HRS DOCUMENTATION RECORD – REVIEW COVER SHEET

Name of Site: Black Butte Mine

Contact Persons:

Site Investigations: Ecology & Environment Inc., April 1998, *Black Butte Mine, Site Inspection Report, TDD: 98-04-0004,* prepared for the U.S. Environmental Protection Agency.

U.S. Environmental Protection Agency, July 20, 2008, *Final Removal Action Report for Black Butte Mine, Cottage Grove, Oregon.*

Ecology & Environment Inc., March 21, 2006, *Black Butte Mine, Removal Assessment Report, TDD: 06-01-0005,* prepared for the U.S. Environmental Protection Agency.

Thoms, Bryn, R.G., August 21, 2008, WR Cleanup Program, State of Oregon, Department of Environmental Quality memorandum to Max Rosenberg, R.G., WR Cleanup Manager regarding Black Butte Mine Mercury Loading Assessment Results.

Documentation Record: Linda Costello, Ecology & Environment Inc., Seattle, WA

Ken Marcy, U.S. Environmental Protection Agency, Seattle, WA

Pathways, Components, or Threats Not Scored

The ground water migration pathway, ground water-to-surface water component of the surface water migration pathway, soil exposure pathway, and air migration pathway were not scored as part of this Hazard Ranking System (HRS) evaluation. These pathways/components were not included because a release to these media does not significantly affect the overall site score and because the overland flow/flood component of the surface water migration pathway produces an overall site score well above the minimum required for the site to qualify for inclusion on the National Priorities List. These pathways are of concern to the U.S. Environmental Protection Agency (EPA) and may be evaluated during future investigations.

The ground water-to-surface water component of the surface water migration pathway was not scored because the overland flow/flood component of the surface water migration pathway generated a higher score. However, the ground water-to-surface water component of the surface water migration pathway is of concern since it is known that contaminated ground water underlying the site is present. This contaminated ground water may be impacting adjacent surface water features.

872735

HRS DOCUMENTATION RECORD

Name of Site: Black Butte Mine

EPA Region 10 Date Prepared: September, 2009

CERCLIS No.: OR0000515759

Street Address of Site*: London Road, Cottage Grove, Oregon, 97424

County and State: Lane, Oregon

General Location in the State: Southwest

Topographic Map: Harness Mountain, Oregon, 1987 (Ref. 3).

Latitude: 43° 34' 46.2576" North Longitude: 123° 04' 00.5160" West (Ref. 3 as determined at the location of the tailing pile near Dennis Creek)

Scores	
Ground Water Pathway	NS
Surface Water Pathway	100.00
Soil Exposure Pathway	NS
Air Pathway	NS
HRS SITE SCORE	50.00

NS = Not Scored

* - *The street address, coordinates, and contaminant locations presented in this HRS documentation record identify the general area the site is located. They represent one or more locations EPA considers to be part of the site based on the screening information EPA used to evaluate the site for NPL listing. EPA lists national priorities among the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, not precisely delineated boundaries. A site is defined as where a hazardous substance has been "deposited, stored, placed, or otherwise come to be located." Generally, HRS scoring and the subsequent listing of a release merely represent the initial determination that a certain area may need to be addressed under the Comprehensive Environmental Response, Compensation, and Liability Act. Accordingly, EPA contemplates that the preliminary description of facility boundaries at the time of scoring will be refined as more information is developed as to where the contamination has come to be located.*

SURFACE WATER OVERLAND FLOW/FLOOD MIGRATION COMPONENTS SCORESHEET

Factor categories and factors			Maximum Value	Value Assigned	
	Drinking Water Threat				
Likelihood of Release:					
	1. Observed Release		550	550	550
	2. Potential to Release by Overland Flow:				
		2a. Containment	10		
		2b. Runoff	25		
		2c. Distance to Surface Water	25		
		2d. Potential to Release by Overland Flow [lines 2a(2b + 2c)]	500		
	3.Potential to Release by Flood:				
		3a. Containment (Flood)	10		
		3b. Flood Frequency	50		
		3c. Potential to Release by Flood (lines 3a x 3b)	500		
	4. Potential to Release (lines 2d + 3c, subject to a maximum of 500)		500		NS
	5. Likelihood of Release (higher of lines 1 and 4)		550		550
Waste Characteristics:					
	6. Toxicity/Persistence		(a)		
	7. Hazardous Waste Quantity		(a)		
	8. Waste Characteristics		100		
Targets:					
	9. Nearest Intake		50		
	10. Population:				
		10a. Level I Concentrations	(b)		
		10b. Level II Concentrations	(b)		
		10c. Potential Contamination	(b)		
		10d. Population (lines 10a + 10b + 10c)	(b)		
	11. Resources		5		
	12. Targets (lines 9 + 10d + 11)		(b)		
Drinking Water Threat Score:					
	13. Drinking Water Threat Score [(lines 5x8x12)/82,500, subject to a max of 100]		100		NS

Factor categories and factors			Maximum Value	Value Assigned	
Human Food Chain Threat					
Likelihood of Release:					
	14. Likelihood of Release (same value as line 5)		550		550
Waste Characteristics:					
	15. Toxicity/Persistence/Bioaccumulation		(a)	500,000,000	
	16. Hazardous Waste Quantity		(a)	10,000	
	17. Waste Characteristics		1,000		1,000
Targets:					
	18. Food Chain Individual		50	45	
	19. Population				
		19a. Level I Concentrations	(b)	0	
		19b. Level II Concentrations	(b)	0.09	
		19c. Potential Human Food Chain Contamination	(b)	0	
		19d. Population (lines 19a + 19b + 19c)	(b)	0.09	
	20. Targets (lines 18 + 19d)		(b)		45.09
Human Food Chain Threat Score:					
	21. Human Food Chain Threat Score [(lines 14x17x20)/82,500, subject to max of 100]		100		100

SURFACE WATER OVERLAND FLOW/FLOOD MIGRATION COMPONENTS SCORESHEET

Factor categories and factors			Maximum Value	Value Assigned	
Environmental Threat					
Likelihood of Release:					
	22. Likelihood of Release (same value as line 5)		550		550
Waste Characteristics:					
	23. Ecosystem Toxicity/Persistence/Bioaccumulation		(a)	500,000,000	
	24. Hazardous Waste Quantity		(a)	10,000	
	25. Waste Characteristics		1,000		1,000
Targets:					
	26. Sensitive Environments				
		26a. Level I Concentrations	(b)	0	
		26b. Level II Concentrations	(b)	450	
		26c. Potential Contamination	(b)	0	
		26d. Sensitive Environments (lines 26a + 26b + 26c)	(b)	450	
	27. Targets (value from line 26d)		(b)		450
Environmental Threat Score:					
	28. Environmental Threat Score [(lines 22x25x27)/82,500, subject to a max of 60]		60		60
	29. Watershed Score[c] (lines 13 + 21 + 28, subject to a maximum of 100)		100		100
	30. Component Score (S_{of})[c] (highest score from line 29 for all watersheds evaluated, subject to a maximum of 100)		100		100

[a] Maximum value applies to waste characteristics category.
[b] Maximum value not applicable.
[c] Do not round to nearest integer.

WORKSHEET FOR COMPUTING HRS SITE SCORE

	S pathway	S^2 pathway
Ground Water Migration Pathway Score (S_{gw})	NS	NS
Surface Water Migration Pathway Score (S_{sw})	100	10,000
Soil Exposure Pathway Score (S_s)	NS	NS
Air Migration Score (S_a)	NS	NS
$S^2_{gw} + S^2_{sw} + S^2_s + S^2_a$		10,000
$(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4$		2,500
$\sqrt{(S^2_{gw} + S^2_{sw} + S^2_s + S^2_a)/4}$		50.00

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2.	U.S. Environmental Protection Agency, January 2004, Superfund Chemical Data Matrix (SCDM), Appendix BI, 12 pages excerpted; and Appendix BII, 1 page excerpted. A complete copy of SCDM is available at http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.
3.	U.S. Geological Survey, 1987, 1:63,360 topographic map, Harness Mountain, Oregon, 1 page.
4.	Ecology & Environment Inc., April 1998, *Black Butte Mine, Site Inspection Report, TDD: 98-04-0004,* prepared for the U.S. Environmental Protection Agency, 317 pages.
5.	U.S. Environmental Protection Agency, July 20, 2008, *Final Removal Action Report for Black Butte Mine, Cottage Grove, Oregon*, 140 pages.
6.	Brooks, Howard C., 1963, State of Oregon, Department of Geology and Mineral Industries, *Quicksilver in Oregon*, 13 pages.
7.	Schuette, C. N., February 1, 1938, State of Oregon, Department of Geology and Mineral Industries, *Quicksilver in Oregon*, 16 pages.
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9.	Derkey, Robert E., 1973, University of Montana, *Geology of the Blackbutte Mercury Mine, Lane County, Oregon*, 85 pages.
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11.	Ecology and Environment, Inc., September 2 and 3, 1998, Black Butte Mine Site Inspection Chain-of-Custody forms, 7 pages.
12.	U.S. Environmental Protection Agency, February 1994, USEPA Contract Laboratory Program, *National Functional Guidelines for Inorganic Data Review*, 45 pages.
13.	Ecology & Environment Inc., March 21, 2006, *Black Butte Mine, Removal Assessment Report, TDD: 06-01-0005,* prepared for the U.S. Environmental Protection Agency, 134 pages.
14.	Ecology & Environment Inc., September 1, 2005, *Black Butte Mine, Site-Specific Sampling Plan, TDD: 05-04-0005,* prepared for the U.S. Environmental Protection Agency, 211 pages.
15.	Ecology & Environment Inc., September 7 through 10, 2005, *Black Butte Mine, Removal Assessment Report,* chain-of-custody forms, 3 pages.
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18.	Ecology & Environment Inc., July 2009, 15-Mile TDL and Wetlands Maps, Black Butte Mine, Lane County Oregon, 2 pages.
19.	Curtis, Lawrence R., May 20, 2003, Department of Environmental and Molecular Toxicology, Oregon State University, *Final Report Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir,* prepared for the U.S. Army Corps of Engineers, 48 pages.
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24.	Curtis, Lawrence R., August 9, 2004, Department of Environmental and Molecular Toxicology, Oregon State University, *Final Report Reconnaissance Soil Sampling at the Black Butte Mine*, prepared for the

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27.	Ziller, Jeff, April 3, 2009, District Fish Biologist, South Willamette Watershed District, Oregon Department of Fish and Wildlife, phone conversation with Linda Costello, Ecology & Environment Inc. regarding Sport Fishing within 15-miles downstream of Black Butte Mine, 1 page.
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29.	United States Environmental Protection Agency, April 13, 2007, memorandum from Kathy Parker, On-Scene Coordinator, and Carl Kitz, On-Scene Coordinator regarding *Request for a Removal Action to be Conducted at the Black Butte Mine, Cottage Grove, Oregon* to Daniel D. Opalski, Director, Office of Environmental Cleanup, 21 pages.
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BLACK BUTTE MINE SUMMARY:

Black Butte Mine is a former mercury mine located in a rural area of southwest Oregon (Ref. 3; Ref. 4, p. 13). The mine is approximately 10 miles south of Cottage Grove, Oregon (Ref. 4, p. 13). The primary features at the mine include a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (New Furnace Area), another mill and furnace area (Old Ore Furnace), several old dilapidated buildings, waste rock / tailings piles, a system of unimproved roads, and mine adits (Ref. 5, p. 9). A map depicting features at the mine follows this section (Figure 1). Much of the mine area was logged during the early 1990s, at which time several old mine structures were reportedly demolished (Ref. 4, p. 13). The main tailings pile, containing both waste rock and mill tailings, is located in a relatively flat area below the New Furnace Area (Ref. 5, p. 9). It is bordered on the northeast by Dennis Creek (Ref. 5, p. 9). Remnants of a second waste pile lie to the northwest of the Old Ore Furnace (Ref. 5, p. 9). This area borders Furnace Creek to the southwest (Ref. 5, p. 9).

The mine is bordered to the northeast by Dennis Creek, to the southwest by Furnace Creek, to the southeast by Black Butte, and to the northwest by the (b) residence (Ref. 5, p. 9). Both Dennis Creek and Furnace Creek flow west–northwest to Garoutte Creek which flows northward approximately six miles to the Coast Fork Willamette River (Ref. 5, p. 9). The Coast Fork Willamette River empties into Cottage Grove Reservoir (Ref. 5, p. 9).

Black Butte Mine was discovered in 1890 (Ref. 6, p. 8). By 1908, approximately 15,000 feet of development work was done on 100, 200, 300, and 400 foot levels (Ref. 6, p. 8). Originally ore was processed using a Scott-Hutner furnace which was later redesigned (Ref. 6, p. 8). From 1909 until 1916 the mine was closed, owing to the depressed price of quicksilver (Ref. 6, p. 8). From 1916 to 1919, a flotation unit and a redesigned Scott furnace were used (Ref. 6, p. 8). When World War I ended, declining mercury prices forced the mine to shut down (Ref. 6, p. 8).

In 1927, a 4 by 60 foot rotary kiln plant was installed at the mine and a second 4 by 60 foot rotary kiln was added in 1929; giving the mill a capacity of 150 tons per day (Ref. 7, pp. 9 and 11; Ref. 6, p. 8). Each kiln had its own stack flue and stack (Ref. 7, p. 11). Operation of the second kiln was discontinued after about three years since it was not as satisfactory as the original one (Ref. 7, p. 11). Black Butte Mine was operated more or less continuously from 1927 to 1942 (Ref. 6, p. 8). During this time levels were established at 500, 600, 900, 1100, 1300, and 1600 feet (Ref. 6, p. 8). After retreating old furnace tailings, the mine was closed in March 1943 and remained idle until 1956 (Ref. 6, p. 8). In 1956 and 1957, the mine was explored, developed, and ore was furnaced from the 900 and 1100 foot levels (Ref. 6, p. 8). In total, Black Butte Mine was developed by eight adit levels distributed over a vertical distance of about 1300 feet (Ref. 6, p. 8).

Before 1927, ore was carried to the mill by an aerial tramway from the 400-foot level (Ref. 6, p. 10). In 1927, the tramway head house was moved to the 900-foot level (Ref. 6, p. 10). The aerial tramway was abandoned in 1939 and ore was brought down inside the mine to the Dennis Creek (1600) level, crushed, and trammed in mine cars to the furnace plant (Ref. 6, p. 10).

Black Butte Mine was the second largest mercury-producing mine in Oregon (Ref. 8, p. 7). This mine and one other mine produced over half of the Oregon State's mercury production (Ref. 8, p. 3). Between 1900 and 1966, a total of 18,156 flasks of elemental mercury were produced at the mine (i.e., 1 flask equals 76 pounds) (Ref. 4, p. 14; Ref. 8, p. 7). Peak production occurred between the years 1927 to 1943 (Ref. 8, p. 7). After 1943, the mine operated intermittently until its last use in 1969 (Ref. 4, p. 13; Ref. 8, p. 7; Ref. 9, p. 11). The current owner, Land and Timber Company, has used the property for logging (Ref. 5, p. 9).

Tailings from the ore milling operations were deposited north (downhill) of one of the mills toward Dennis Creek (Ref. 4, p. 14).

The EPA has conducted a site inspection (SI) at the Black Butte Mine (Ref. 4). This investigation has been used to document the presence of hazardous substances in sources and/or targets. The sources included in this document are the tailings piles (Source 1), contaminated soil near the new furnace area (Source 2), and one mine adit (Source 3). Targets subject to actual contamination in the surface water migration pathway include a fishery, the Federal-listed threatened Upper Willamette River Chinook salmon Evolutionarily Significant Unit (ESU), and wetlands (see Section 4.1.3.3.2.2 for references).

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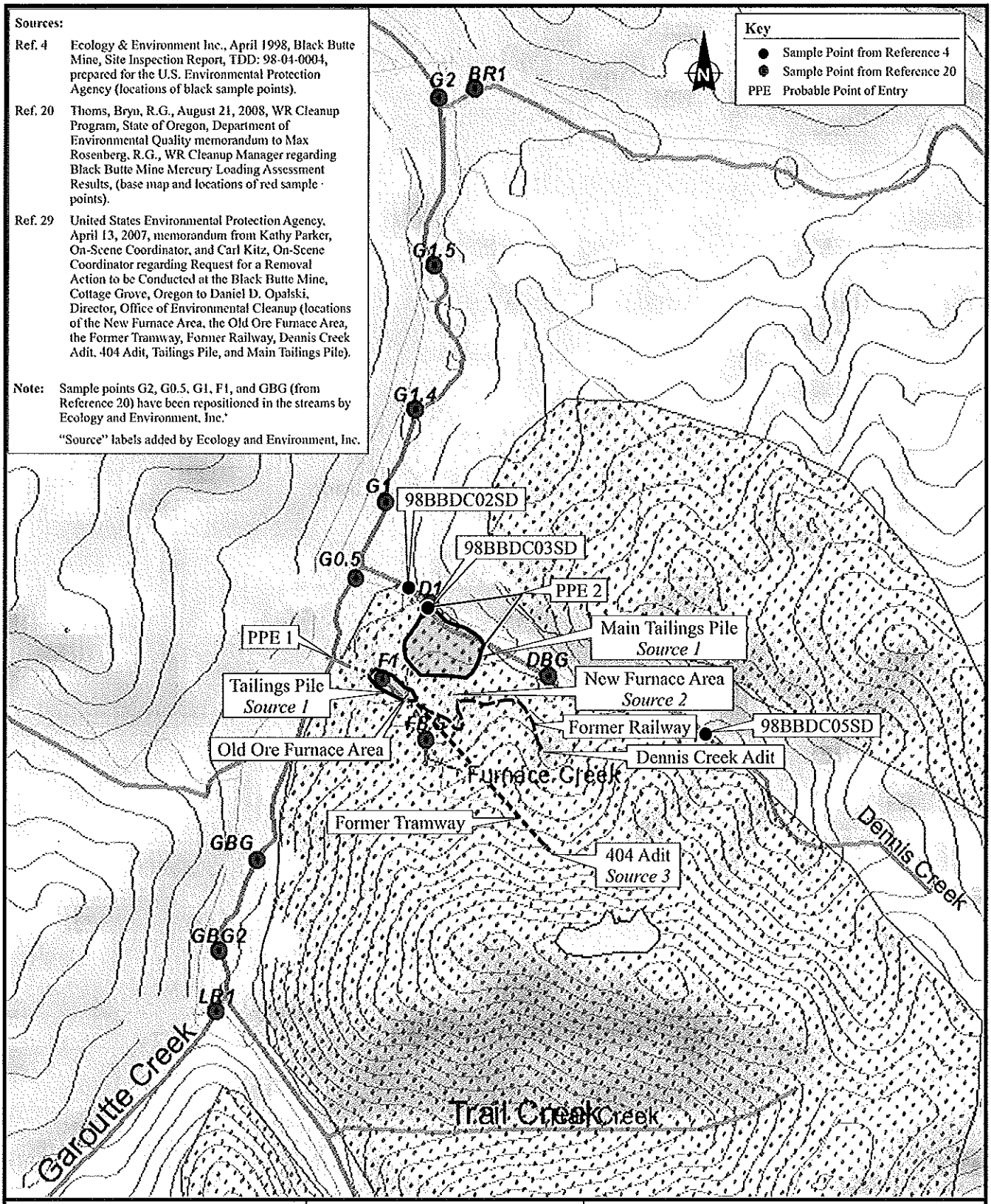

ecology and environment, inc.
International Specialists in the Environment
Seattle, Washington

BLACK BUTTE MINE
Lane County, Oregon

Figure 1
SITE MAP

Date:	Drawn by:	
7-14-09	AES	10:START-3\09020006\Fig 1

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SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Number of the Source: 1

Name and description of the source: Tailings Piles (Pile)
Source 1 consists of tailings piles which are present at Black Butte Mine near both the New Ore Furnace Area and the Old Ore Furnace Area. Tailings from the ore milling operations were deposited north (downhill) of one of the New Ore Furnace Area mills toward Dennis Creek (Ref. 4, p. 14). The tailings in the New Ore Furnace area (also referred to as the New Furnace Area in other documents [Ref. 5, p. 14]) form two "piles," essentially part of the same tailings deposit (also referred to as the Main Tailings Pile in other documents [Ref. 5, p. 12]), but separated by dense brush on the surface (Ref. 4, p. 14). The two "piles" include an "upper" pile (Upper Tailings Pile) and a "lower" pile (Lower Tailings Pile): the "upper" pile is immediately below a mill, while the "lower" pile has a north-facing slope which angles steeply downward toward Dennis Creek (Ref. 4, p. 14).

In the Old Ore Furnace Area, a thin layer of waste rock / tailings covers the majority of the immediately adjacent area (Ref. 5, p. 13). Historically, tailings were reportedly removed from this area and reprocessed through the New Furnace after it became operational (Ref. 5, p. 13). Further downslope from the Old Ore Furnace, tailings are thicker and may not have been reprocessed (Ref. 5, p. 13). These tailings appeared to have spilled into Furnace Creek (Ref. 5, p. 13). In the paragraphs below samples of tailings material are classified as soil samples for the purpose of identifying the appropriate analytical method; however, they are actually waste material.

EPA Site Inspection, 1998 (Ref. 4) –
In 1998, a Site Inspection was conducted by the EPA (Ref. 4, p. 13). During this investigation, two surface soil samples (98BBMT01SS and 98BBMT02SS) were collected from the Upper Tailings Pile; and four surface soil samples (98BBMT03SS through 98BBMT06SS) were collected from the Lower Tailings Pile (Ref. 4, p. 43). In addition, two subsurface soil samples (98BBMT01SB and 98BBMT02SB) were collected from the Upper Tailings Pile; and four subsurface soil samples (98BBMT03SB through 98BBMT06SB) were collected from the Lower Tailings Pile (Ref. 4, p. 43). Further, one background surface soil sample (98BBBG01SS); and one background subsurface soil sample (99BBBG01SB) were collected approximately 0.5 mile west of the mine for comparison to mine tailings samples (Ref. 4, pp. 32 and 38). Sample matrices were determined to be consistent with tailings material (Ref. 4, p. 32).

Surface soil samples were collected between 0 and 2 inches below ground surface (bgs) with the exception of the background sample which was collected from 0 to 6 inches bgs (Ref. 4, pp. 32 and 37). Subsurface soil samples were collected between 14 and 26 inches bgs (Ref. 4, p. 38). Surface soil samples were collected with clean, dedicated plastic spoons and transferred to a clean, dedicated plastic bowl for homogenization (Ref. 4, p. 22). Following thorough homogenization, the sample material was placed directly into pre-labeled sample containers (Ref. 4, p. 22). Subsurface soil sample 98BBMT01SB was collected by use of a powered auger to a depth of 20 inches bgs; followed by use of a decontaminated stainless steel hand auger (Ref. 10, p. 33). The other five subsurface soil samples (98BBMT02SB through 98BBMT06SB) were collected using only the decontaminated hand auger (Ref. 10, pp. 34, and 37 – 40). Following retrieval of subsurface soil in the decontaminated hand auger, the sample was collected with clean, dedicated plastic spoons and transferred to a clean, dedicated plastic bowl for homogenization (Ref. 10, pp. 33, 34, and 37 – 40). Following thorough homogenization, the sample material was placed directly into pre-labeled sample containers (Ref. 4, pp. 22 and 23). The hand auger was decontaminated using the following procedure: alconox and water wash, followed by a water rinse, followed by a nitric acid (HNO_3)-solution rinse, followed by a de-ionized water rinse; and then air dried (Ref. 10, p. 31).

Samples were analyzed for EPA Target Analyte List (TAL) inorganic elements using EPA Method 200.7 for antimony, beryllium, arsenic, cadmium, chromium, copper, manganese, nickel, vanadium, zinc (Ref. 4, pp. 107 – 118, 132, and 135), EPA Method 200.9 for lead (Ref. 4, pp. 107 - 118, 132, and 135), and EPA Method 245.5 for mercury (Ref. 4, pp. 153 – 158, 162 – 167, 181, and 183). Samples were hand delivered under chain-of-custody in coolers with ice to EPA's Region 10 Laboratory at Manchester, Washington (Ref. 4, pp. 21 and 23; Ref. 11, pp. 5

and 6). Data was validated following USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (Ref. 4, pp. 27, 89 through 95, and 192; Ref. 12). Analytical results document the presence of arsenic and mercury at significant concentrations in this source as presented in section 2.2.2 below.

EPA Removal Action, 2008 (Ref. 5) -
In 2007, field work for a Removal Action (RA) was conducted by the EPA (Ref. 5, p. 7). At this time, there had been no previous removal actions at Black Butte Mine (Ref. 5, p. 10). During this Removal Action earth work was conducted on waste rock and tailings along the northeast side of the Main Tailings Pile (where the tailings followed a steep angle down toward Dennis Creek) to decrease the angle of the slope in order to reduce the likelihood that tailings would continue to erode into Dennis Creek (Ref. 5, p. 64 and 65). Drainage benches, topsoil, slash, and straw bales were installed to minimize erosion and control the flow of water and sediment off the slopes and into Dennis Creek (Ref. 5, p. 64). This process involved the removal of a substantial volume of tailings from the slope (Ref. 5, pp. 64 and 65). These tailings were analyzed using an X-Ray Fluorescence (XRF) Analyzer to determine if the mercury concentration was less than the 115 milligrams per kilogram (mg/kg) Removal Action level for dermal contact and suitable for use as cover in other areas of the mine (Ref. 5, p. 65). The material that was not used as cover was placed on-site in an area designated as the repository (Ref. 5, p. 65). The removal activities did not involve treatment or disposal (Ref. 5, p. 23). Tailings that were removed from the Main Tailings Pile were used to cover areas around the Old Ore Furnace and the New Furnace areas that exceeded the 115 mg/kg Removal Action cleanup criteria for dermal exposure (Ref. 5, p. 65).

EPA Removal Assessment (Ref. 13) –
In 2005, a Removal Assessment was conducted on behalf of the EPA (Ref. 13, pp. 9 and 20). In the Removal Assessment report, the two tailings piles near the New Ore Furnace were designated as the "Main Tailings Pile" (i.e., previously termed the "Lower Tailings Pile") and the "New Furnace Area" (i.e., previously termed the "Upper Tailings Pile") (Ref. 13, pp. 19, 20, and 24). Eight soil borings (MP01, MP02, MP03, MP04, MP08, MP09, MP10, and MP11) were installed in the Main Tailings Pile and one (MP12) in the New Furnace Area (Ref. 13, pp. 20 and 24). In addition, three soil borings (MP05, MP06, and MP07) were installed in the Old Ore Furnace Area (Ref. 13, pp. 20 and 24).

A surface soil sample was collected at each boring location (Ref. 13, p. 20). Subsurface soil samples were collected utilizing a direct-push Geoprobe equipped with a 4-foot long MacroCore soil sampler (Ref. 13, p. 20). All samples were collected following the guidance of the Site-Specific Sampling Plan (Ref. 13, p. 20; Ref. 14, pp. 8, 93, 142, and 143). Field sampling notes are provided as Reference 34.

Each tailings soil sample was field screened for total mercury and total arsenic using an Innov-X Systems XRF Analyzer; and total mercury using a Lumex Mercury Analyzer (Lumex) (Ref. 13, p. 20). Selected samples were submitted to a fixed laboratory for metals analysis using EPA SW-846 Methods 6010 and 7471 for the analysis of arsenic and mercury, respectively (Ref. 13, pp. 98 through 109). Six subsurface tailings soil samples (MP01SS12, MP01SS20, MP05SS04, MP07SS04, MP09SS04, and MP12SS08) were submitted under chain-of-custody to the fixed laboratory (Ref. 13, pp. 42 and 43; Ref. 15, p. 1). All results were validated (Ref. 13, pp. 92, 93, 122, and 123). These samples consisted of three from the Main Tailings Pile (MP01SS12, MP01SS20, and MP09SS04), one from the New Furnace Area (MP12SS08), and two from the Old Ore Furnace Area (MP05SS04 and MP07SS04) (Ref. 13, pp. 42 and 43). Sample depths ranged from 0 to 20 feet bgs in the Main Tailings Pile (MP01SS12, MP01SS20, and MP09SS04), from 4 to 8 feet bgs in the New Furnace Area (MP12SS08), and from 0 to 4 feet bgs in the Old Ore Furnace Area (MP05SS04 and MP07SS04) (Ref. 13, pp. 42 and 43). All six samples contained arsenic and mercury (Ref. 13, pp. 42 and 43).

<u>Location of the source, with reference to a map:</u>
Tailings are present near Dennis Creek and near Furnace Creek (Ref. 32, p. 2).

Containment

Release to Surface Water via Overland Migration and/or Flood: The source consists of tailings piles. Tailings are exposed as indicated in SI photographs 1.12 and 2.5 through 2.8 (Ref. 4, pp. 66, 71, and 76). A surface water containment factor value of 10 is assigned because there is no evidence of maintained engineered cover, or functioning and maintained run-on control system and runoff management system (Ref. 1, p. 51609, Table 4-2; Ref. 4, p. 35; Ref. 5, pp. 74 – 76).

Containment Value: 10

2.2.2 HAZARDOUS SUBSTANCES ASSOCIATED WITH THE SOURCE

EPA Site Inspection (Ref. 4):

- Background Concentrations: For illustration purposes, "native" soil samples are presented to demonstrate that the levels of naturally occurring metals in the tailings are higher than they are in the surrounding surface soils, although this is not required for HRS scoring purposes. Also, although not required for HRS scoring purposes, estimated background sample concentrations were adjusted in the tables below per *EPA, November 1996, Using Qualified Data to Document an Observed Release and Observed Contamination, EPA/540/F-94/028* (Ref. 30) as a conservative approach to demonstrate the relative increase of contaminants in source samples over naturally occurring levels in background samples. One background surface soil sample and one background subsurface soil sample were collected during the EPA SI as presented in Table 1 below:

Table 1
EPA 1998 Site Inspection
Background Samples

Sample ID	Associated Source Sample	Date	Hazardous Substance	Hazardous Substance Concentration (mg/kg)	Sample Quantitation Limit (mg/kg)	Reference
Surface Soil Sample						
98BBBG01SS	98BBMT03SS 98BBMT04SS 98BBMT06SS	9/3/1998	Arsenic	68.5	0.10	Ref. 4, p. 132, Ref. 31, p. 3
Subsurface Soil Sample						
98BBBG01SB	98BBMT02SB 98BBMT03SB 98BBMT04SB 98BBMT06SB	9/3/1998	Arsenic	69.4	0.10	Ref. 4, pp. 135, 183, Ref. 31, p. 3
			Mercury	11.1 JK (20.3 AC)	0.10	

Key:
AC = Adjusted Concentration (Ref. 30, pp. 8 and 18).
JK = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is unknown (Ref. 4, p. 89).
mg/kg = milligrams per kilogram.

- Source Samples: Seven tailings samples collected during the EPA SI contained significant concentrations of hazardous substances as presented in Table 2 below:

Table 2
EPA 1998 Site Inspection
Source Samples

Sample ID	Date	Hazardous Substance	Hazardous Substance Concentration (mg/kg)	Sample Quantitation Limit (mg/kg)	Reference
Surface Tailings Samples					
98BBMT03SS	9/3/1998	Arsenic	269	0.10	Ref. 4, p. 109, Ref. 31, p. 3
98BBMT04SS	9/3/1998	Arsenic	348	0.10	Ref. 4, p. 110, Ref. 31, p. 3
98BBMT06SS	9/3/1998	Arsenic	382	0.10	Ref. 4, p. 112, Ref. 31, p. 3

Table 2 EPA 1998 Site Inspection Source Samples					
Sample ID	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration (mg/kg)**	**Sample Quantitation Limit (mg/kg)**	**Reference**
Subsurface Tailings Samples					
98BBMT02SB	9/3/1998	Arsenic	239	0.10	Ref. 4, pp. 114 and 163, Ref. 31, p. 3
		Mercury	148	0.10	
98BBMT03SB	9/3/1998	Arsenic	356	0.10	Ref. 4, p. 115, Ref. 31, p. 3
98BBMT04SB	9/3/1998	Arsenic	338	0.10	Ref. 4, p. 116, Ref. 31, p. 3
98BBMT06SB	9/3/1998	Arsenic	330	0.10	Ref. 4, p. 118, Ref. 31, p. 3
Key: mg/kg = milligrams per kilogram.					

EPA Removal Assessment (Ref. 13):

- Source Samples: Six tailings samples collected during the EPA Removal Assessment contained hazardous substances as presented in Table 3 below:

Table 3 EPA 2006 Removal Assessment Source Samples					
Sample ID	**Date**	**Hazardous Substance**	**Hazardous Substance Concentration (mg/kg)**	**Method Detection Limit (mg/kg)**	**Reference**
Subsurface Soil Samples					
MP01SS12	9/7/2005	Arsenic	197	0.957	Ref. 13, pp. 98 and 99; Ref. 15, p. 1
		Mercury	7.35	0.0881	
MP01SS20	9/7/2005	Arsenic	34.6	1.2	Ref. 13, pp. 100 and 101; Ref. 15, p. 1
		Mercury	0.808	0.00618	
MP05SS04	9/8/2005	Arsenic	118	1.17	Ref. 13, pp. 102 and 103, Ref. 15, p. 1
		Mercury	17.7	0.102	
MP07SS04	9/8/2005	Arsenic	17.7	1.08	Ref. 13, pp. 104 and 105; Ref. 15, p. 1
		Mercury	3.83	0.0488	
MP09SS04	9/9/2005	Arsenic	35.3	1.08	Ref. 13, pp. 106 and 107; Ref. 15, p. 1
		Mercury	5.42	0.0498	
MP12SS08	9/9/2005	Arsenic	7.33	1.15	Ref. 13, pp. 108 and 109; Ref. 15, p. 1
		Mercury	0.952	0.00476	
Key: mg/kg = milligrams per kilogram.					

List of Hazardous Substances Associated with Source

Arsenic and mercury.

2.4.2 Hazardous Waste Quantity

2.4.2.1.1 Hazardous Constituent Quantity

Available data are insufficient to document a hazardous constituent quantity (Ref. 1, p. 51590, Section 2.4.2.1.1).

Hazardous Constituent Quantity Value (S): NS

2.4.2.1.2 Hazardous Wastestream Quantity

Available data are insufficient to document a hazardous wastestream quantity (Ref. 1, p. 51591, Section 2.4.2.1.2).

Hazardous Wastestream Quantity (W): NS

2.4.2.1.3 Volume

Based on sampling information, the depth of tailings in both tailings piles is a minimum of 4 feet (Ref. 13, pp. 42 and 43). The total volume of tailings in the Main Tailings Pile is estimated to be 54,142.77 cubic yards; while the volume of tailings in the Furnace Creek Tailings Pile is estimated to be 11,915.6 cubic yards (Ref. 32, pp. 1 and 2). Summing these two values provides a total volume of tailings at Black Butte Mine of 66,058.37 cubic yards (Ref. 32, pp. 1 and 2).

The value assigned to the volume measure is calculated as follows:

66,058.37 cubic yards/2.5 = 26,423

Volume Assigned Value (V): 26,423
Ref. 1, p. 51591 Table 2-5

2.4.2.1.4 Area

Since the volume measure was determined, the area measure was not evaluated (Ref. 1, p 51591, Section 2.4.2.1.4).

Area Assigned Value (A): 0

Source Hazardous Waste Quantity Factor Value (Ref. 1, p. 51591): 26,423

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Number of the source: 2

Name and description of the source: New Furnace Area (Contaminated Soil)

Source 2 consists of contaminated soil in the area of the New Furnace (also referred to as the Former Mill/Rotary Kiln). In 2007, features at the New Furnace Area included a former mill structure containing a rotary kiln, mercury condenser, and ore storage/crushing equipment (Ref. 5, p. 9).

The highest concentrations of mercury were in the immediate area of the mill structure and furnace and were likely the result of localized spillage of elemental mercury during processing activities (Ref. 5, p. 14).

EPA Site Inspection, 1998 (Ref. 4) –
In 1998, a Site Inspection was conducted on behalf of EPA (Ref. 4, p. 11). During this investigation, six surface soil samples (98BBMK01SS through 98BBMK06SS) and four subsurface soil samples (98BBMK01SB through 98BBMK04SB) were collected from areas around and within the former mill/rotary kiln in the New Furnace Area (Ref. 4, pp. 36, 39, and 40). Further, one background surface soil sample (98BBBG02SS); and one background subsurface soil sample (99BBBG01SB) were collected approximately 0.5 mile west of the mine for comparison to samples collected from this area (Ref. 4, pp. 32, 33, 39, and 40). Sample matrices were determined to be consistent with material from the former mill/rotary kiln area (Ref. 4, p. 32).

Surface soil samples were collected between 0 and 2 inches bgs with the exception of the background sample which was collected from 0 to 6 inches bgs (Ref. 4, p. 32). Subsurface soil samples were collected between 10 and 24 inches bgs; with the exception of sample 98BBMK02SB which was collected underneath the mill through a trap door from 1 to 7 inches bgs (Ref. 4, p. 40; Ref. 10, pp. 42 and 43; Ref. 16, p. 23). This sample is considered to be a subsurface sample since this location was five feet below the mill foundation grade (Ref. 10, p. 43). Surface soil samples were collected with clean, dedicated plastic spoons and transferred to a clean, dedicated plastic bowl for homogenization (Ref. 4, p. 22). Following thorough homogenization, the sample material was placed directly into pre-labeled sample containers (Ref. 4, p. 22). Subsurface soil samples were collected using a decontaminated hand auger (Ref. 10, pp. 42, 43, and 44). Following retrieval of subsurface soil in the decontaminated hand auger, the sample was collected with clean, dedicated plastic spoons and transferred to a clean, dedicated plastic bowl for homogenization (Ref. 10, pp. 33, 42, 43, and 44). Following thorough homogenization, the sample material was placed directly into pre-labeled sample containers (Ref. 4, pp. 22 and 23). The hand auger was decontaminated using the following procedure: alconox and water wash, followed by a water rinse, followed by an HNO3-solution rinse, followed by a de-ionized water rinse; and then air dried (Ref. 10, p. 31).

Samples were analyzed for EPA TAL inorganic elements using EPA Method 200.7 for antimony, beryllium, arsenic, cadmium, chromium, copper, manganese, nickel, vanadium, zinc (Ref. 4, pp. 119 - 128), EPA Method 200.9 for lead (Ref. 4, pp. 119 - 128), and EPA Method 245.5 for mercury (Ref. 4, pp. 153 – 158, 162 – 167, 181, and 183). Samples were hand delivered under chain-of-custody in coolers with ice to EPA's Region 10 Laboratory at Manchester, Washington (Ref. 4, pp. 21 and 23; Ref. 11, pp. 3 – 7). Data was validated following USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (Ref. 4, pp. 27, 89 through 95, and 192; Ref. 12). Analytical results document the presence of arsenic, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc at significant concentrations in this source as presented in section 2.2.2 below.

EPA Removal Action, 2008 (Ref. 5) -
In 2007, field work for a Removal Action was conducted by the EPA (Ref. 5, p. 7). At this time, there had been no previous removal actions at Black Butte Mine (Ref. 5, p. 10). During this investigation, sampling and analyses of the tailings and soil around the New Furnace Area was completed using an XRF (Ref. 5, 14). Twenty-three samples (10EK-2001 through 10EK-2023) were collected to delineate the extent of mercury contamination above the

removal action level of 115 mg/kg (Ref. 5, p. 14). Total mercury concentrations as analyzed using an XRF ranged from 32.6 mg/kg to 1,630 mg/kg (Ref. 5, p. 14).

Tailings were removed from the Main Tailings Pile to cover areas around the New Furnace Area that exceeded the 115 mg/kg cleanup criteria for dermal exposure (Ref. 5, p. 65). Confirmation sampling and field analysis completed once the cap was in place confirmed that the capping material used was lower than the 115 mg/kg action level (Ref. 5, p. 65). The removal activities did not involve treatment or disposal (Ref. 5, p. 23).

Location of the source, with reference to a map:
The New Furnace Area (i.e., Former Mill/Rotary Kiln area) is located south of Dennis Creek and mine tailings (Ref. 4, pp. 19 and 44; Ref. 5, p. 28).

Containment:
Release to Surface Water via Overland Migration and/or Flood: The source is not covered, no engineered run-on or run-off controls exist, and no liner is known to be present (Ref. 4, p. 35). A surface water containment factor value of 10 is assigned (Ref. 1, p. 51610, Table 4-2).

Containment Value: 10

2.2.2 Hazardous Substances

EPA Site Inspection (Ref. 4):

- Background Concentrations: For illustration purposes, "native" soil samples are presented to demonstrate that the levels of naturally occurring metals soil near the New Furnace Area are higher than they are in the surrounding surface soils, although this is not required for HRS scoring purposes. Also, although not required for HRS scoring purposes, estimated background sample concentrations were adjusted in the tables below per *EPA, November 1996, Using Qualified Data to Document an Observed Release and Observed Contamination, EPA/540/F-94/028* (Ref. 30) as a conservative approach to demonstrate the relative increase of contaminants in source samples over naturally occurring levels in background samples. One background surface soil sample and one background subsurface soil sample were collected during the EPA SI as presented in Table 4 below:

Table 4
EPA 1998 Site Inspection
Background Samples

Sample ID	Associated Source Samples	Date	Hazardous Substance	Hazardous Substance Concentration (mg/kg)	Sample Quantitation Limit (mg/kg)	Reference
Surface Soil Sample						
98BBBG02SS	98BBMK01SS 98BBMK02SS 98BBMK03SS 98BBMK04SS 98BBMK05SS 98BBMK06SS	9/3/1998	Arsenic	18.8 JL (32.7 AC)	0.10	Ref. 4, pp. 133, 134, and 182, Ref. 31, p. 3
			Cadmium	0.23	0.20	
			Chromium	61.4	0.50	
			Copper	120	0.30	
			Lead	9.74	0.10	
			Mercury	5.48	0.10	
			Nickel	28.9	1.0	
			Vanadium	184	0.30	
			Zinc	105	0.40	
Subsurface Soil Sample						
98BBBG01SB	98BBMK01SB 98BBMK02SB 98BBMK03SB 98BBMK04SB	9/3/1998	Cadmium	0.20 U	0.20	Ref. 4, pp. 135 and 183, Ref. 31, p. 3
			Lead	4.93	0.10	
			Mercury	11.1 JK (20.3 AC)	0.10	
			Zinc	84.7	0.40	

Key:
AC = Adjusted Concentration (Ref. 30, pp. 8 and 18).
JK = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is unknown (Ref. 4, p. 89).
JL = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is low (Ref. 4, p. 89).
mg/kg = milligrams per kilogram.
U = The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit (Ref. 4, p. 95).

- Source Samples: Ten soil samples collected during the EPA SI contained significant concentrations of hazardous substances as presented in Table 5 below:

Table 5
EPA 1998 Site Inspection
Source Samples

Sample ID	Date	Hazardous Substance	Hazardous Substance Concentration (mg/kg)	Sample Quantitation Limit (mg/kg)	Reference
Surface Soil Samples					
98BBMK01SS	9/2/1998	Arsenic	270	0.10	Ref. 4, pp. 119 and 168, Ref. 31, p. 3
		Mercury	2550	0.10	
		Zinc	926	0.40	
98BBMK02SS	9/2/1998	Arsenic	145	0.10	Ref. 4, pp. 120 and 169, Ref. 31, p. 3
		Mercury	1800	0.10	
		Zinc	1170	0.40	
98BBMK03SS	9/2/1998	Arsenic	153	0.10	Ref. 4, pp. 121 and 170, Ref. 31, p. 3
		Cadmium	1.92	0.20	
		Lead	57.4	0.10	
		Mercury	2390	0.10	
		Zinc	2330	0.40	
98BBMK04SS	9/2/1998	Arsenic	952	0.10	Ref. 4, pp. 122 and 171, Ref. 31, p. 3
		Chromium	858	0.50	
		Copper	535	0.30	
		Mercury	54,300	0.10	
		Nickel	188	1.0	
		Vanadium	682	0.30	
98BBMK05SS	9/2/1998	Arsenic	183	0.10	Ref. 4, pp. 123 and 172, Ref. 31, p. 3
		Lead	31.1	0.10	
		Mercury	359	0.10	
		Zinc	454	0.40	
98BBMK06SS	9/2/1998	Arsenic	114	0.10	Ref. 4, pp. 124 and 173, Ref. 31, p. 3
		Lead	57.5	0.10	
		Mercury	174	0.10	
Subsurface Soil Samples					
98BBMK01SB	9/3/1998	Mercury	397	0.10	Ref. 4, p. 174, Ref. 31, p. 4
98BBMK02SB	9/3/1998	Cadmium	0.21	0.20	Ref. 4, pp. 128 and 175, Ref. 31, p. 4
		Lead	34.4	0.10	
		Mercury	237	0.10	
98BBMK03SB	9/3/1998	Mercury	91.9	0.10	Ref. 4, p. 176, Ref. 31, p. 4
98BBMK04SB	9/3/1998	Lead	51.7	0.10	Ref. 4, pp. 128, 177, Ref. 31, p. 4
		Mercury	264	0.10	
		Zinc	307	0.40	

Key:
mg/kg = milligrams per kilogram.

<u>List of Hazardous Substances Associated with Source</u>
Arsenic, cadmium, chromium, copper, lead, mercury, nickel, vanadium, and zinc.

2.4.2 Hazardous Waste Quantity
2.4.2.1.1 Hazardous Constituent Quantity

Available data are insufficient to document a hazardous constituent quantity (Ref. 1, p. 51590, Section 2.4.2.1.1).

Hazardous Constituent Quantity (S): NS

2.4.2.1.2 Hazardous Wastestream Quantity

Available data are insufficient to document a hazardous wastestream quantity (Ref. 1, p. 51591, Section 2.4.2.1.2).

Hazardous Wastestream Quantity (W): NS

2.4.2.1.3 Volume

Based on sampling information, the depth of contaminated soil samples 98BBMK01SB through 98BBMK04SB is a minimum of 16 inches bgs (Ref. 4, p. 37; Ref. 10, pp. 42 and 43; Ref. 16, p. 23). The total volume of contaminated soil present between contaminated sample points is estimated to be 10.49 cubic yards (Ref. 32, pp. 1 and 3). Since the mill building is present between these points, a conservative volume of greater than 0 is assigned.

Volume Assigned Value (V) : >0
Ref. 1, p. 51591 Table 2-5

2.4.2.1.4 Area

Since the volume measure was determined, the area measure was not evaluated (Ref. 1, p 51591, Section 2.4.2.1.4).

Area Assigned Value (A): 0

Source Hazardous Waste Quantity Factor Value: >0

SOURCE DESCRIPTION

2.2 SOURCE CHARACTERIZATION

Number of Source: 3

Name and Description of the Source: Mine Adit (other)

Source 3 consists of a mine adit. Two adits exist at the site; the Dennis Creek Adit and the 404 Adit (Ref. 29, p. 20). One of these is filled with water which discharges onto the ground surface at an estimated rate of approximately 1 gallon per minute (Ref. 4, p. 35).

EPA Site Inspection, 1998 (Ref. 4) –
In 1998, a Site Inspection was conducted on behalf of the EPA (Ref. 4, p. 11). During this investigation, one water sample (98BBMA01SW) and one sediment sample (98BBMA01SD) were collected from one of the mine adits (Ref. 4, pp. 36, 41 and 42). The name of the adit is not provided in the Site Inspection report; however, the adit appears to the be the 404 adit based on a comparison of a Site Inspection map showing the sampled adit's location to a map from another document showing both adits locations (Ref. 4, p. 60; Ref. 29, p. 20). One background sediment sample (99BBDC05SD) was collected for comparison to the sediment sample collected from the adit (Ref. 4, p. 42). Sample 99BBDW07GW, collected from a spring at the mine, will be used as the background sample for comparison to the adit water sample (Ref. 4, p. 54).

The adit water and spring samples were collected by hand-dipping the sample container into the water to a depth of 2 inches below the water surface (Ref. 4, pp. 21 and 22). The water sample was collected prior to the sediment sample (Ref. 4, p. 21). During the collection of all surface water samples, care was taken to avoid introduction of sediment into the sample containers (Ref. 4, p. 21). The adit sediment and background sediment samples were collected between 0 and 2 inches bgs (Ref. 4, p. 42). Sediment sample material was collected using clean, dedicated plastic spoons, and placed directly into clean, dedicated, plastic mixing bowls for homogenization (Ref. 4, p. 22). Following thorough homogenization, the sediment was transferred to prelabeled 8-ounce glass jars (Ref. 4, p. 22).

Samples were analyzed for EPA TAL inorganic elements using EPA Method 200.7 for antimony, beryllium, arsenic, cadmium, chromium, copper, manganese, nickel, vanadium, zinc (Ref. 4, pp. 105, 106, 202, and 220), EPA Method 200.8/200.9 for lead (Ref. 4, pp. 105, 106, 202, and 220), and EPA Method 245.1/245.5 for mercury (Ref. 4, pp. 151, 152, 202, and 220). Samples were hand delivered under chain-of-custody in coolers with ice to EPA's Region 10 Laboratory at Manchester, Washington (Ref. 4, pp. 21 and 22; Ref. 11, pp. 1, 3, and 5). Data was validated following USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (Ref. 4, pp. 27, 89 through 95, and 192; Ref. 12). Analytical results document the presence of antimony, beryllium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc at significant concentrations in this source as presented in section 2.2.2 below.

Location of the source, with reference to a map:
The mine adit is located south of Dennis Creek and other mine features (Ref. 4, pp. 19 and 60; Ref. 29, p. 20).

Containment:
Release to Surface Water via Overland Migration and/or Flood: No run-on or run-off controls exist at the mine adit (Ref. 4, p. 35). The open mine adit is filled with water which discharges to the ground surface, through a drainage ditch to a culvert, then downslope toward a intermittent tributary to Dennis Creek (Ref. 4, pp. 35, 45, 49, and 60). A containment factor value of 10 is assigned (Ref. 1, p. 51609, Table 4-2; Ref. 4, p. 35).

Containment Value: 10

2.2.2 Hazardous Substances

EPA Site Inspection (Ref. 4):

- Background Concentrations: For illustration purposes, "native" water and sediment samples are presented to demonstrate that the levels of naturally occurring metals at the adit are higher than they are in the surrounding areas, although this is not required for HRS scoring purposes. Also, although not required for HRS scoring purposes, estimated sample concentrations were adjusted in the tables below per *EPA, November 1996, Using Qualified Data to Document an Observed Release and Observed Contamination, EPA/540/F-94/028* (Ref. 30) as a conservative approach to demonstrate the relative increase of contaminants in source samples over naturally occurring levels in background samples. One background spring water sample and one background sediment sample were collected during the EPA Site Inspection as presented in Table 6 below:

Table 6
EPA 1998 Site Inspection
Background Samples

Sample ID	Associated Source Samples	Date	Hazardous Substance	Hazardous Substance Concentration	Sample Quantitation Limit	Reference
Water Sample						
98BBDW07GW	98BBMA01SW	9/2/1998	Antimony	0.63 U ug/L	0.63	Ref. 4, p. 202, Ref. 31, p. 4
			Chromium	6.3 U ug/L	6.3	
			Cobalt	6.3 U ug/L	6.3	
			Copper	3.8 U ug/L	3.8	
			Manganese	20.1 ug/L	1.3	
			Nickel	13 U ug/L	13	
Sediment Sample						
98BBDC05SD	98BBMA01SD	9/2/1998	Beryllium	0.85 mg/kg	0.10	Ref. 4, pp. 105 and 151, Ref. 31, p. 4
			Cobalt	20.6 mg/kg	0.50	
			Copper	71.7 mg/kg	0.30	
			Lead	3.27 mg/kg	0.10	
			Manganese	1160 mg/kg	0.10	
			Mercury	1.41 JH mg/kg	0.10	
			Nickel	23.5 mg/kg	1.0	
			Zinc	72.6 mg/kg	0.40	

Key:
JH = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is high (Ref. 4, p. 89).
mg/kg = milligrams per kilogram.
U = The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit (Ref. 4, p. 95).
ug/L = micrograms per liter.

- Source Samples: Two adit samples collected during the EPA Site Inspection contained significant concentrations of hazardous substances as presented in Table 7 below:

Table 7
EPA 1998 Site Inspection
Source Samples

Sample ID	Date	Hazardous Substance	Hazardous Substance Concentration	Sample Quantitation Limit	Reference
Water Sample					
98BBMA01SW	9/3/1998	Antimony	1.6 ug/L	0.63	Ref. 4, p. 220, Ref. 31, p. 4
		Chromium	18 ug/L	6.3	
		Cobalt	11 ug/L	6.3	
		Copper	13.5 ug/L	3.8	
		Manganese	508 ug/L	1.3	
		Nickel	34 ug/L	13	
Sediment Sample					
98BBMA01SD	9/3/1998	Beryllium	10.8 mg/kg	0.10	Ref. 4, pp. 106 and 152, Ref. 31, p. 4
		Cobalt	325 mg/kg	0.50	
		Copper	967 mg/kg	0.30	
		Lead	25.9 mg/kg	0.10	
		Manganese	8320 mg/kg	0.10	
		Mercury	21.0 JH (11.5 AC)	0.10	
		Nickel	168 mg/kg	1.0	
		Zinc	297 mg/kg	0.40	

Key:
mg/kg = milligrams per kilogram.
ug/L = micrograms per liter.

<u>List of Hazardous Substances Associated with Source</u>

Antimony, beryllium, chromium, cobalt, copper, lead, manganese, mercury, nickel, and zinc.

2.4.2 Hazardous Waste Quantity
2.4.2.1.1 Hazardous Constituent Quantity

Available data are insufficient to document a hazardous constituent quantity (Ref. 1, p. 51590, Section 2.4.2.1.1).

Hazardous Constituent Quantity (S): NS

2.4.2.1.2 Hazardous Wastestream Quantity

During the EPA SI conducted from August 31 to September 3, 1998, flow at the adit was estimated to be 1 gallon per minute (Ref. 4, pp. 21 and 35). Using this estimate the discharge over 4 days is estimated as follows:

> 1 gallon per minute x 60 minutes per hour x 24 hours per day = 1,440 gallons per day x 4 days of the field event = 5,760 gallons

This value is converted from gallons to pounds as follows (Ref. 1, p. 51591):

> 5,760 gallons X 10 pounds per gallon = 57,600 pounds

The value assigned to the Hazardous Wastestream Quantity is calculated as follows (Ref. 1, p. 51591):

> 57,600 pounds / 5,000 = 11.52

Since it can be expected that the adit continued to flow over several weeks or months, this 4 day estimate is conservative.

Hazardous Wastestream Quantity (W): 11.52

2.4.2.1.4 Volume

Since the Hazardous Wastestream Quantity was used, the volume measure was not evaluated (Ref. 1, p 51591, Section 2.4.2.1.4).

Volume Assigned Value (V): 0

2.4.2.1.4 Area

Since the Hazardous Wastestream Quantity was used, the area measure was not evaluated (Ref. 1, p 51591, Section 2.4.2.1.4).

Area Assigned Value (A): 0

Source Hazardous Waste Quantity Factor Value: 11.52

Table 8
Summary of Source Descriptions

Source Number	Source Hazardous Waste Quantity Value [a]	Source Hazardous Constituent Quantity Complete? (Y/N)	Containment Value for Surface Water [b]
1. Tailings Piles	26,423	N	10
2. Contaminated Soil	>0	N	10
3. Adit	11.52	N	10

[a] See section 2.2 of this document.
[b] Ref. 1, pp. 51609, 51610, Table 4-2.

2.12 Other Possible Sources

Old Furnace Area - A thin layer of waste rock / tailings covers the majority of the area immediately adjacent to the Old Ore Furnace (Ref. 5, p. 13). Tailings were reportedly removed and reprocessed through the New Furnace after it became operational (Ref. 5, p. 13). Further downslope from the Old Ore Furnace tailings are thicker and may not have been reprocessed (Ref. 5, p. 13). These tailings appeared to have spilled into Furnace Creek (Ref. 5, p. 13).

During a Removal Action completed on behalf the EPA in 2008, sampling and analyses of the tailings and soil near the Old Ore Furnace Area was completed using an XRF (Ref. 5, p. 13). Total mercury concentrations as analyzed using an XRF ranged from non-detect (or less than 12.4 mg/kg) to 10,500 mg/kg (Ref. 5, p. 13). Seventy-five of a total of 80 samples collected immediately adjacent as well as upslope of the Old Ore Furnace were above the action level of 23 mg/kg (Ref. 5, pp. 13 and 14).

Tailings were removed from the Main Tailings Pile to cover areas around the Old Ore Furnace Area that exceeded the 115 mg/kg cleanup criteria for dermal exposure (Ref. 5, p. 65). Samples that were collected once the cap was in-place confirmed that total mercury in the capping material was below the 115 mg/kg action level (Ref. 5, p. 65). Total mercury concentrations in cap confirmation samples ranged from non-detect (or less than 12.5 mg/kg) to 22.9 mg/kg; below the 115 mg/kg action level (Ref. 5, p. 14). The removal activities did not involve treatment or disposal (Ref. 5, p. 23).

Mine Roads – Several of the roads that traverse the mine appear to have been surfaced with the reddish mine tailings (Ref. 17, p. 10). Road building for logging efforts apparently made extensive use of the tailings (Ref. 17, p. 10). A failing portion of one of the main roads at the mine clearly showed use of the distinct reddish mine tailings that appeared to have been used over the years for roads at the mine (Ref. 17, p. 10). Samples from the roads at the mine have not been collected; however, as presented in Source 1 (Section 2.2), mine tailings contain arsenic and mercury at significant concentrations.

Dennis Creek Adit – This adit has not been previously sampled. This adit may be another source of hazardous substance at the site.

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1 GENERAL CONSIDERATIONS

4.1.1.1 Definition of Hazardous Substance Migration Path for Overland/Flood Component

The mine is bordered to the northeast by Dennis Creek, to the southwest by Furnace Creek (an intermittent stream), and to the northwest by Garoutte Creek (Ref. 3). Both Dennis Creek and Furnace Creek flow west–northwest to Garoutte Creek which flows northward approximately six miles to the Coast Fork Willamette River (Ref. 3; Ref. 18). The Coast Fork Willamette River empties into Cottage Grove Reservoir (Ref. 18).

Cottage Grove Reservoir is a U.S. Army Corps of Engineers flood-control reservoir (Ref. 19, p. 6). The reservoir was constructed in 1942, with the intent to regulate the flow of the headwaters of the Coast Fork Willamette River (Ref. 19, p. 6). The reservoir is seasonally managed for flood control, conservation storage, and water release to downstream areas (Ref. 19, p. 6). The beneficial uses of the reservoir include resident fish and aquatic life, water contact recreation, fishing, and aesthetics (Ref. 19, p. 6).

Fishing is known to occur on Garoutte Creek, the Coast Fork Willamette River, and Cottage Grove Reservoir; and the threatened Spring Chinook salmon and wetlands are present within the Surface Water Migration Pathway (see Sections 4.1.3.3 and 4.1.3.4 below).

4.1.1.2 Target Distance Limit

Two probable points of entry (PPEs) to surface water exist. The PPEs are present where Furnace Creek enters Garoutte Creek (PPE 1) and where mine tailings are in contact with Dennis Creek (PPE 2) (see Section 4.1.2.2.1 below). These PPEs are somewhat different from those indicated in the Site Inspection report (Ref. 4, pp. 49 and 60). The surface water migration pathway target distance limit (TDL) begins at PPE 1 located at the mouth of Furnace Creek downstream to the mouth of Dennis Creek, then 1.15 miles in Garoutte Creek to the Coast Fork Willamette River, then 7.56 miles from the Coast Fork Willamette River to Cottage Grove Reservoir, then 2.92 miles within the reservoir, ending 3.17 miles downstream in the Coast Fork Willamette River (Ref. 18). PPE 2 is 0.23 mile of tailings in contact with Dennis Creek (Ref. 18). The TDL includes this PPE and also the portion of Dennis Creek downstream 0.2 mile from PPE 2 to Garoutte Creek (Ref. 18).

In June 2008, the flow rate of Dennis Creek was estimated to be 0.915 cubic feet per second (cfs), Garoutte Creek downstream of Dennis Creek to be 19.6 cfs, and Coast Fork Willamette River to be 53.28 cfs at a location (i.e., CFW1) approximately 3,000 feet upstream of Cottage Grove Reservoir (Ref. 20, pp. 8 and 9). Cottage Grove Reservoir is a dammed section of the Coast Fork Willamette River (Ref. 4, p. 49). In 1986, the average annual flow rate of the Coast Fork Willamette River above the reservoir at London, Oregon was 180 cfs; and below the reservoir it was 252 cfs (Ref. 21, pp. 2 and 4). For HRS scoring purposes, it is estimated that the average annual flow rate of the reservoir is between 100 and 1,000 cfs. In 2006, the year of the most recent recorded flow rate, the average annual flow rate of the Coast Fork Willamette River below Cottage Grove Dam was 356 cfs (Ref. 21, p. 5).

4.1.2.1 LIKELIHOOD OF RELEASE

4.1.2.1.1 Observed Release

Direct Observation

Basis for Direct Observation:

EPA Site Inspection (Ref. 4): In 1998, field work for an SI was conducted for the EPA at the Black Butte Mine (Ref. 4, pp. 11 and 21). During this investigation, it was observed that mine tailings were present in Dennis Creek (Ref. 10, pp. 15 and 16). Samples of tailings from this area contained arsenic and mercury (see Source 1).

ODEQ Preliminary Assessment (Ref. 17): In 1996, ODEQ visited the Black Butte Mine as a component of a Preliminary Assessment (Ref. 17, p. 10). At that time, part of the toe of the tailings pile were observed to slope directly into Dennis Creek at a very steep angle; and appeared to be eroding directly into the creek (Ref. 17, p. 10). The tailings were observed to front the creek for approximately 600 feet (Ref. 17, p. 10). A gravel bed in the creek showed signs of the red-colored ore at a location downstream from the tailings pile (Ref. 17, p. 10). Samples of tailings from this area contained arsenic and mercury (see Source 1).

Chemical Analysis

EPA Site Inspection, 1998 (Ref. 4) –
In 1998, a Site Inspection was conducted on behalf of the EPA (Ref. 4, p. 11). During this investigation, four sediment samples (98BBDC01SD through 98BBDC04SD) and one background sediment sample (98BBDC05SD) were collected from Dennis Creek (Ref. 4, pp. 50 and 51). The background sediment sample (99BBDC05SD) was collected on Dennis Creek, upstream of mine features (Ref. 4, p. 60).

The sediment samples were collected between 0 and 2 inches bgs (Ref. 4, p. 56). Sediment sample material was collected using clean, dedicated plastic spoons, and placed directly into clean, dedicated, plastic mixing bowls for homogenization (Ref. 4, p. 22). Following thorough homogenization, the sediment was transferred to prelabeled 8-ounce glass jars (Ref. 4, p. 22).

Samples 98BBDC01SD through 98SSDC05SD were analyzed for EPA TAL inorganic elements using EPA Method ILM 4.0 (Ref. 4, p. 23) and for mercury by Method 245.5 (Ref. 4, pp. 143, 145, 149, and 150 – 151). Samples were hand delivered under chain-of-custody in coolers with ice to EPA's Region 10 Laboratory at Manchester, Washington (Ref. 4, pp. 21 and 23; Ref. 11, pp. 2 – 4). Data was validated following USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (Ref. 4, p. 27; Ref. 12). Analytical results document the presence of mercury at elevated concentrations in Dennis Creek as presented in Tables 9 and 10 below.

Table 9
EPA 1998 Site Inspection
Background Sample Concentrations

Sample ID	Sample Medium	Sample Location	Date	Hazardous Substance	Concentration (mg/kg)	Sample Quanti-tiation Limit (mg/kg)	References
98BBDC05SD	Sediment	Dennis Creek	9/2/98	Mercury	1.41 JH	0.10	Ref. 4, p. 151; Ref. 31, p. 4

Key:
JH = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is high (Ref. 4, p. 89).
mg/kg = milligrams per kilogram.

Table 10 EPA 1998 Site Inspection Dennis Creek Observed Release Sample Concentrations						
Sample ID	**Sample Location**	**Date**	**Hazardous Substance**	**Concentration (mg/kg)**	**Sample Quantitation Limit (mg/kg)**	**References**
98BBDC03SD	Dennis Creek at PPE 1	9/2/98	Mercury	48.0 JH (26.23 AC)	0.10	Ref. 4, p. 149

Key:
AC = Concentration (Ref. 30, pp. 8 and 18).
JH = The associated numerical value is an estimated quantity (Ref. 4, p. 95). The bias of the estimated value is high (Ref. 4, p. 89).
mg/kg = milligrams per kilogram.

ODEQ Mercury Loading Assessment, 2008 (Ref. 20): In June 2008, the ODEQ conducted an assessment of the various tributaries in the Coast Fork Willamette River watershed above the Cottage Grove Reservoir to determine the relative mercury contribution from them (Ref. 20, p. 1). Results of the assessment were used to provide a quantitative evaluation of the need for further cleanup work on Furnace Creek at the former Black Butte Mine and thus support a recommendation to list the mine on EPA's National Priorities List and refer the project to EPA's Remedial Program for further assessment and cleanup (Ref. 20, p. 1). The surface water assessment was conducted following an ODEQ-approved workplan (Ref. 20, pp. 1 and 63 through 72). Field notes are provided as Reference 33. The following is a partial summary of what data were collected and why:

- Mercury in Surface Water – Twenty-one surface water samples were collected for total mercury analysis using EPA Method 1631E with a detection limit of 5 nanograms per liter (ng/L) (Ref. 20, p. 1). Samples were collected from various tributaries throughout the watershed and results were used to calculate mercury loads from each of the tributaries (Ref. 20, pp. 1, 22, and 23).
- Mercury in Sediment - Twenty sediment samples were collected for mercury analysis using EPA Method 7471A with a detection limit of 0.1 mg/kg (Ref. 20, pp. 1 and 24). Sediment samples were co-located with surface water samples to qualitatively identify mercury loads within each of the tributaries (Ref. 20, p. 1).

Of these samples, two co-located surface water/sediment samples were collected from Dennis Creek (Ref. 20, pp. 1 and 9). These were at sample location D1, positioned downstream of the main tailings pile; and sample location DBG, the background sample for this stream (Ref. 20, p. 3). The background sample location was from an area that may be affected by both the mineralized soil and potential minor mine-related sources (Ref. 20, p. 3).

Further, seven co-located surface water/sediment samples were collected from Garoutte Creek (Ref. 20, pp. 1, 3 and 9). Two locations, GBG and GBG2, were selected to represent background conditions (Ref. 20, p. 3). The remaining five locations were as follows:

- G0.5 - about 200 feet downstream of the confluence of Furnace Creek and Garoutte Creek;
- G1 - about 50 feet downstream of the confluence of Dennis Creek and Garoutte Creek;
- G1.4 - about 1,200 feet downstream of the confluence of Dennis Creek and Garoutte Creek;
- G1.5 - about 3,000 feet downstream of the confluence of Dennis Creek and Garoutte Creek; and
- G2 - about 4,000 feet downstream of the confluence of Dennis Creek and Garoutte Creek (Ref. 20, p. 3).

Surface water samples were collected directly into sample jars by placing the open jar beneath the water in an area of the stream that best approximated the whole stream channel environment, and where the sample jar could be placed in the stream without disturbing the sediment (Ref. 20, p. 70). Surface water samples were preserved with HCl prior to shipment to the laboratory (Ref. 20, pp. 33, 34, 47, 48, and 61). Sediment samples were collected after the water samples in order to reduce potential turbidity impacts to the water samples (Ref. 20, p. 70). Sediment samples were collected using new, disposable plastic scoops (Ref. 20, p. 70). Attempts were made to pour off

supernatant water in each scoop, without loss of fine-grained particles, before transferring the sediment to the sample jar (Ref. 20, p. 70).

Sample material was placed in certified clean jars provided by the laboratory, labeled, and placed on ice in a cooler (Ref. 20, p. 70). All samples were shipped to the laboratory under chain-of-custody (Ref. 20, pp. 33, 34, 47, 48, and 61). Analytical results document the presence of mercury at elevated concentrations in Dennis Creek and Garoutte Creek as presented in Tables 11 through 14 below.

Background Samples -

Table 11
ODEQ 2008 Mercury Loading Assessment
Background Samples

Sample ID	Sample Medium	Sample Location	Date	References
DBG – Sediment	Sediment	Dennis Creek	6/23/08	Ref. 20, p. 33
GBG - Sediment	Sediment	Garoutte Creek	6/25/08	Ref. 20, p. 47
GBG2 - Sediment	Sediment	Garoutte Creek	6/25/08	Ref. 20, p. 47

Table 12
ODEQ 2008 Mercury Loading Assessment
Background Sample Concentrations

Sample ID	Hazardous Substance	Concentration	Method Reporting Limit	References
DBG - Sediment	Mercury	4.82 mg/kg	0.314 mg/kg	Ref. 35, p. 6
GBG - Sediment	Mercury	1.92 mg/kg	0.0348 mg/kg	Ref. 35, p. 19
GBG2 - Sediment	Mercury	0.0517 mg/kg	0.0276 mg/kg	Ref. 35, p. 19

Key:
ND = Not detected.
mg/kg = milligrams per kilogram.

Release Samples -

Table 13
ODEQ 2008 Mercury Loading Assessment
Contaminated Samples

Sample ID	Sample Medium	Sample Location	Distance from PPE	Date	References
D1 - Sediment	Sediment	Dennis Creek	At PPE 1	6/23/08	Ref. 20, pp. 9 and 33
G0.5 - Sediment	Sediment	Garoutte Creek	0.04 mile downstream of PPE 2	6/25/08	Ref. 20, pp. 9 and 47

Table 14 ODEQ 2008 Mercury Loading Assessment Observed Release Sample Concentrations				
Sample ID	**Hazardous Substance**	**Concentration**	**Method Reporting Limit**	**References**
D1 - Sediment	Mercury	49.4 mg/kg	0.992 mg/kg	Ref. 35, p. 6
G0.5 - Sediment	Mercury	159 mg/kg	2.78 mg/kg	Ref. 35, p. 19
Key: mg/kg = milligrams per kilogram.				

OSU and East Tennessee State University (ETSU), Mercury Distribution in Sediment and Bioaccumulation by Fish in Two Oregon Reservoirs: Point-Source and Nonpoint-Source Impacted Systems, 1997 – In 1997, mercury pollution was compared in two Oregon reservoirs of similar size and age, located within the same ecoregion (Ref. 23, p. 1). Cottage Grove Reservoir is distinguished by a history of mercury mining and processing within its watershed, while Dorena Reservoir was not (Ref. 23, p. 1). Mercury concentrations in sediments of the reservoirs, tributary streams, and three species of fish were measured (Ref. 23, p. 1). In total ten sediment samples were collected from the Cottage Grove Reservoir and its tributaries as follows: five from within the reservoir; one each from the mouths of the Coast Fork Willamette River, Wilson Creek, Cedar Creek, and Williams Creek; and one from below the Cottage Grove dam in the Coast Fork Willamette River (Ref. 23, p. 3 [Figure 2]). Similarly, a total of ten sediment samples were collected from Dorena Reservoir and its tributaries as follows: four from within the reservoir; one each from the mouths of the Row River, Vaughn Creek, Bluff Creek, Teeter Creek, and Rat Creek; and one from below the Dorena Reservoir dam (Ref. 23, p. 4 [Figure 3]).

Samples from the Dorena Reservoir will be used to establish background concentrations for comparison to samples from Cottage Grove Reservoir for the following reasons:

- It is in the same ecoregion as the Cottage Grove Reservoir;
- Drainage basin and limnological characteristics of these reservoirs are similar and representative of reservoirs of similar size within the ecoregion; and
- Both reservoirs were established in the 1940s (Ref. 23, p. 1).

During this investigation, duplicate sediment samples were collected from 10 sites at each reservoir in March 1994 with an Ekman dredge (Ref. 23, p. 1). Sediment samples were placed in acid-pretreated I-Chem jars, placed on ice, and stored frozen in the laboratory until analysis (Ref. 23, p. 2). Sediment samples were analyzed for mercury as outlined in Allen-Gil *et al.* (Ref. 23, p. 2). Analytical results documenting the presence of mercury at elevated concentrations in sediment samples is presented in Tables 15 and 16 below. Since mercury has a high affinity for fine-grained particulates (Ref. 23, p. 6), samples have been separated by grain size in these tables with background and release samples of like grain size being compared to one another for determining observed releases.

Table 15 OSU and ETSU 1995 Background Sample Concentrations				
Sample ID	**Location**	**Hazardous Substance**	**Concentration (ug/g)**	**Reference**
Silty Sand Sediment				
A	Row River	Mercury	0.14	Ref. 23, p. 4 (Figure 3)
I	Dorena Reservoir	Mercury	0.11	Ref. 23, p. 4 (Figure 3)
D	Dorena Reservoir Outflow	Mercury	0.12	Ref. 23, p. 4 (Figure 3)
Silt with Sand Sediment				
G	Dorena Reservoir	Mercury	0.21	Ref. 23, p. 4 (Figure 3)
H	Dorena Reservoir	Mercury	0.17	Ref. 23, p. 4 (Figure 3)
Sandy Clay Sediment				
J	Dorena Reservoir	Mercury	0.22	Ref. 23, p. 4 (Figure 3)
Key: ug/g = micrograms per gram.				

Table 16 OSU and ETSU 1995 Observed Release Sample Concentrations					
Sample ID	**Location**	**Distance from PPE**	**Hazardous Substance**	**Concentration (ug/g)**	**Reference**
Silty Sand Sediment					
A	Coast Fork Willamette River	8.68 miles from PPE 1	Mercury	0.83	Ref. 23, p. 3 (Figure 2); Ref. 22
Silt with Sand Sediment					
H	Cottage Grove Reservoir	10.52 miles from PPE 1	Mercury	0.68	Ref. 23, p. 3 (Figure 2); Ref. 22
Sandy Clay Sediment					
I	Cottage Grove Reservoir	10.93 miles from PPE 1	Mercury	1.03	Ref. 23, p. 3 (Figure 2); Ref. 22
J	Cottage Grove Reservoir	11.38 miles from PPE 1	Mercury	1.11	Ref. 23, p. 3 (Figure 2); Ref. 22
D	Cottage Grove Reservoir Outflow	11.54 miles from PPE 1	Mercury	1.75	Ref. 23, p. 3 (Figure 2); Ref. 22
Key: ug/g = micrograms per gram.					

Attribution:

As demonstrated in Section 2.2, several hazardous substances are present in the three sources (i.e., Sources 1, 2, and 3) with containment values greater than 0 at Black Butte Mine including arsenic and mercury which also are present in observed releases to Dennis Creek (see Section 4.1.2.1.1). No other mines are present on Dennis Creek or Furnace Creek (Ref. 3). For this reason, Black Butte Mine is the only mine that would be contributing to contamination in those streams. Based on a topographic map of the area, no other mines appear to be present upstream of the Black Butte Mine (Ref. 3).

EPA RA, 2008 - Mercury occurs naturally at Black Butte Mine in mercury-bearing ore (Ref. 5, p. 17). The distribution of mercury throughout Black Butte Mine, however is primarily the result of the mining operations that occurred from the late 1890s through the late 1960s (Ref. 5, p. 17).

The primary ore mineral at the mine was cinnabar, a mercuric sulfide (Ref. 5, p. 17). The extraction and processing of the mercury-bearing ore (including roasting of crushed ore) alters the mercury-bearing ore both physically and chemically (Ref. 5, pp. 17 and 18). Physically, the materials left after processing (waste rock and particularly tailings) are more vulnerable to mechanical movement through natural processes due to the smaller grain-size and are in unstable settings, such as in huge piles with steep slopes adjacent to rivers and creeks (Ref. 5, p. 18). Chemically, some of the mercury sulfide in the mercury-bearing ore is converted into other forms of mercury that are more reactive and more soluble and therefore more mobile in the environment (Ref. 5, p. 18).

During the removal assessment, analyses were completed to determine the species and solubility of mercury present on site (Ref. 5, p. 18). Based on the low concentrations of total mercury in leachates produced using Synthetic Precipitation Leaching Procedure and on the low solubility of the predominant mercury species indicated by sequential selective extraction, the main mechanism for the transportation of mercury in the environment at Black Butte Mine was determined to be mechanical (i.e. erosion) (Ref. 5, p. 18).

ODEQ Mercury Loading Assessment, 2008 – In 2008, ODEQ conducted a mercury loading assessment on various tributaries in the Coast Fork Willamette River watershed above Cottage Grove Reservoir (Ref. 20, p. 1). Mercury loading calculations were based on the principle that a one-time mercury concentration within a stream can be multiplied by the stream discharge at the time of sample collection to get a mass of mercury within the stream (Ref. 20, p. 67). This assessment noted that a one-time sample collected during spring base flow was not necessarily representative of the whole year due to the variety of discharging related to precipitation fluctuations (Ref. 20, p. 68). However, this study determined that spring base flow (i.e., non-storm-related discharge in the spring) approximated the mean annual discharge (Ref. 20, p. 68). It should be noted that the loads calculated from samples with no mercury detected, used half the detection limit (i.e., 2.5 ng/L) in the load calculation as a conservative measure (Ref. 20, p. 5). The mercury load calculated for sample point F1 in Furnace Creek (average of the primary and duplicate result) was the highest in the study at 177.5 grams per year (g/yr) (Ref. 20, p. 5). The background Furnace Creek mercury load (FBG) was calculated at 0.4 g/yr (Ref. 20, p. 5). Dennis Creek load at sample point D1 was calculated at 8.2 g/yr and the background load at DBG was calculated at 4.3 g/yr (Ref. 20, p. 5). Mercury loads for sites along Garoutte Creek (G0.5, G1, G1.4, G1.5, and G2) below the confluence with Furnace Creek ranged from 44 g/yr at G1.4 which was a non-detect sample to 122 g/yr at G2 (Ref. 20, pp. 5 and 8). The background sites (GBG and GBG2) on Garoutte Creek had no detects of mercury, but utilizing half the detection limit in the load calculation provides 14 and 31 g/yr (Ref. 20, pp. 5 and 6).

Other tributaries to the Coast Fork Willamette River watershed included Little River (LR1) with a mercury load calculated to be 79 g/yr which was determined to be most likely related to the naturally-occurring mineralized zone upstream (Ref. 20, pp. 6 and 69). Mercury was not detected at the remaining sample locations within the watershed (i.e., those from Big River [BR1], Combs Creek [C1], Hambrick Creek [H1], Hobart Creek [HOB1], Johnson Creek [J1], Cedar Creek [CED1], and Wilson Creek [W1]); except at Anderson Creek (A1) which had a mercury load of 4.1 g/yr (Ref. 20, pp. 6, 8, 69, and 70).

This assessment determined that, in general, if half the detection limit is used for a mercury concentration at sites that had non-detects, Furnace Creek contributes about 50% of the mercury to the Coast Fork Willamette River (Ref. 20s, pp. 1 and 6). If sites with non-detects are assumed to contain no mercury, Furnace Creek contributes about 75% of the mercury to the Coast Fork Willamette River (Ref. 20, pp. 1 and 6). The results of the ODEQ 2008 surface water mercury loads assessment clearly indicate that Furnace Creek is a significant contributor of mercury to the Coast Fork Willamette River and potentially Cottage Grove Reservoir (Ref. 20, p. 6).

ODEQ, Reconnaissance Soil Sampling, 2004 – A soil sampling event was conducted for ODEQ to increase the understanding of special distribution and mobility of mercury in soils in and around Black Butte Mine (Ref. 24, pp. 1 and 3). The reconnaissance area was a 1.5 mile radius circle centered on Black Butte Mine (Ref. 24, p. 5). A total of 99 composite soil samples were collected from seven, roughly concentric circles ranging up to 1.5 miles from the abandoned kilns at Black Butte Mine (Ref. 24, pp. 1, 6, and 12). Soil composites consisted of five sample locations within a square meter area (Ref. 24, p. 5). Surface samples were taken in a "W-shaped" pattern (Ref. 24, p. 5). One sample was taken at each point of the "W" at a depth of 3 to 10 centimeters using clean stainless steel spoons (Ref. 24, pp. 5 and 6). Soil samples were placed in "zip-lock" type plastic bags and admixed thoroughly through the walls of the bags by hand and placed in "ICHEM" jars for delivery to the laboratory (Ref. 24, p. 6). The samples were analyzed by cold vapor atomic absorption spectrometry (Ref. 24, p, 6). This sampling revealed that the most heavily mercury contaminated soils were in the vicinity of abandoned kilns (Ref. 24, p. 1). There was a general trend for decreased total mercury in soil with increased distance from the mine (Ref. 24, p. 1). Two slopes facing Black Butte Mine contained three- to six-fold higher total mercury concentrations than slopes of the same ridges opposite Black Butte Mine (Ref. 24, p. 1). This distribution suggests potential atmospheric mercury transport in the past (Ref. 24, p. 1).

OSU, Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir, 2003 -
In 2003, an investigation of mercury contamination in the Cottage Grove Reservoir was completed (Ref. 19, p. 1). During this investigation, two sediment samples, six surface sediment samples, and food web samples representing three trophic levels were collected from the Cottage Grove Reservoir (Ref. 19, p. 10). These trophic levels included benthic invertebrates, omnivorous amphibians/fish, and piscivorous fish (i.e., largemouth bass) (Ref. 19, p. 31). In addition, 26 surface sediment grab samples were collected from several of the tributaries throughout the watershed (Ref. 19, p. 10).

Two sediment cores were collected from the deepest areas of the reservoir in 2002; the depth of the water at the collection point was approximately 16 meters (Ref. 19, p. 10). Cores were collected by boat using a coring device with a detachable, 83 millimeter diameter PVC barrel (Ref. 19, p. 10). Cores obtained were 36 centimeters in length (Ref. 19, p. 10). Following collection, each core was immediately cut into 2 centimeter intervals (resulting in 18 or 12 samples per core), placed in pretreated ICHEM glass jars, and placed in a cooler on ice until they reached the laboratory (Ref. 19, p. 10). Selected intervals within each sediment core were analyzed for excess ^{210}Pb, ^{226}Ra, and ^{137}Cs activity to estimate sediment accumulation rates ages (Ref. 19, p. 14). Core profiles indicate the reservoir serves as a sink for mercury released to the watershed above the reservoir and also as a source of mercury for release into the watershed below the reservoir (Ref. 19, p. 31).

Six surface sediment samples were collected, representing a longitudinal transect through the center of the reservoir (Ref. 19, p. 10). Each surface sediment sample was collected by boat, using a ponar dredge at approximately one-half mile sampling intervals (Ref. 19, p. 10). Chironomid larvae samples were also collected by boat using the ponar dredge from locations near the spillway of the dam (where the sediment layer was estimated to be deepest) (Ref. 19, p. 10). Surface sediment samples were collected and sieved until the number of Chironomid larvae was sufficient for approximately three sample replicates (Ref. 19, pp. 10 and 12).

All surface sediment, sediment grab samples, and foodweb samples were placed in pretreated ICHEM glass jars, and placed in a cooler on ice until they reached the laboratory (Ref. 19, p. 12). With the exception of the foodweb samples, all sediment samples were held in a cooler at 4° celsius until analysis (Ref. 19, p. 12). All foodweb samples were frozen until the time of analysis (Ref. 19, p. 12).

All sediment and foodweb samples were analyzed for total mercury concentrations on a wet-weight basis in accordance with EPA Method 7471 (Ref. 19, p. 12). The method detection limit achieved was approximately 0.2 mg/kg (Ref. 19, p. 13). Results of foodweb benthic samples suggest that little biomagnification is taking place at

lower trophic levels (Ref. 19, p. 43). However, concentrations of mercury in largemouth bass indicate that significant biomagnification is occurring within the food web (Ref. 19, p. 43).

The percentage of sediment stored permanently by the Cottage Grove Reservoir and temporarily stored and then flushed through, remains unknown (Ref. 19, p. 25). This reservoir has not been dredged in its history (Ref. 19, p. 25). Mercury concentrations in the surface sediment transect gradually increase from locations near the inlet to the dam (Ref. 19, p. 28). These results suggest an increased mercury deposition rate as suspended solids approach the dam (Ref. 19, p. 28). This study determined that Black Butte Mine is a continuing source of mercury to Dennis Creek and Garoutte Creek; and also that a strong concentration gradient exists from the area of the mine to the headwaters of the Coast Fork Willamette River (Ref. 19, p. 27). This study also concluded that sediments in the creeks that flow directly into the reservoir (i.e., Wilson Creek, Cedar Creek, and Williams Creek) have not been impacted by mining activities (Ref. 19, p. 27).

OSU and ETSU, Mercury Distribution in Sediment and Bioaccumulation by Fish in Two Oregon Reservoirs: Point-Source and Nonpoint-Source Impacted Systems, 1997 – In 1997, mercury pollution was compared in two Oregon reservoirs of similar size and age, located within the same ecoregion (Ref. 23, p. 1). Cottage Grove Reservoir is distinguished by a history of mercury mining and processing within its watershed, while Dorena Reservoir was not (Ref. 23, p. 1). Sediments are effective sinks for mercury, once it has been released into the aquatic environment (Ref. 23, p. 6).

Sediment mercury concentrations in the main tributary of Cottage Grove Reservoir (i.e., the Coast Fork Willamette River), which drains the sub basin where past mercury mining occurred, were tenfold higher than mercury in sediments from other reservoir tributaries (Ref. 23, p. 1). The highest mercury concentration observed in sediment samples was in a sample collected immediately downstream of the Cottage Grove Dam (Ref. 23, p. 3). High mercury concentrations in sediments downstream from the dam were explained to likely be the result of reservoir sediment mobilization during drawdown and major storm events (Ref. 23, p. 5).

Mercury contamination to Cottage Grove Reservoir sediments was determined to likely be due to transport and deposition of suspended particular matter brought into the drainage by erosion from mining wastes (Ref. 23, p. 6). The results of this work were determined to indicate that a point source, Black Butte Mine, contributed amounts of mercury to the reservoir greatly in excess of mobilization from natural deposits, atmospheric deposition, and small-scale uses of the metal as an amalgamating agent in gold mining (Ref. 23, p. 1).

EPA Removal Action (Ref. 5): In 2007, field work for an RA was conducted for the EPA at Black Butte Mine (Ref. 5, p. 7). During this work, tailings were appeared to have spilled into Furnace Creek downslope from the Old Ore Furnace (Ref. 5, p. 13). Samples of tailings from this area contained arsenic and mercury (see Source 1).

Hazardous Substances Released

The hazardous substances found in observed releases to surface water bodies within the TDL are arsenic and mercury.

Observed Release Factor Value: 550

4.1.3.2 WASTE CHARACTERISTICS

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Table 17 below provides Human Food Chain Threat Waste Characteristics Factor Values for those hazardous substances present in sources at the Black Butte Mine (see Section 2.2).

Table 17
Human Food Chain Threat Waste Characteristics Factor Values

Hazardous Substance	Source	Toxicity Factor Value	Persistence Factor Value[a]	Bioaccumulation Factor Value[b]	Toxicity/Persistence/Bioaccumulation Value (Ref. 1, p. 51619 Table 4-16)	Page Number in Reference 2
Antimony	3	10,000	1	5	5×10^4	BI-1
Arsenic	1, 2	10,000	1	5	5×10^4	BI-1
Beryllium	3	10,000	1	50	5×10^5	BI-2
Cadmium	2	10,000	1	5,000	5×10^7	BI-2
Chromium	2, 3	10,000	1	500	5×10^6	BI-3
Cobalt	3	10	1	5,000	5×10^4	BI-3
Copper	2, 3	0	1	500	0	BI-3
Lead	2, 3	10,000	1	5	5×10^4	BI-8
Manganese	3	10,000	1	50,000	5×10^8	BI-8
Mercury	1, 2, 3	10,000	1	50,000	5×10^8	BI-8
Nickel	2, 3	10,000	1	0.5	5,000	BI-9
Vanadium	2	100	1	500	5×10^4	BI-11
Zinc	2, 3	10	1	5	50	BI-12

a. River persistence value (Ref. 2).
b. Fresh water values (Ref. 1, p. 51617; Ref. 2).

The hazardous substances having the highest Toxicity/Persistence/Bioaccumulation Value of 5×10^8 are manganese and mercury.

Toxicity/Persistence/Bioaccumulation Factor Value: 5×10^8

4.1.3.2.2 Hazardous Waste Quantity

Table 18 Hazardous Waste Quantity		
Source No.	**Source Type**	**Source Hazardous Waste Quantity**
1. Tailings Piles	Pile	26,423
2. Contaminated Soil	Contaminated Soil	>0
3. Adit	Other	11.52
Sum of Values		**26,434.52**

Hazardous Waste Quantity Factor Value (Ref. 1, p. 51591, Table 2-6): 10,000

4.1.3.2.3 Waste Characteristics Factor Category Value

Toxicity/Persistence Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 10,000

Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value: 1×10^{8}

(Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value) x
Bioaccumulation Factor Value: 5×10^{12} subject to a maximum value of 1×10^{12} (Ref. 1, p. 51620)

Waste Characteristics Factor Category Value (Ref. 1, p. 51592, Table 2-7): 1,000

Hazardous Waste Quantity Factor Value: 10,000
Waste Characteristics Factor Category Value: 1,000
Ref. 1, p. 51592, Table 2-7

4.1.3.3 HUMAN FOOD CHAIN TARGETS
4.1.3.3.1 Food Chain Individual

The Oregon Department of Human Services has issued a fish advisory for Cottage Grove Reservoir due to very high mercury levels (Ref. 25, pp. 1 and 2). The advisory states that women of childbearing age, children under 6, and people with liver and kidney damage should avoid eating fish from these waters (Ref. 25, p. 2). It is further advised that healthy adults should eat no more than one 8-ounce meal per month (Ref. 25, p. 2). A fish advisory has also been issued for the Coast Fork Willamette River to Cottage Grove Reservoir (Ref. 25, p. 4). This advisory states that children under 6 should eat no more than one 4-ounce meal every two months, women of childbearing age should eat no more than one 8-ounce meal every month, and healthy adults should eat no more than one 8-ounce meal every two weeks from these waters (Ref. 25, p. 4). A human health advisory recommending limited consumption of fish from the Cottage Grove Reservoir was first posted in 1979 (Ref. 26, p. 14).

Portions of a fishery within the TDL are subject to Level II concentrations as indicated in sections 4.1.2.1.1 and 4.1.3.3.2.2.

Food Chain Individual Factor Value: 45
Ref. 1, p. 51620

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

Level I Concentrations to the Human Food Chain Threat is not being scored; however, previous investigations indicate that mercury contamination may be present in human food chain organisms above the EPA reference dose screening concentration as indicated below:

OSU, Sources and Chronology of Mercury Contamination in Cottage Grove Reservoir, 2003 -
Although not used to document Level I concentrations, an investigation concluded by OSU in 2003 also revealed mercury fish tissue (i.e., largemouth bass) results above the EPA reference dose screening concentration of 0.41 mg/kg in fish collected from the Cottage Grove Reservoir (Ref. 2, p. BII-8; Ref. 19, pp. 10 and 23). During this investigation, two sediment samples, six surface sediment samples, and food web samples representing three trophic levels were collected from the Cottage Grove Reservoir (Ref. 19, p. 10). These trophic levels included benthic invertebrates, omnivorous amphibians/fish, and piscivorous fish (i.e., largemouth bass) (Ref. 19, p. 31). Largemouth bass less than 15 inches are caught by sport fishermen for human consumption from this reservoir (Ref. 27).

All surface sediment, sediment grab samples, and foodweb samples were placed in pretreated ICHEM glass jars, and placed in a cooler on ice until they reached the laboratory (Ref. 19, p. 12). All foodweb samples were frozen until the time of analysis (Ref. 19, p. 12).

All sediment and foodweb samples were analyzed for total mercury concentrations on a wet-weight basis in accordance with EPA Method 7471 (Ref. 19, p. 12). The method detection limit achieved was approximately 0.2 mg/kg (Ref. 19, p. 13). Results of foodweb benthic samples suggest that little biomagnification is taking place at lower trophic levels (Ref. 19, p. 43). However, concentrations of mercury in largemouth bass indicate that significant biomagnification is occurring within the food web (Ref. 19, p. 43).

OSU and ETSU, Mercury Distribution in Sediment and Bioaccumulation by Fish in Two Oregon Reservoirs: Point-Source and Nonpoint-Source Impacted Systems, 1997 – Although not used to document Level I concentrations, an investigation concluded by OSU and ETSU in 1997 also revealed mercury fish tissue results above the EPA reference dose screening concentration of 0.41 mg/kg in fish collected from the Cottage Grove Reservoir (Ref. 2, p. BII-8). For this study, mercury pollution was compared in two Oregon reservoirs of similar size and age, located within the same ecoregion (Ref. 23, p. 1). Mercury concentrations in sediments of the reservoirs, tributary streams, and three species of fish were measured (Ref. 23, p. 1). Fish species sampled included largemouth bass, bluegill, and crappie; all human food chain organisms (Ref. 27, p. 2), which were collected at four times using electroshock at Cottage Grove Reservoir (June 1993, September 1994, July 1995, and November 1995) and two times at Dorena Reservoir (August 1993 and September 1995) (Ref. 23, p. 2). A total of 20 largemouth bass, 11 bluegill, and 13 crappie were collected from the Cottage Grove Reservoir; while a total of 14 largemouth bass, 4 bluegill, and 8 crappie were collected from the Dorena Reservoir (Ref. 23, p. 5 [Figure 4 and Figure 5 footnotes; respectively]).

Samples from the Dorena Reservoir can be used to provide an indication of background concentrations for comparison to samples from Cottage Grove Reservoir for the following reasons:

- It is in the same ecoregion as the Cottage Grove Reservoir;
- Drainage basin and limnological characteristics of these reservoirs are similar and representative of reservoirs of similar size within the ecoregion; and
- Both reservoirs were established in the 1940s (Ref. 23, p. 1).

The fish were stored on ice in the field, and then filleted and frozen in the laboratory (Ref. 23, p. 2). Mercury concentrations in fish epaxial muscle was determined using hot-base digestion followed by cold vapor atomic absorption (Ref. 23, p. 2). Mercury concentrations in fish from the Cottage Grove Reservoir were near or exceeded the U.S. Food and Drug Administration (FDA) human consumption limit of 1 ug/g wet weight for larger and older largemouth bass and bluegill; which also would exceed the EPA mercury reference dose screening concentration for fish tissue of 0.41 mg/kg (Ref. 2, p. BII-8; Ref. 23, p. 3). No fish species from Dorena Reservoir exceeded the FDA human consumption limit for mercury (Ref. 23, p. 3). Average mercury concentrations in fish from Dorena

Reservoir were one-third those for fish taken from Cottage Grove Reservoir (Ref. 23, p, 5). Concentrations of mercury in fish tended to increase with increased age (Ref. 23, pp. 5 and 6).

ODEQ, Mercury in Oregon Lakes, 1996 – Although not used to document Level I concentrations, an investigation concluded by ODEQ in 1996 also revealed mercury fish tissue results above the EPA reference dose screening concentration of 0.41 mg/kg in two species of fish collected from the Cottage Grove Reservoir (Ref. 2, p. BII-8; Ref. 26, pp. 1 and 21). Largemouth bass, bluegill, bullhead, and black crappie were collected on multiple occasions from September 1, 1990 to September 24, 1994 (Ref. 26, pp. 37, 38, and 39). Concentrations of mercury in tissue from 23 largemouth bass ranged from 0.22 mg/kg to 1.79 mg/kg; with tissue from 17 fish exceeding the EPA reference dose screening concentration (Ref. 2, p. BII-8; Ref. 26, pp. 37 and 38). Concentrations of mercury in tissue from seven bluegill ranged from 0.46 mg/kg to 1.13 mg/kg; with tissue from all seven fish exceeding the EPA reference dose screening concentration (Ref. 2, p. BII-8; Ref. 26, p. 38). Concentrations of mercury in tissue from 12 bullhead ranged from 0.26 mg/kg to 0.75 mg/kg; with tissue from nine fish exceeding the EPA reference dose screening concentration (Ref. 2, p. BII-8; Ref. 26, pp. 38 and 39). Concentrations of mercury in tissue from six black crappie ranged from 0.38 mg/kg to 0.75 mg/kg; with tissue from three fish exceeding the EPA reference dose screening concentration (Ref. 2, p. BII-8; Ref. 26, p. 39).

Level I Concentrations Factor Value: NS

4.1.3.3.2.2 Level II Concentrations

Dennis Creek is a perennial stream which contains cutthroat trout, although fishing within the stream has not been confirmed (Ref. 27, p. 1). Garoutte Creek is a fish bearing stream and is open for fishing for consumption (Ref. 27, p. 1). Rainbow trout and cutthroat trout are popular with sport anglers on the Coast Fork Willamette River both upstream of and below the Cottage Grove Reservoir (Ref. 27, p. 1). Fishing locations on these streams would include those open to the public (Ref. 27, p. 1). The entire Cottage Grove Reservoir is an extremely popular sport fishing area (Ref. 27, p. 1). Large mouth bass less than 15 inches in length can be retained for consumption; and are retained for consumption (Ref. 27, p. 1). Large mouth bass larger than 15 inches in length must be released due to mercury contamination (Ref. 27, p. 1). Other popular sport fish that are caught for consumption in the Cottage Grove Reservoir include bluegill sunfish, stocked rainbow trout, white and black crappie; and brown bullhead which are popular with the Asian community (Ref. 27, p. 1). Fish catch figures for water bodies within the 15-mile target distance limit are not maintained (Ref. 27, p. 1). For scoring purposes, it is assumed that greater then 1 pound of fish per year containing mercury above the reference dose screening concentration of 0.41 mg/kg (Ref. 2, p. BII-8) is harvested for human consumption from Garoutte Creek, the Coast Fork Willamette River, and Cottage Grove Reservoir. Each of these water bodies is subject to actual contamination (see Section 4.1.2.1.1; Ref. 27). Table 19 below provides the calculation of the Level II Concentrations Human Food Chain Population Value.

Table 19
Human Food Chain Population Values

Identity of Fishery	Annual Production (pounds)	References	Human Food Chain Population Value (Ref. 1, Table 4-18)
Garoutte Creek	>1	Ref. 27, p. 1	0.03
Coast Fork Willamette River	>1	Ref. 27, p. 1	0.03
Cottage Grove Reservoir	>1	Ref. 27, p. 1	0.03
Sum of Level II Human Food Chain Population Values:			**0.09**

Level II Concentrations Factor Value: 0.09

4.1.3.3.2.3 Potential Human Food Chain Contamination

Potential Human Food Chain Contamination is not being scored.

Potential Human Food Chain Contamination Factor Value: NS

4.1.4.2 WASTE CHARACTERISTICS

4.1.4.2.1 Ecosystem Toxicity/Persistence/Bioaccumulation

Table 20 below provides Environmental Threat Waste Characteristics Factor Values for those hazardous substances present in sources at the Black Butte Mine (see Section 2.2).

Table 20 Environmental Threat Waste Characteristics Factor Values

Hazardous Substance	Source	Ecosystem Toxicity Factor Value [a]	Persistence Factor Value [b]	Environmental Bioaccumulation Factor Value [c]	Ecosystem Toxicity/Persistence/Bioaccumulation Value (Ref. 1, p. 51619, Table 4-16)	Page Number in Reference 2
Antimony	3	100	1	5	500	BI-1
Arsenic	1, 2	10	1	5,000	5×10^4	BI-1
Beryllium	3	0	1	50	0	BI-2
Cadmium	2	10,000	1	50,000	5×10^8	BI-2
Chromium	2, 3	10,000	1	500	5×10^6	BI-3
Cobalt	3	0	1	5,000	0	BI-3
Copper	2, 3	1,000	1	5,000	5×10^6	BI-3
Lead	2, 3	1,000	1	50,000	5×10^7	BI-8
Manganese	3	0	1	50,000	0	BI-8
Mercury	1, 2, 3	10,000	1	50,000	5×10^8	BI-8
Nickel	2, 3	100	1	500	5×10^4	BI-9
Vanadium	2	0	1	500	0	BI-11
Zinc	2, 3	10	1	50,000	5×10^5	BI-12

a. Fresh water values (Ref. 1, p. 51621; Ref. 2).
b. River persistence values (Ref. 2).
c. Fresh water values (Ref. 1, p. 51622; Ref. 2).

The hazardous substances having the highest Ecosystem Toxicity/Persistence/Environmental Bioaccumulation Factor value of 5×10^8 are cadmium and mercury.

Ecosystem Toxicity/Persistence/Bioaccumulation Factor Value: 5×10^8

4.1.3.2.2 Hazardous Waste Quantity

Table 21 Hazardous Waste Quantity		
Source No.	**Source Type**	**Source Hazardous Waste Quantity**
1. Tailings Piles	Pile	26,423
2. Contaminated Soil	Contaminated Soil	>0
3. Adit	Other	11.52
Sum of Values		**26,434.52**

Hazardous Waste Quantity Factor Value (Ref. 1, p. 51591, Table 2-6): 10,000

4.1.3.2.3 Waste Characteristics Factor Category Value

Ecosystem Toxicity/Persistence Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 10,000

Ecosystem Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value: 1×10^{8}

(Ecosystem Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value) x
Environmental Bioaccumulation Factor Value: 5×10^{12} subject to a maximum value of 1×10^{12}

Waste Characteristics Factor Category Value (Ref. 1, p. 51592, Table 2-7): 1,000

Hazardous Waste Quantity Factor Value: 10,000
Waste Characteristics Factor Category Value: 1,000
Ref. 1, p. 51592, Table 2-7

4.1.4.3 ENVIRONMENTAL THREAT – TARGETS

Level I concentrations for the Environmental Threat is not being scored.

4.1.4.3.1 Sensitive Environments

4.1.4.3.1.1 Level I Concentrations

Sensitive Environments

Not scored.

Wetlands

Not scored.

Level I Concentrations Factor Value: NS

4.1.4.3.1.2 Level II Concentrations

Upper Willamette River ESU Chinook salmon are listed as threatened (Ref. 28, p. 1). All naturally spawned populations of Spring-run Chinook salmon in the Willamette River, and its tributaries, above Willamette Falls, Oregon are included in the Upper Willamette River Chinook ESU (Ref. 28, pp. 1 and 2). This ESU is considered to represent critical habitat for this species (Ref. 28, p. 1). Portions of the Coast Fork Willamette River, a tributary to the Willamette River, are subject to actual contamination (see Section 4.1.2.1.1).

Table 22 below provides the calculation of the Level II Sensitive Environments value.

Table 22
Level II Sensitive Environments Value

Identity of Sensitive Environment	References	Sensitive Environments Rating Value (Ref. 1, p. 51624 [Table 4-23])
Upper Willamette River ESU Chinook salmon	Ref. 28, pp 1 and 2	100
Sum of Level II Sensitive Environments Value		**100**

Level II Wetland Frontages

Wetlands are present along the Coast Fork Willamette River within the area subject to actual contamination (see Section 4.1.2.1.1; Ref. 18, Ref. 22).

Table 23 below provides the calculation of the Level II Wetlands value. The wetlands included in this calculation are only those meeting the 40 CFR 230.3 definition of a wetland.

Table 23
Level II Wetlands Value

Wetlands	Wetland Frontage	Wetlands Rating Value (Ref. 1, p. 51725 [Table 4-24])	References
Coast Fork Willamette River	14.2 miles	350	Ref. 18; Ref. 22
Sum of Level II Wetlands Value		**350**	

Sum of Level II Sensitive Environments Value + Wetlands Value: 450

Level II Concentrations Factor Value: 450

4.1.4.3.1.3 Potential Contamination

Potential Sensitive Environment Targets

Not Scored.

Potential Wetland Frontages

Not Scored.

Potential Contamination Factor Value: 0