Dissolved Metals, as summarized in the table below. Results in bold print indicate contaminants that were present in concentrations exceeding established cleanup levels.

Analyte	Water Concentrations (ug/l)	Cleanup Level (ug/l)
Antimony*	296	6.4
Arsenic	220	5.0
Beryllium	<0.2	--
Cadmium	<8.9	5.0
Chromium	<4.7	50
Lead	<0.5	15
Mercury	<0.3	2.0
Selenium	<6.0	--
Silver	<4.7	--
Copper	<20	--
Zinc	26.4	--
Nickel	<10	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Cleanup Levels for Ground Water for Unrestricted Land Uses.

*Cleanup level value for Antimony reflects Model Toxics Control Act (MTCA) Soil Method B, Non-carcinogenic, Standard Formula Value.

This site was revisited on August 21st, 2009, by Douglas Hale and Mike Harr of Okanogan County Public Health. All of the features noted in the previous site visit were identified, with the only substantial difference being the further collapse of the lowest adit, and the absence of any standing water in it.

Three soil samples were collected from the lower waste rock pile, and three samples were collected from the upper waste rock slope. The samples were analyzed for Total Metals, with the lab results summarized in the tables below:

2009 Sample Results

Analyte	Sample AQ001 Concentrations (mg/kg)	Sample AQ002 Concentrations (mg/kg)	Sample AQ003 Concentrations (mg/kg)	Cleanup Level (mg/kg)
Arsenic	6650	9100	7300	20
Barium	223	202	161	--
Cadmium	15.1	8.95	9.10	2.0
Chromium	2.55	2.40	3.12	2000
Lead	108	52.0	85.5	250
Mercury	0.4089	0.5938	0.6095	2.0
Selenium	<2.5	<2.5	<2.5	--
Silver	<0.25	<0.25	<0.25	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Soil Cleanup Levels for Unrestricted Land Uses.

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2009 Sample Results

Analyte	Sample AQ004 Concentrations (mg/kg)	Sample AQ005 Concentrations (mg/kg)	Sample AQ006 Concentrations (mg/kg)	Cleanup Level (mg/kg)
Arsenic	10350	9500	10700	20
Barium	78.5	143	126	--
Cadmium	6.65	8.6	8.70	2.0
Chromium	3.12	2.48	2.41	2000
Lead	30.3	99.0	193	250
Mercury	0.7302	0.4073	0.5139	2.0
Selenium	<2.5	<2.5	<2.5	--
Silver	<0.25	<0.25	<0.25	--

Cleanup level values reflect Model Toxics Control Act (MTCA) Method A Soil Cleanup Levels for Unrestricted Land Uses.



Primitive campsite across the creek from the mine appears to receive regular use from campers and hunters.

SPECIAL CONSIDERATIONS (include limitations in site file data or data which cannot be accommodated in the model, but which are important in evaluating the risk associated with the site, or any other factor(s) over-riding a decision of no further action for the site):

The model does not take into consideration the possible exposure to recreational users who may be accessing the site. The primitive campsite across the creek had two tents in it at the time of our inspection, and appears to receive frequent use. Game hanging poles tied to nearby trees indicate that the area is also popular with hunters. The creek is small enough that it can be easily crossed by hopping on boulders, and a well-worn foot path leading up to the mine entrance is indicative of how frequently the site is accessed by curious explorers.

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ROUTE SCORES:

Surface Water/Human Health: **21.2**
Air/Human Health: **6.0**
Groundwater/Human Health: **22.1**

Surface Water/Environmental: **56.4**
Air/Environmental: **45.2**

OVERALL RANK: 1

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WORKSHEET 2
Route Documentation

1. **SURFACE WATER ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium.
- b. Explain basis for choice of substance(s) to be used in scoring.
Soil sample analysis shows arsenic contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of this contaminant in on-site soils.

2. **AIR ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium.
- b. Explain basis for choice of substance(s) to be used in scoring:
Soil sample analysis shows arsenic contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source: 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of this contaminant in on-site soils.

3. **GROUNDWATER ROUTE**

- a. List those substances to be considered for scoring: Source: 1,2
Arsenic, cadmium.
- b. Explain basis for choice of substance(s) to be used in scoring:
Soil sample analysis shows arsenic contamination of on-site soils in excess of MTCA Method A Cleanup Levels for Unrestricted Land Use.
- c. List those management units to be considered for scoring: Source: 1,2
Contaminated on-site soils.
- d. Explain basis for choice of unit to be used in scoring:
Analytical confirmation of this contaminant in on-site soils.

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WORKSHEET 4

Surface Water Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Human Toxicity										
Substance		Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	10	8	763 (rat)	5	0.001	3	1	1.75	7
2	Cadmium	5	8	225 (rat)	5	0.0005	5	0.8	ND	--

**Potency Factor*

Source: 1, 2, 5

Highest Value: 8
(Max = 10)

Plus 2 Bonus Points? 2
Final Toxicity Value: 10
(Max = 12)

1.2 Environmental Toxicity					
Substance			Acute Water Quality Criteria		Non-Human Mammalian Acute Toxicity
			(µg/L)	Value	(mg/kg) Value
1	Arsenic		360	4	NS --
2	Cadmium		3.9	8	NS --

Source: 1, 2, 5

Highest Value: 8
(Max = 10)

1.3 Substance Quantity	
Explain Basis: Area measured at about 10,320 sq. ft. by handheld GPS.	Source: <u>1, 6, 11, 15</u> Value: 7 (Max = 10)

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2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment: Waste pile with no runoff control, located outside. Explain basis: Waste rock piles extend to the creek channel.	<u>1, 6, 15</u>	<u>10</u> (Max = 10)
2.2	Surface Soil Permeability: Sands/gravels/gravelly sandy loam	<u>1, 3, 6, 15</u>	<u>1</u> (Max = 7)
2.3	Total Annual Precipitation: 19.0", based on Stockdill Ranch station.	<u>6, 7</u>	<u>2</u> (Max = 5)
2.4	Max 2yr/24hr Precipitation: 1.54"	<u>6, 14</u>	<u>2</u> (Max = 5)
2.5	Flood Plain: Not in a flood plain.	<u>8, 11</u>	<u>0</u> (Max = 2)
2.6	Terrain Slope: 64%	<u>11</u>	<u>5</u> (Max = 5)

3.0 TARGETS

		Source	Value
3.1	Distance to Surface Water: Waste rock extends to active channel.	<u>11</u>	<u>10</u> (Max = 10)
3.2	Population Served within 2 miles (see WARM Scoring Manual Regarding Direction): No homes served by surface water intakes.	<u>10</u>	<u>0</u> (Max = 75)
3.3	Area Irrigated by surface water within 2 miles downstream: $0.75 \times \sqrt{\text{acres}} = 0.75 \times \sqrt{92} = 7.19$	<u>10</u>	<u>7</u> (Max = 30)
3.4	Distance to Nearest Fishery Resource: Gold Creek is a fish-bearing stream; waste rock extends to creek.	<u>11</u>	<u>12</u> (Max = 12)
3.5	Distance to, and Name(s) of, Nearest Sensitive Environment(s): Gold Creek, National Forest land are immediately adjacent.	<u>11</u>	<u>12</u> (Max = 12)

4.0 RELEASE

Explain Basis: No confirmed release.	Source: <u>1, 2, 6, 15</u> Value: 0 (Max = 5)
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WORKSHEET 5

Air Route

1.0 SUBSTANCE CHARACTERISTICS

1.1 Introduction – Review WARM Scoring Manual before scoring

1.2 Human Toxicity										
Substance		Amb. Air Standard (µg/m³)	Value	Acute Toxicity (mg/ m³)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	0.00023	10	ND	--	ND	--	1	50	9
2	Cadmium	0.00056	10	25 (rat)	10	ND	--	0.8	6.1	7

* *Potency Factor*

Source: 5, 6

Highest Value: 10

(Max = 10)

Plus 2 Bonus Points? 2

Final Toxicity Value: 12

(Max = 12)

1.3 Mobility (Use numbers to refer to above listed substances)				
1.3.1 Gaseous Mobility		1.3.2 Particulate Mobility		
Vapor Pressure(s) (mmHg)		Soil Type	Erodibility	Climatic Factor
1		Loamy sand	134 tons/acre/yr	1 - 10

Source: NA

Value: NS

(Max = 4)

Source: 3, 6

Value: 2

(Max = 4)

1.4 Highest Human Health Toxicity/ Mobility Matrix Value (from Table A-7)

Final Matrix Value: 12

(Max = 24)

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1.5 Environmental Toxicity/Mobility						
Substance		Non-human Mammalian Inhalation Toxicity (mg/m ³)	Acute Value	Mobility (mmHg)	Value	Matrix Value
1	Arsenic	ND	--	ND	--	--
2	Cadmium	25 (rat)	10	(particulate)	1	5

Highest Environmental Toxicity/Mobility Matrix Value (from Table A-7)

Final Matrix Value: 10
(Max = 24)

1.6 Substance Quantity	
Explain Basis: 10,320 sq. ft.	Source: <u>1, 6, 11, 15</u> Value: <u>5</u> (Max = 10)

2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment: Waste pile outdoors, and uncovered.	<u>1, 6, 15</u>	<u>10</u> (Max = 10)

3.0 TARGETS

		Source	Value
3.1	Nearest Population: Nearest home is about 1,790' from site.	<u>1, 6, 11</u>	<u>8</u> (Max = 10)
3.2	Distance to [and name(s) of] nearest sensitive environment(s) [fisheries excluded]: Site is located on National Forest land.	<u>6, 11</u>	<u>7</u> (Max = 7)
3.3	Population within 0.5 miles: $\sqrt{\text{pop.}} = \sqrt{3} = 1.73$	<u>6, 11</u>	<u>2</u> (Max = 75)

4.0 RELEASE

Explain Basis for scoring a release to air: None documented.	Source: <u>6</u> Value: <u>0</u> (Max = 5)
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WORKSHEET 6
Groundwater Route

1.0 SUBSTANCE CHARACTERISTICS

1.2 Human Toxicity										
Substance		Drinking Water Standard (µg/L)	Value	Acute Toxicity (mg/ kg-bw)	Value	Chronic Toxicity (mg/kg/day)	Value	Carcinogenicity		Value
								WOE	PF*	
1	Arsenic	10	8	763 (rat)	5	0.001	3	1	1.75	7
2	Cadmium	5	8	225 (rat)	5	0.0005	5	0.8	ND	--

* *Potency Factor*

Source: 1, 2, 5
Highest Value: 8
 (Max = 10)
Plus 2 Bonus Points? 2
Final Toxicity Value: 10
 (Max = 12)

1.2 Mobility (use numbers to refer to above listed substances)										
Cations/Anions [Coefficient of Aqueous Migration (K)]					OR Solubility (mg/L)					
1	Arsenic >1.0 = 3									
2	Cadmium >1.0 = 3									

Source: 5, 6
Value: 3
 (Max = 3)

1.3 Substance Quantity:										
Explain basis: Lower waste pile: 3,000 sq. ft. x 3' depth = 9,000 cu. ft. Upper waste slope: 7,320 sq. ft. x 0.5' depth = 3,660 cu. ft. 9,000 + 3,660 = 12,660 / 27 = 468.88 cu. yds.									Source: <u>1, 6, 15</u> Value: <u>3</u> (Max=10)	

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2.0 MIGRATION POTENTIAL

		Source	Value
2.1	Containment (explain basis): Waste pile with no liner, no cover, and no containment.	<u>3</u>	<u>10</u> (Max = 10)
2.2	Net precipitation: $13.2'' - 1.7'' = 11.5''$	<u>7</u>	<u>2</u> (Max = 5)
2.3	Subsurface hydraulic conductivity: Sands/gravels/gravelly sandy loam	<u>1, 3</u>	<u>4</u> (Max = 4)
2.4	Vertical depth to groundwater: Few well logs available, nearest log shows water at 160'.	<u>4, 6</u>	<u>3</u> (Max = 8)

3.0 TARGETS

		Source	Value
3.1	Groundwater usage: Private supply, no alternates available	<u>1, 9</u>	<u>5</u> (Max = 10)
3.2	Distance to nearest drinking water well: 1,790' to nearest residence.	<u>6, 11</u>	<u>3</u> (Max = 5)
3.3	Population served within 2 miles: $\sqrt{\text{pop.}} = \sqrt{18} = 4.24$ Six homes visible on aerial photos (18 residents).	<u>6, 11</u>	<u>4</u> (Max = 100)
3.4	Area irrigated by wells within 2 miles: $0.75 \times \sqrt{\text{acres}} = 0$	<u>4, 6</u>	<u>0</u> (Max = 50)

4.0 RELEASE

		Source	Value
	Explain basis for scoring a release to groundwater: None documented.	<u>6</u>	<u>0</u> (Max = 5)

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SOURCES USED IN SCORING

1. Initial Investigation by Michael Huchton, June 13th, 1995.
2. Soil sample analysis reports by White Earth Analytical and Cascade Analytical.
3. Soil log(s) on file at Okanogan County Health District.
4. Water Well Reports on file at Okanogan County Health District.
5. Washington Department of Ecology, Toxicology Database for Use in Washington Ranking Method Scoring, January 1992.
6. Washington Department of Ecology, WARM Scoring Manual, April 1992.
7. See attached table identified as Reference 7.
8. Flood Insurance Rate Maps (FIRM).
9. Ecology Water Rights Information System (WRIS).
10. Washington Department of Fish & Wildlife StreamNet database.
11. GIS data layers provided by Okanogan County Planning Department, composite map is attached as Reference 11.
12. US Census 2000 data.
13. SENTRY Public Water system data from Washington Department of Health.
14. NOAA Atlas II Precipitation Frequency Data Output, site specific estimate.
15. Site Hazard Assessment visit by Douglas Hale, August 21st, 2009.