HRS DOCUMENTATION RECORD REVIEW COVER SHEET

Name of Site:	**BLUE LEDGE MINE**	
Contact Person:	Karen Jurist, EPA Region 9	(415) 972-3219
Site Investigation:	Karen Jurist, EPA Region 9	(415) 972-3219
Documentation Record:	Amanda K.C. Reilly, Weston Solutions, Inc.	(541) 593-3800

Pathways, Components, or Threats Not Scored

Ground Water Pathway

The ground water pathway was evaluated, but not scored. There are no known uses of ground water on the Blue Ledge Mine facility. Residences in the Joe Bar community, located approximately 3 miles north-northeast of the facility, utilize ground water wells for drinking water. Existing analytical data indicate that arsenic, cadmium, copper, lead and zinc were detected in two residences' drinking water wells and one spring used for drinking water. Only detections of dissolved arsenic exceeded associated screening criteria with concentrations ranging from 0.22 micrograms per liter (ug/l) to 6.27 ug/l. Although arsenic was detected in all three ground water sources, there was no evidence that the levels were related to concentrations of arsenic detected in surface water adjacent to the Blue Ledge Mine facility, but rather to be due to high levels of arsenic in local soils (Ref. 4, p. 20, 21). Based on the information at this time, evaluation of the ground water pathway would not affect the listing decision.

Surface Water Pathway

The drinking water threat was evaluated, but not scored. Joe Creek and Elliott Creek are not used as a direct source of drinking water (Ref. 4, p. 20). The environmental threat was evaluated, but not scored. There are no known sensitive environments within the surface water pathway. In addition, the ground water to surface water migration component was not evaluated. Based on the information at this time, evaluation of the drinking water threat, environmental threat, and the ground water to surface water components of the surface water pathway would not affect the listing decision.

Air Migration Pathway

The air migration pathway was evaluated, but not scored. The Blue Ledge Mine facility is not paved, so potential exists for hazardous substances to become airborne (Ref. 5, p. 1).

Without analytical data, only potential to release can be scored for this pathway. Scoring potential to release does not affect the listing decision.

HRS DOCUMENTATION RECORD

Name of Site:	**BLUE LEDGE MINE**
EPA ID#:	CAN000906063
EPA Region:	9
Date Prepared:	March 2011
Address of Site*:	Sections 34, Township 48 North, Range 11 West
County and State:	Siskiyou County, California
Zip:	96086
Topographic Maps:	Dutch Creek USGS 7.5-minute Topographic Map Series, 1980.

Latitude: 41° 57' 35.86" North (Ref. 3; Ref. 6)

Longitude: 123° 06' 26.79" West*

Latitude/Longitude Reference Point: The approximate center of the waste rock pile WRP-1 was determined using a scaled U.S. Geological Survey topographic map and GIS mapping software (Ref. 3; Ref. 6).

* The coordinates and contaminant locations presented in this Hazard Ranking System (HRS) documentation record identify the general site location. The information represents one or more locations the U.S. Environmental Protection Agency (EPA) considers part of the site based on screening information EPA used to evaluate the site for National Priorities List (NPL) listing. EPA assigns national priorities from the known "releases or threatened releases" of hazardous substances; thus, the focus is on the release, and not on precisely delineated boundaries. A site is defined as an area where a hazardous substance has been "deposited, stored, placed, or otherwise have come to be located." Generally, HRS scoring and the subsequent listing of a release represent the initial determination that a certain area may need to be addressed under the Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA). Accordingly, EPA contemplates that the preliminary description of site boundaries at the time of HRS scoring will be defined as more information is developed on the locations of contamination.

SCORES

Air Pathway	=	Not scored
Ground Water Pathway	=	Not scored
Soil Exposure Pathway	=	10.66
Surface Water Pathway	=	100.00
HRS SITE SCORE	=	**50.28**

HAZARD RANKING SYSTEM
SUMMARY SCORESHEETS

SITE NAME: Blue Ledge Mine

CITY/COUNTY/STATE: Rogue River-Siskiyou National Forest, Siskiyou County, California

EPA ID #: CAN000906063

EVALUATOR: Amanda K.C. Reilly **DATE:** January 25, 2011

LATITUDE: 41° 57' 35.86" N **LONGITUDE:** 123° 06' 26.79" W

	S	S^2
Ground Water Migration Pathway Score (S_{gw})	Not scored	Not scored
Surface Water Migration Pathway Score (S_{sw})	100.00	10,000.00
Soil Exposure Pathway Score (S_s)	10.66	113.6356
Air Migration Pathway Score (S_a)	Not scored	Not scored
$S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2$	XXXXXXX	10,113.6356
$(S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2) / 4$	XXXXXXX	2,528.4089
$\sqrt{(S_{gw}^2 + S_{sw}^2 + S_s^2 + S_a^2) / 4}$	XXXXXXX	50.28

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

Factor Categories and Factors	Maximum Value	Assigned Value
DRINKING WATER THREAT - Not Scored (NS)		
Likelihood of Release		
1. Observed Release	550	550
2. Potential to Release by Overland Flow:		
2a. Containment	10	NS
2b. Runoff	25	NS
2c. Distance to Surface Water	25	NS
2d. Potential to Release by Overland Flow (lines 2a[2b + 2c])	500	NS
3. Potential to Release by Flood:		
3a. Containment (Flood)	10	NS
3b. Flood Frequency	50	NS
3c. Potential to Release Flood (lines 3a x 3b)	500	NS
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	NS
7. Hazardous Waste Quantity	a	NS
8. Waste Characteristics (Toxicity/Persistence x Hazardous Waste quantity, then assign a value from Table 2-7)	100	NS
Targets		
9. Nearest Intake	50	NS
10. Population		
10a. Level I Concentrations	b	NS
10b. Level II Concentrations	b	NS
10c. Potential Contamination	b	NS
10d. Population (lines 10a + 10b + 10c)	b	NS
11. Resources	5	NS
12. Targets (lines 9 + 10d +11)	b	NS

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET - CONTINUED

		Maximum Value	Assigned Value
	Drinking Water Threat Score		
13.	Drinking Water Threat Score [(lines 5 x 8 x 12)/82,500 subject to a maximum of 100]	100	NS
Factor Categories and Factors			
HUMAN FOOD CHAIN THREAT			
	Likelihood of Release		
14.	Likelihood of Release (Same value of line 5)	550	550
	Waste Characteristics		
15.	Toxicity/Persistence/ Bioaccumulation	a	$5x10^8$
16.	Hazardous Waste Quantity	a	10,000
17.	Waste Characteristics (Toxicity/Persistence/Bioaccumulation x Hazardous Waste quantity, then assign a value from Table 2-7)	1,000	1,000
	Targets		
18.	Food Chain Individual	50	20
19.	Population		
	19a. Level I Concentrations	b	0
	19b. Level II Concentrations	b	0
	19c. Potential Human Food Chain Contamination	b	0.00306
	19d. Population (lines 19a + 19b + 19c)	b	0.00306
20.	Targets (lines 18 + 19d)	b	20.00306
	Human Food Chain Threat Score		
21.	Human Food Chain Threat Score [(lines 14 x 17 x 20)/82,500 subject to a maximum of 100]	100	100

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET - CONTINUED

Factor Categories and Factors	Maximum Value	Assigned Value
ENVIRONMENTAL THREAT		
Likelihood of Release		
Likelihood of Release (Same value of line 5)	550	550
Waste Characteristics		
23. Ecosystem Toxicity/Persistence Bioaccumulation	a	NS
24. Hazardous Waste Quantity	a	NS
25. Waste Characteristics (Ecosystem Tox./Persistence x Bioaccumulation x Hazardous Waste Quantity, then assign a value from Table 2-7)	1,000	NS
Targets		
26. Sensitive Environments		
26a. Level I Concentrations	b	NS
26b. Level II Concentrations	b	NS
26c. Potential Contamination	b	NS
26d. Sensitive Environments (lines 26a + 26b + 26c)	b	NS
27. Targets (value from line 26d)	b	NS
Environmental Threat Score		
28. Environmental Threat Score [(lines 22 x 25 x 27)/82,500 subject to a maximum of 60]	60	NS

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE FOR A WATERSHED

29. Watershed Score [(Lines 13 + 21+ 28), subject to a maximum of 100]	100	100

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET - CONTINUED

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE

		Maximum Value	Assigned Value
30.	Component Score (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.

SOIL EXPOSURE PATHWAY SCORESHEET

Factor Categories and Factors		Maximum Value	Assigned Value
RESIDENT POPULATION THREAT			
	Likelihood of Exposure		
1.	Likelihood of Exposure	550	550
	Waste Characteristics		
2.	Toxicity	a	10,000
3.	Hazardous Waste Quantity	a	100
4.	Waste Characteristics (Toxicity x Hazardous Waste quantity, then assign a value from Table 2-7)	100	32
	Targets		
5.	Resident Individual	50	NE
6.	Resident Population		
	6a. Level I Concentrations	b	NE
	6b. Level II Concentrations	b	NE
	6c. Resident Population (lines 6a + 6b)	b	NE
7.	Workers	15	NE
8.	Resources	5	NE
9.	Terrestrial Sensitive Environments	c	50
10.	Targets (lines 5 + 6c + 7 + 8 + 9)	b	50
	Resident Population Threat Score		
11.	Resident Population Threat Score (lines 1 x 4 x 10)	b	880,000
	Soil Exposure Pathway Score		
12.	Soil Exposure Pathway Score (line 11/82,500, subject to a maximum of 100)	100	10.66

REFERENCES

Reference Number	Description of the Reference
1	Hazard Ranking System (HRS); Final Rule, 14 December 1990, Vol. 55, No. 241. (A complete copy of the HRS Final Rule is also available at http://www.epa.gove/superfund/sites/npl/hrsres/index.htm).
2	U.S. Environmental Protection Agency (EPA), Superfund Chemical Data Matrix (SCDM) Methodology, January 2004. 47 p. (A complete copy of the SCDM is available at available at http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm.)
3	U.S. Geological Survey, Dutch Creek, California 7.5 Minute quadrangle 1980. 1 p.
4	URS, Site Inspection Report, Blue Ledge Mine, April 2009. 573 p.
5	Brian P. Reilly, Weston Solutions, Inc., Site Reconnaissance and Photographic Documentation, Blue Ledge Mine Site, June 8 and June 30 – July 1, 2010. 11 p.
6	Google Earth, 41° 57' 35.86" N, 123° 06' 26.79" W, California, http://earth.google.com/, accessed August 2010. 1 p.
7	Weston Solutions, Inc., Preliminary Assessment/Site Inspection Report, Blue Ledge Mine, April 2004. 38 p.
8	URS, Removal Action, Engineering Evaluation & Cost Analysis, Blue Ledge Mine Site, April 26, 2010. 268 p.
9	Pete Jones, United States Department of Agriculture, Forest Service, Telephone Conversation recorded on Contact Report by Amanda K.C. Reilly, Weston Solutions, Inc., September 8, 2010. 1 p.
10	Environmental International Ltd., Preassessment Screen for the Blue Ledge Mine Site, October 28, 2002. 48 p.
11	Ecology and Environmental, Inc., Superfund Technical Assessment and Response Team, Blue Ledge Mine Removal Assessment, Final Report, September 2005. 137 p.
12	Environmental Protection Agency, Envirofacts Warehouse CERCLIS query results, http://www.epa.gov/enviro/html/cerclis/cerclis_query.html, accessed May 6, 2010. 2 p.
13	Bureau of Land Management, Survey Protocol for the Siskiyou Mountains Salamander (*Plethodon stormi*), undated. 6 p.
14	David Clayton, Forest Wildlife Biologist, Rogue River-Siskiyou National Forest, Blue Ledge Mine Project, Rogue River-Siskiyou National Forest, Terrestrial Wildlife Biological Evaluation, October 1, 2009. 40 p.
15	Ian S. Reid, Fisheries Biologist, Rogue River-Siskiyou National Forest, Applegate Ranger District, Applegate Lake Fishery Assessment, 2003. 45 p.

Reference Number	Description of the Reference
16	Weston Solutions, Inc., logbook, Blue Ledge Mine, EPA HRS Package Sampling, June 30, 2010 through July 2, 2010. 9 p.
17	Weston Solutions, Inc., Blue Ledge Mine HRS Sampling, Sampling and Analysis Plan, June 2010. 46 p.
18	URS, Preliminary Geotechnical Investigation Report, Blue Ledge Mine, November 2008. 60 p.
19	California Emergency Management Agency, Hazardous Materials Spill Report, Blue Ledge Mine Site, August 18, 2010. 2 p.
20	EPA, Office of Emergency Response, *Establishing an Observed Release*. Fact Sheet EPA/540/F-94/031. September 1995. 18 p.
21	FishBase, Length-Weight Relationship for *Pomoxis nigromaculatus*, www.fishbase.org, data extracted August 20, 2010. 1 p.
22	FishBase, Length-Weight Relationship for *Lepomis macrochirus*, www.fishbase.org, data extracted August 20, 2010. 1 p.
23	FishBase, Length-Weight Relationship for *Oncorhynchus tshawytscha*, www.fishbase.org, data extracted August 20, 2010. 1 p.
24	FishBase, Length-Weight Relationship for *Oncorhynchus mykiss*, www.fishbase.org, data extracted August 20, 2010. 1 p.
25	FishBase, Length-Weight Relationship for *Micropterus dolomieu*, www.fishbase.org, data extracted August 20, 2010. 1 p.
26	Reference omitted.
27	Ian Reid, Fisheries Biologist, Rogue River-Siskiyou National Forest, Applegate Ranger District, Telephone Conversation recorded on Contact Report by Amanda K.C. Reilly, Weston Solutions, Inc., August 20, 2010 and January 14, 2011. 1 p.
28	Lindelof, Doug, ICF Consulting/Laboratory Data Consultants, Memorandum to Karen Jurist, EPA, Subject: Review of Analytical Data, Blue Ledge Mine, SDG No: MY6ZE3, August 9, 2010. 11 p.
29	Lindelof, Doug, ICF Consulting/Laboratory Data Consultants, Memorandum to Karen Jurist, EPA, Subject: Review of Analytical Data, Blue Ledge Mine, SDG No: MY6ZF4, August 13, 2010. 13 p.
30	Brenda Bettencourt, U.S. Environmental Protection Agency, Memorandum to Karen Jurist, Subject: Analytical Testing Results – Project R10SA2, Blue Ledge Mine, August 16, 2010. 7 p.
31	Carlson, Sam, United States Department of Agriculture, Forest Service, Subject: Non-Time-Critical Removal Action Memorandum, Blue Ledge Mine Site, May 13, 2010. 22 p.
32	SLV Analytical, Inc., SDG Narrative, Case No: 40296, SDG No: MY6ZE3, July 20, 2010. 466 p.
33	SLV Analytical, Inc., SDG Narrative, Case No: 40296, SDG No: MY6ZF4, July 16, 2010. 969 p.
34	Geddes, C. W., Notes on the Blue Ledge Mine, February 28, 1905. 12 p.

Reference Number	Description of the Reference
35	Pete Jones, United States Department of Agriculture, Forest Service, E-mail Correspondence recorded on Contact Report by Karen Jurist, USEPA November 17, 2010. 1 p.
36	Western Regional Climate Center, Period of Record Monthly Climate Summary, Happy Camp Ranger Station, California, www.wrcc.dri.edu, data extracted January 11, 2011. 1 p.
37	B.C. Adventure, Rainbow Trout and Steelhead, http://www.bcadventure.com/adventure/angling/game_fish/rainbow.phtml, data extracted January 13, 2011. 3 p.
38	Columbia Analytical Services, Inc., Analytical Report for Service Request No: K0805944, Blue Ledge Mine, July 24, 2008. 110 p.
39	Pete Jones, United States Department of Agriculture, Forest Service, Telephone Conversation recorded on Contact Report by Amanda K.C. Reilly, Weston Solutions, Inc., January 13, 2011. 1 p.
40	Reilly, Amanda K.C., Weston Solutions, Inc., Memorandum, Re: Sample Quantitation Limits, January 14, 2011. 5 p.
41	Switlaski, Gloria, Weston Solutions, Inc., Memorandum, Subject: Review and Validation – Metals in Soils Data, Laboratory Group: K0805944, January 21, 2011. 6 p.
42	Weston Solutions, EquipTrack, Calibrations of Water Quality Meter YSI 600XL, June 25th, 2010. 1 p.

ACRONYM LIST

AMD	Acid Mine Drainage
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CRDL	Contract Required Detection Limit
EPA	United States Environmental Protection Agency
gpm	gallons per minute
HRS	Hazard Ranking System
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
NPL	National Priorities List
PA	Preliminary Assessment
PPE	Probable Point of Entry
RSL	Regional Screening Level
SCDM	Superfund Chemical Data Matrix
SI	Site Inspection
SPLP	Synthetic Precipitation Leaching Procedure
SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
TDL	Target Distance Limit
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
USFS	United States Department of Agriculture, Forest Service
µg/l	micrograms per liter

NOTES TO THE READER

1. Attachment A (A-1) contains the following maps:

   Figure A-1: Blue Ledge Mine Site Location Map

   Figure A-2: Blue Ledge Mine Site Map

   Figure A-3: 2008 USFS Sample Location Map

   Figure A-4: 2010 EPA HRS Sample Location Map

   Figure A-5: 15-mile Surface Water Target Distance Limit Map

SITE DESCRIPTION

The Blue Ledge Mine facility is located within the Rogue River-Siskiyou National Forest in Siskiyou County, California, approximately 33 miles southwest of Jacksonville, Oregon (Ref. 3; Ref. 4, p. 6; Ref. 10, p. 9). The facility is located on rural patented land approximately three miles south of the California-Oregon border. The mine spans in elevation from approximately 4,000 to 4,800 feet above mean sea level. The mine is located near the upper headwaters of the Joe Creek Watershed, on a steep, generally north-facing hillslope, adjacent to Joe Creek. Joe Creek flows north to Elliott Creek, which is a tributary to the Middle Fork of the Applegate River. The Applegate River flows north across the California-Oregon border to Applegate Reservoir (Ref. 4, p. 6; Ref. 10, p. 9). A site location map is presented in Figure A-1.

The Blue Ledge Mine was discovered by panners in approximately 1898. Inception, initial ownership and significant development of the mine occurred between 1902 and 1909. The mine experienced periods of activity and inactivity over the next 20 years. Extensive excavations were undertaken, and a substantial amount of waste rock was generated as mine workings were developed and ore was removed. Mining cars carried extracted materials from the interior of the mine to a mine adit atop the Blue Ledge Mine. The separated ore was trammed down the hillside via an overhead cable to a location close to Joe Creek. Ore was then trucked out of the state to Washington for further processing. No large scale mining activities have occurred since the 1930s. The facility has had at least 14 owners/leases/operators throughout its existence (Ref. 7, p. 6; Ref. 10, p. 5, 9, 14 15; Ref. 34, p. 1 through 11).

The Waste Rock pile has been identified as a hazardous substance source on the Blue Ledge Mine facility. The Waste Rock pile is comprised of a majority of the waste rock on the facility. Previous investigations have separated the Waste Rock pile into four separate piles; WRP-1, WRP-2, WRP-3 and WRP-4 (Ref 8, p. 1-2, 2-3). Figure A-2 presents the Waste Rock pile.

The Waste Rock pile extends from multiple formerly productive adits. Two formerly productive adits, Adit 1N and Adit 1S, located in the central portion of the facility, produced waste rock in the WRP-1 area. Two formerly productive adits, Adit 2A and Adit 2B, and two exploratory adits, Adit 2C and Adit 2D, located in the south-central portion of the facility, produced the waste rock in the WRP-2 area. One formerly productive adit, Adit 3A, located in the southern portion of the facility, produced the waste rock in the WRP-3 area. One productive adit, Adit 4A, and one exploratory adit, Adit 4B, located in the northern portion of the facility, produced the waste rock in the WRP-4 area (Ref. 8, p. 17; Figure A-2). An unnamed ephemeral tributary of Joe Creek flows along the western edge of WRP-1 and is completely covered by the waste rock in the area near the log dam (Ref. 5, p. 9; Ref. 8, p. 78; Ref. 11, p. 5).

Ground water discharging from Adit 1N has been identified as a hazardous substance source on the Blue Ledge Mine facility. In 2008, groundwater from Adit 1N was observed discharging from the adit and flowing over the WRP-1 into Joe Creek (Ref. 4, p. 12). In June 2010, groundwater from Adit 1N was observed discharging from the adit and flowing over WRP-1 for approximately 100 feet before it percolated below the waste rock surface. Previous investigations have documented increased sulfate concentrations and acidity emerging from the Blue Ledge Mine adits (Ref. 4, p. 13). In July 2010, the acid mine drainage (AMD) exhibited an acidic pH of 2.6 (Ref. 16, p. 5). The sulfide deposits on the Blue Ledge Mine facility provide a continuing source of AMD. AMD is continually formed by a weathering

process that oxidizes sulfur-bearing minerals to sulfate and acidity. The AMD process is further expedited by oxidation of the reduced minerals by microbes. The production of acidity at the Blue Ledge Mine facility causes metals to leach from surrounding waste rock as water percolates through the scattered waste piles. During periods of higher precipitation, the AMD infiltrates through the waste rock and leaches metals. The finer the waste particle, the more surface area is available for the AMD to leach metals from (Ref. 10, p. 16).

The Blue Ledge Mine facility was identified as a potential hazardous waste site and entered into the CERCLIS on October 31, 2002 and assigned EPA Identification Number CAN000906063 (Ref. 12).

In May 2005, EPA tasked the Superfund Technical Assessment and Response Team (START) to conduct a site screening sampling event followed by a removal assessment. Sample results from the screening sampling event were used to identify contaminants of concern. During the removal assessment, eight surface soil samples and eight subsurface samples were collected from the waste pile. All samples were analyzed for lead and arsenic. In addition, two of the subsurface samples were analyzed for cadmium, copper, iron, manganese, mercury and zinc. The sampling event demonstrated that metals concentrations significantly exceeded the Region 9 Preliminary Remediation Goals and background concentrations (Ref. 4, p. 13; Ref. 11, p. 19).

In 2006, remediation efforts by EPA included grading of waste rock piles below the lowermost adit, redirecting AMD into a marble-lined runoff channel and creating a settling pond above the log dam to capture sediment eroded from the waste piles. By May 2007, an approximate 90-cm thick deposit of sediment had accumulated in the pond, nearly filling its capacity. In June 2008 and June 2010, water was observed flowing over the log dam from the settling pond (Ref. 4, p. 13, 14; Ref. 5, p. 10).

In 2009, the USFS completed an SI on the Facility. During the sampling event a continuous overland flow path for groundwater discharging from Adit 1N (also referred to as adit AD-01) and seep SP-01 to Joe Creek was observed. Groundwater emerging from Adit 1N and seep SP-01 flowed down the runoff channel to the settling pond behind the log dam, where it overtopped the dam and discharged into Joe Creek. The SI field work, which included the collection of waste rock, river sediment, and riparian soil, was conducted in June 2008 (Ref. 4, p. 536 through 573). In addition, water samples were collected from on-site seeps and adits, the log dam, tributaries to Joe Creek, Joe Creek, Elliott Creek, the Middle Fork Applegate River, and Applegate Reservoir. Analytical results exhibited elevated concentrations of metals in on-site waste rock, downstream surface water and downstream sediment (Ref. 4, p. 212 through 221, 268 through 295, 367 through 407.

In 2010, the USFS began to conduct a removal action on the Blue Ledge Mine facility. The goal was to remove hazardous substances associated with the waste rock piles (Ref. 31, p. 10). Surface mine wastes were to be removed and contained in a repository to be constructed on nearby private land under the same ownership as the mine. Temporary roads were constructed to gain access to the waste rock piles. The repository site is located less than one mile from the mine. The repository was designed to be a fully enclosed system with a geosynthetic cover and liner. The design included provisions to neutralize and collect any leachate that may be generated (Ref. 31, p. 11). On August 18, 2010, while removing waste rock from the hillside of the Waste Rock pile, an excavator ruptured an unmapped adit. It was estimated

that 50,000 to 75,000 gallons of water was released, however the exact volume was not known. The adit was sandbagged following the release, however ground water continues to be discharging from the unnamed adit at a rate of approximately two to five gpm. In addition, three adits and one shaft were discovered subsequent to the release. One of these adits has a pool of standing water but does not appear to be flowing. The other two adits and one shaft appeared to be dry (Ref. 9).

In June and July 2010, EPA tasked WESTON to conduct sampling in order to investigate sediment and surface water contamination in the vicinity of the Blue Ledge Mine facility. To confirm if a release to the surface water pathway had occurred, sediment and surface water samples were collected from various locations along the surface water pathway extending downstream from the facility to Joe Creek. To demonstrate the presence of hazardous substances in the sources to surface water, samples were collected from the waste rock piles and adit AMD within the surface water pathway. All four of the Waste Rock Pile samples exhibited concentrations of metals for at least one of the following analytes: antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, silver, thallium, vanadium, and zinc. Sediment samples collected adjacent to and downstream of the facility exhibited elevated concentrations of metals for at least one of the following analytes: arsenic, cadmium, copper, lead, mercury, and zinc. All three downstream surface water samples exhibited elevated concentrations of metals for at least one of the following analytes: copper, manganese, and zinc (Ref. 29, p. 11, 12; Ref. 33, p.11 - 24, 65, 73).

In July and August 2010, removal activities occurred under USFS oversight on the Blue Ledge Mine facility. A total of 54,700 cubic yards of waste rock was removed from WRP-1 and WRP-2. WRP-2 was removed in its entirety and approximately 95 percent of WRP-1 was removed. In addition, 2,100 cubic yards of waste rock was removed from WRP-4, with an estimated 2,000 cubic yards remaining. There was no removal conducted on WRP-3. The USFS estimates that WRP-3 is approximately 11,600 cubic yards (Ref. 35).

The surface water pathway was evaluated on an observed release to Joe Creek. Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir are fisheries located within the 15-mile Target Distance Limit (TDL). Multiple fish species, known to be consumed by humans, are present within these fisheries (Ref. 9; Ref. 15, p. 2 through 42; Ref. 27). The soil exposure pathway was evaluated based on the presence of terrestrial sensitive environments. The Blue Ledge Mine facility lies in within the terrestrial sensitive environments of the Siskiyou Mountains salamander, the Black Salamander, the Blue-gray taildropper, and the Traveling sideband snail (Ref. 13, p. 2; Ref. 14, p. 24 through 28).

The surface water pathway was maximized at 100 and the soil exposure pathway scores 42.66, generating a site score of 54.35. The drinking water threat and environmental threats were not scored because scoring these would not significantly impact the overall site score. The ground water pathway was not scored due to the lack of targets. The air pathway was not scored since data is not available to establish an observed release to air.

SOURCE DESCRIPTION

2.2 Source Characterization

Name of Source: Waste Rock Pile
Number of Source: Source 1
Source Type: Pile

The Blue Ledge Mine facility is located within the Condrey Mountain Schist in the east-central portion of the Klamath Mountains geomorphic province, which comprise a series of north-south trending sedimentary and volcanic rocks containing massive sulfide deposits. Rocks underlying the Blue Ledge Mine facility are predominantly north-south striking, steeply west dipping, and metamorphosed sedimentary and volcanic rocks. A majority of the ore zone of the mine is localized within schist. Massive sulfide mineralization underlies the mine, with the main ore body consisting of lenses, stringers, and bands of primary copper-zinc sulfides (Ref. 10, p. 11).

The Blue Ledge Mine facility had a total of 27 claims, 16 claims were on a strike of a vein covering the length of approximately 4.5 miles, additional claims were on side lines, and three claims were on a parallel vain. . The main vein occurred as an extensive fissure in schist, conforming in a general way to the stratification. Mineralization extended into the wall rock, making the vein zone 50 to 300 feet in width. The ore occurred as shoots containing both massive and disseminated sulphides (Ref. 34. p. 1).

In 1905, the adits and tunnels making up the Blue Ledge Mine property were evaluated. The following table presents the conclusions (Ref. 34, p. 9, 10, 11):

Adit/Tunnel Number	Dip	Assayed Copper	Additional Comments
1	55 degrees	6 percent	Starts in ore and continues in ore for 56 feet.
2	10 degrees	6 percent	On the dip of the vein, and runs of the ore body and into the hanging wall at a depth of 40 feet.
3	Cross cut	6 percent	Cross cut hole and shows the ore for 19 feet.
4	Unknown	Unknown	Starts in ore, but on account of its dip, looses the ore in 8 feet.
5	Unknown	Unknown	Adit is down hole, both on its dip and the strike of the ore body. Runs out of the ore body at 20 feet.
6	Unknown	Unknown	Continues the course of the west cross cut for 147 feet.
7	Unknown	Unknown	Attains a length of 172 feet without encountering any ore.
8	Unknown	16 percent	Has a total depth of 212 feet. At the 128 foot mark it encounters the continuation of the ore

Adit/Tunnel Number	Dip	Assayed Copper	Additional Comments
			exposed in the east cross cut of tunnel 1.
9	Unknown	16 percent	Attains a length of 289 feet. At the 256 foot mark, it encounters the east body ore.
10	Unknown	5 to 6 percent	Adit is down hole from the surface and is 420 feet long. At the 159 feet mark, it encounters the east ore body (6 percent copper). At the 212 foot mark it shows 20 feet of copper and sulphide ore (5 percent copper).

Source 1 consists of the Waste Rock pile, and is comprised of a majority of the waste rock on the facility. Previous investigations have separated the Waste Rock pile into four separate piles; WRP-1, WRP-2, WRP-3 and WRP-4 (Ref. 8, p. 1-2, 2-3). Figure A-2 presents the Waste Rock pile.

The Waste Rock pile extends from multiple formerly productive adits. Two formerly productive adits, Adit 1N and Adit 1S, located in the central portion of the facility, produced waste rock in the WRP-1 area. Two formerly productive adits, Adit 2A and Adit 2B, and two exploratory adits, Adit 2C and Adit 2D, located in the south-central portion of the facility, produced the waste rock in the WRP-2 area. One formerly productive adit, Adit 3A, located in the southern portion of the facility, produced the waste rock in the WRP-3 area. One productive adit, Adit 4A, and one exploratory adit, Adit 4B, located in the northern portion of the facility, produced the waste rock in the WRP-4 area (Ref. 8, p. 17; Figure A-2).

Although multiple adits exist on the Blue Ledge Mine facility, and previous investigations have considered the waste rock to be in four separate piles, the Waste Rock pile is considered to be one pile based on the geologic makeup of the site. In addition, Pete Jones, a geologist with the USFS, has made visual observations of piles WRP-1 through WRP-4 and concluded that they are comprised of the same material. He stated that all of the waste rock (WRP-1 through WRP-4) on the Blue Ledge Mine property was a product of mining along the same ore body, and therefore the waste rock throughout the property is the same geologic makeup. Mining occurred along the same strike of mineralization. The mineralization zone mined was approximately 2,000 feet in length (Ref. 39).

Waste rock was observed in direct contact with Joe Creek in June and July 2010 (Ref. 5, p. 1,,5, 6). A log dam, constructed during mining operations, is present at the base of the slope where the deepest deposits are located. An unnamed ephemeral tributary of Joe Creek flows along the western edge of the Waste Rock pile and is completely covered by the waste rock in the area near the log dam (Ref. 5, p. 9; Ref. 8,p. 78; Ref. 11, p. 5). Over time, the waste rock has eroded and leached acidity and metals to Joe Creek. Previous investigations estimated up to 70,000 tons of sulfide-rich rock were discarded on the hillside below the adits (Ref. 8, p. 11, 12).

Source Location

The Waste Rock Pile is located on the Blue Ledge Mine facility (Ref. 5, p. 3; Ref. 8, p. 16, 78,). The pile can be observed from National Forest System Road 1060 and extends from an elevation of approximately 4,100 feet to 4,800 feet (Ref. 5, p. 3; Ref. 11, p. 5).

Source Containment

Release to surface water:

In June and July 2010, the Waste Rock pile was observed to be in direct contact with Joe Creek. There was no engineered cover or retaining wall supporting the waste rock from coming into contact with surface water (Ref. 5, p. 5, 6). In addition, seasonal drainage gullies run through the lower portions of WRP-2 and WRP-3. Both gullies drain to Joe Creek. There has been no obvious drainage way observed within WRP-4 (Ref. 8, p. 17).

In September 2000, April 2001 and August 2001, the USFS conducted investigations on the Blue Ledge Mine facility and collected samples from the onsite run-off channel, Joe Creek, and Elliott Creek. Analytical results indicated that concentrations of cadmium, copper, iron, lead and zinc in Joe Creek increased significantly in surface water downstream of the Blue Ledge Mine facility (Ref. 4, p. 12).

In 2008, water samples were collected from multiple locations within Joe Creek, Elliott Creek, the Middle Fork of the Applegate River, and Applegate Reservoir. Seven surface water samples were collected from Joe Creek downstream of the facility (JC-01 through JC-04, JC-07 through JC-09). In addition, seven surface water samples were collected from Elliott Creek (EC-01 through EC-07), two surface water samples were collected from Middle Fork Applegate River (AR-01 and AR-02), and one surface water sample was collected from the Applegate Reservoir (ARV-01). Six background surface water samples were collected in Joe Creek upstream of the facility (JC-10 through JC-15). All water samples were analyzed for dissolved metals (arsenic, cadmium, copper, iron, lead and zinc), sulfate, total suspended solids (TSS), total dissolved solids (TDS), alkalinity and hardness (Ref. 4, p. 14 through 16, 53, 62 through 64, 91, 536 through 573).

Analytical results indicated that dissolved cadmium, iron, lead, and TSS were not detected in any background surface water samples. Dissolved copper and dissolved zinc were detected in all background surface water samples at concentrations ranging from 0.71 ug/l to 0.84 ug/l for copper and 0.49 ug/l to 1.1 ug/l for zinc. Dissolved cadmium was detected in all downstream surface water samples at concentrations ranging from 0.012 ug/l in ARV-1 to 0.564 ug/l in JC-01. Dissolved copper was detected in all downstream surface water samples, with the exception of AR-01, at concentrations ranging from 0.46 ug/l in EC-07 to 62.8 ug/l in JC-07. Zinc was detected in all downstream surface water samples, with the exception of AR-01, at concentrations ranging from 0.61 ug/l in EC-07 to 88.5 ug/l in JC-07. The Maximum Contaminant Levels (MCLs) for cadmium, copper, and zinc are 5.0 ug/l, 1,300 ug/l and 26,000 ug/l, respectively (Ref. 4, p. 23).

To further evaluate the containment of the Waste Rock pile during the June and July 2010 HRS Sampling event, one selected sample was analyzed using a modified Synthetic Precipitation Leaching Procedure (SPLP). The standard SPLP was modified to use the mine drainage instead of the synthetic precipitation in order to show that the mine drainage from the adit(s) is leaching hazardous substances from the waste rock and subsequently to Joe Creek (Ref. 17, p. 23). The waste rock sample was collected from sample location

BLM-WR-3 and the mine drainage was collected from Adit 1N. Both samples were collected on July 1, 2010 (Ref. 16, p. 5, 6; Ref. 30, p. 2). Waste rock sample BLM-WR-3 exhibited elevated concentrations of antimony (2.2 mg/kg), arsenic (102 mg/kg), cadmium (2.5 mg/kg), chromium (7.0 mg/kg), copper (314 mg/kg), lead (201 mg/kg), manganese (146 mg/kg), mercury (1.2 mg/kg), silver (3.9 mg/kg), vanadium (40.5 mg/kg), and zinc (145 mg/kg) (Ref. 28, p. 9). The water sample BLM-SW-6 collected from Adit 1N exhibited elevated concentrations of arsenic (18.1 ug/l), cadmium (887 ug/l), chromium (37.2 ug/l), cobalt (65.8 ug/l), copper (160,000 ug/l), lead (186 ug/l), manganese (3,180 ug/l), nickel (201 ug/l), selenium (5.1 ug/l), silver (4.0 ug/l), and zinc (236,000 ug/l) (Ref. 29, p. 11).

The sample was analyzed for total metals using the modified SPLP EPA test method 1312 (Ref. 30, p. 1).

Summarized below is analytical evidence of contamination in source sample BLM-WR-3 associated with the Waste Rock Pile located on the Blue Ledge Mine facility.

Hazardous Substance	Hazardous Substance Concentration (mg/L)	SQL (mg/L)	References
Cadmium	1.1	0.005	Ref. 30, p. 2
Chromium	0.049	0.01	Ref. 30, p. 2
Copper	160	0.4	Ref. 30, p. 2
Lead	0.31	0.03	Ref. 30, p. 2
Silver	0.028	0.01	Ref. 30, p. 2
Zinc	250	0.8	Ref. 30, p. 2

2.4.1 Hazardous Substances

As part of the June and July 2010 HRS sampling event on the Blue Ledge Mine facility, surface samples were collected from four locations within WRP-1. Sample BLM-WR-1 was collected from light brown silty sand located on the northern portion of WRP-1; sample BLM-WR-2 was collected from light to medium brown silty sand with subangular gravel with clasts up to 0.5 inches in diameter located on the central eastern portion of WRP-1; sample BLM-WR-3 was collected from reddish-brown clayey silt with little sub-angular gravel located on the central portion of WRP-1; and sample BLM-WR-4 was collected from medium brown silty sand with subangular gravel located on the central western portion of WRP-1. All four samples were collected using clean and dedicated plastic scoops at depths between 0.5 and 1 foot below ground surface (bgs) (Ref. 16, p. 6, 7; Ref. 17, p. 22 through 23). Sample locations are presented in Figure A-4.

The waste rock pile samples were submitted to a laboratory for definitive metals analysis. The samples were analyzed for total metals using EPA test method ILM05.4 (Ref. 28, p. 2). The data validation results are in Reference 28.

All four of the WRP-1samples exhibited concentrations of metals for at least one of the following analytes: antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, silver, thallium, vanadium, and zinc (Ref. 28, p. 9).

Summarized below is analytical evidence of contamination in source samples associated with the Waste Rock Pile located on the Blue Ledge Mine facility.

Source 1:

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Antimony	BLM-WR-1 (MY6ZE3)	7/1/10	18.2 J[1,2] (9.19)	7.03	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.6 J[1,2] (1.82)	6.73	
	BLM-WR-3 (MY6ZE5)	7/1/10	2.2 J[1,2] (1.11)	6.96	
	BLM-WR-4 (MY6ZE6)	7/1/10	2.6 J[1,2] (1.31)	7.01	
Arsenic	BLM-WR-1 (MY6ZE3)	7/1/10	301	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	124	1.12	

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
	BLM-WR-3 (MY6ZE5)	7/1/10	102	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	104	1.17	
Cadmium	BLM-WR-1 (MY6ZE3)	7/1/10	3.9	0.59	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.9	0.56	
	BLM-WR-3 (MY6ZE5)	7/1/10	2.5	0.58	
	BLM-WR-4 (MY6ZE6)	7/1/10	2.6	0.59	
Chromium	BLM-WR-1 (MY6ZE3)	7/1/10	2.7 J[1, 3] (2.09)	1.17	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 5-7, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	9.8 J[1, 3] (7.6)	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	7.0 J[1, 3] (5.43)	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	9.2 J[1, 3] (7.13)	1.17	
Copper	BLM-WR-1 (MY6ZE3)	7/1/10	981 J[1, 3] (804.1)	2.93	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 5-7, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	1,290 J[1, 3] (1,057.4)	2.8	
	BLM-WR-3 (MY6ZE5)	7/1/10	314 J[1, 3] (257.38)	2.9	
	BLM-WR-4 (MY6ZE6)	7/1/10	441 J[1, 3] (361.48)	2.93	
Lead	BLM-WR-1 (MY6ZE3)	7/1/10	7,890	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	609	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	201	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	227	1.17	
Manganese	BLM-WR-1 (MY6ZE3)	7/1/10	25.4	1.76	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	182	1.68	
	BLM-WR-3 (MY6ZE5)	7/1/10	146	1.74	
	BLM-WR-4 (MY6ZE6)	7/1/10	162	1.76	
Mercury	BLM-WR-1 (MY6ZE3)	7/1/10	92.8 J[2]	5.85	Ref. 16, p. 6, 7; Ref. 20, p. 8; Ref. 28, p. 5-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 39, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.4 J[2]	0.11	
	BLM-WR-3 (MY6ZE5)	7/1/10	1.2 J[2]	0.12	

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
	BLM-WR-4 (MY6ZE6)	7/1/10	0.89 J[2]	0.12	
Selenium	BLM-WR-1 (MY6ZE3)	7/1/10	29.3	4.1	Ref. 16, p. 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	9.1	3.92	
Silver	BLM-WR-1 (MY6ZE3)	7/1/10	390	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	18.3	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	3.9	1.16	
Thallium	BLM-WR-1 (MY6ZE3)	7/1/10	6.9	2.93	Ref. 16, p. 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
Vanadium	BLM-WR-1 (MY6ZE3)	7/1/10	49.3	5.9	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p.1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	39.6	5.6	
	BLM-WR-3 (MY6ZE5)	7/1/10	40.5	5.8	
	BLM-WR-4 (MY6ZE6)	7/1/10	49.9	5.9	
Zinc	BLM-WR-1 (MY6ZE3)	7/1/10	159 J[2]	7.03	Ref. 16, p. 6, 7; Ref. 20, p. 8; Ref. 28, p. 5-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	193 J[2]	6.73	
	BLM-WR-3 (MY6ZE5)	7/1/10	145 J[2]	6.96	
	BLM-WR-4 (MY6ZE6)	7/1/10	138 J[2]	7.01	

Notes:

J[1]: The analyte was positively identified, however the reported value is an estimate due to ICP inter-element interference problems. The result was reported from undiluted analyses that contained iron concentrations above the level present in the interference check sample (ICS) solution, therefore the applied inter-element correction (IEC) factors may not sufficiently compensate.
For chromium: the value reported may be biased low. However, the presence of the analyte in the sample is not in doubt.
For antimony and copper the value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

J[2] The analyte was positively identified, however the reported value is an estimate due to matrix spike recovery results being outside method quantitation control limits. The reported value may be bias low. However, the presence of the analyte in the sample is not in doubt.

J[3] The analyte was positively identified, however the reported value is an estimate due to the serial dilution percent differences being outside the method quantitation control limits. The value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with

any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$SQL\left(\frac{mg}{kg\ dry\ wgt}\right) = CRDL\left(\frac{\mu g}{L}\right) \times \frac{1\ mg}{1000\ \mu g} \times \frac{final\ volume\ (mL)}{sample\ weight\ (g\ wet\ wgt)\ \times\ \%S} \times \frac{1L}{1000\ mL} \times \frac{1000\ g}{1\ kg} \times DF$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Sample weight (g wet wgt) is the weight of the sample used for analysis
% S is % solids value divided by 100; % solids is determined as follows: (g dry weight of sample used for analysis)/(g wet weight of sample used for analysis) x100%
DF is the dilution factor for the instrumental analysis

2.4.2. Hazardous Waste Quantity

Tier A: Hazardous Constituent Quantity

The information available is not sufficient to meaningfully evaluate Tier A, hazardous constituent quantity; therefore it is not possible to adequately determine a hazardous constituent quantity for the Waste Rock Pile (Ref. 1, Section 2.4.2.1.1). Scoring proceeds to the evaluation of Tier B, hazardous wastestream quantity (Ref. 1, Section 2.4.2.1.2).

Hazardous Constituent Quantity Value: NE

Tier B: Hazardous Wastestream Quantity

The information available is not sufficient to accurately evaluate Tier B, hazardous wastestream quantity; therefore it is not possible to adequately determine a hazardous wastestream quantity for the Waste Rock Pile (Ref. 1, Section 2.4.2.1.1). Scoring proceeds to the evaluation of Tier C, volume (Ref. 1, Section 2.4.2.1.2).

Hazardous Wastestream Quantity Value: NE

Tier C: Volume

In November 2008, a geotechnical investigation was conducted on the Blue Ledge Mine facility. During the investigation, the volume of waste rock piles WRP-1 through WRP-4 was calculated. WRP-1 had an estimated volume of 20,000 cubic yards, WRP-2 had an estimated volume of 5,000 cubic yards, WRP-3 had an estimated volume of 5,000 cubic yards, and WRP-4 had an estimated volume of 1,000 cubic yards (Ref. 18, p. 17,. 51 through 53) The thicknesses were estimated by comparing local rock outcrop elevations with the undisturbed waste rock slope face. The investigation concluded that there may be considerable variability between the interpolated thicknesses and actual thickness due to bedrock surface irregularity (Ref. 18, p. 17).

In July and August 2010, removal activities occurred under USFS oversight on the Blue Ledge Mine facility. A total of 54,700 cubic yards of waste rock was removed from WRP-1 and WRP-2. WRP-2 was removed in its entirety and approximately 95 percent of WRP-1 was removed. In addition, 2,100 cubic yards of waste rock was removed from WRP-4, with an estimated 2,000 cubic yards remaining. There was no removal conducted on WRP-3. The USFS estimates that WRP-3 is approximately 11,600 cubic yards (Ref. 35).

Utilizing conservative volume estimates, approximately 1,000 cubic yards remains in WRP-1, 5,000 cubic yards remains in WRP-3, and 1,000 cubic yards remains in WRP-4; totaling 7,000 cubic yards of waste rock (Ref. 18, p. 17; Ref. 35).

The Waste Rock Pile is characterized as a Pile. This provides a Hazardous Waste Quantity Value of (Ref. 1, Table 2-5):

7,000 cubic yards/2.5 = 2,800

Volume Assigned Value: 2,800

Tier D: Area

The volume was adequately determined for the Waste Rock Pile; therefore it is not necessary to determine an area for Source 1 (Ref. 1, Section 2.4.2.1.2).

Area Assigned Value: NE

Source Hazardous Waste Quantity Value

According to Section 2.4.2.1.5 of the HRS, the highest of the values assigned to the source for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), Volume (Tier C), and Area (Tier D) should be assigned as the source hazardous waste quantity value (Ref. 1, Section 2.4.2.1.5).

Tier Evaluated	Source 1 Values
A	NE
B	NE
C	2,800[1]
D	0

Notes:

[1] Value selected for the source hazardous waste quantity according to the HRS.
NE Not Evaluated.

Source Hazardous Waste Quantity Value: 2,800

SOURCE DESCRIPTION

2.2 Source Characterization

Name of Source: Adit 1N Acid Mine Drainage
Number of Source: Source 2
Source Type: Other

The Blue Ledge Mine was discovered by panners in approximately 1898. Inception, initial ownership, and significant development of the mine occurred between 1902 and 1909. The mine experienced periods of activity and inactivity over the next 20 years. Extensive excavations were undertaken, and a substantial amount of waste rock was generated as mine workings were developed and ore was removed. Mining cars carried extracted materials from the interior of the mine to mine adits atop the Blue Ledge Mine. The separated ore was trammed down the hillside via an overhead cable to a location close to Joe Creek (Ref. 7, p. 5, 6; Ref. 10, p. 9, 13).

Ground water discharging from Adit 1N has been identified as a hazardous substance source on the Blue Ledge Mine facility. In 2008, groundwater from Adit 1N was observed discharging from the adit and flowing over the log waste rock dam into Joe Creek (Ref. 4, p. 12, 14, 85). In June 2010, groundwater from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile for approximately 100 feet before it percolated below the waste rock surface. Previous investigations have documented increased sulfate concentrations and acidity emerging from the Blue Ledge Mine adits (Ref. 4, p. 13). In July 2010, the AMD exhibited an acidic pH of 2.6 (Ref. 16, p. 5). The sulfide deposits on the Blue Ledge Mine facility provide a continuing source of AMD. AMD is continually formed by a weathering process that oxidizes sulfur-bearing minerals to sulfate and acidity. The AMD process is further expedited by oxidation of the reduced minerals by microbes. The production of acidity at the Blue Ledge Mine facility causes metals to leach from surrounding waste rock as water percolates through the scattered waste piles. During periods of higher precipitation, the AMD infiltrates through the waste rock and leaches metals. The finer the waste particle, the more surface area is available for the AMD to leach metals from (Ref. 10, p. 16).

USFS personnel have observed ground water discharging from Adit 1N throughout late spring to fall. Due to the elevation of the Blue Ledge Mine facility, access to the mine is limited during winter and early spring to snowmobiles. USFS personnel have not visited the site during these seasons, and therefore have not documented ground water discharging from the adit perennially (Ref. 39).

The Waste Rock Pile is located on the Blue Ledge Mine facility, and is comprised of a majority of the waste rock on the facility (Ref. 8, p. 12, Figure 1-2). During investigations conducted in 2008 and 2010, ground water from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile towards Joe Creek (Ref. 5, p. 7, 8; Ref. 8, p. 78). In 2008, the ground water discharging from Adit 1N flowed from the adit directly into Joe Creek (Ref. 4, p. 12). In June 2010, the ground water discharging from Adit 1N was observed flowing from the adit for approximately 100 feet before percolating into the

Waste Rock pile (Ref. 5, p. 7, 8). A log dam, constructed during mining operations, is present at the base of the slope where the deepest deposits are located (Ref. 5, p. 4; Ref. 8, p. 78; Ref. 11, p. 5, p. 25).

Source Location

The Acid Mine Drainage is ground water discharging from Adit 1N (Ref. 5, p.7). Adit 1N is located on the Waste Rock Pile, in the area referred to as WRP-1 in previous reports (Ref. 8, p. 17, 78).

Source Containment

Release to surface water:

In 2006, the WRP-1 was terraced and regraded in an effort to redirect AMD to a channel-lined with marble boulders. A setline basin was constructed behind the log dam to trap sediment eroded from the waste rock piles. The goal was to stabilize the slope, reduce erosion, and provide passive treatment of acidic run-off. In 2007, it was observed that the marble boulders became coated with iron precipitates in approximately three weeks after construction and the sedimentation basin quickly filled with sediment. It was observed that run-off and AMD from higher on the slope flow in an undeveloped and unlined channel until directed into the settling pond by a marble berm. During periods of heavy precipitation, run-off overtops the log dam and drains into Joe Creek (Ref. 8, p. 14, 15, 92 through 94).

During investigations conducted in June 2008, ground water was observed discharging from Adit 1N and flowing over the Waste Rock pile directly to Joe Creek. It was observed to be flowing down the run-off channel into the settling pond behind the log dam, where it overtopped the dam and discharged into Joe Creek (Ref. 4, p. 22; Ref. 8, p. 94).

In June 2010, the ground water discharging from Adit 1N was observed flowing from the adit for approximately 100 feet before percolating into the Waste Rock pile (Ref. 5, p. 7, 8).

In April 1992, the USFS collected surface water samples from the mine drainage. Analytical results indicated that the mine drainage contained cadmium, copper and zinc at levels exceeding EPA freshwater criteria. In addition, the mine drainage sample exhibited an acidic pH of 3.1 (Ref. 4, p. 12).

In September 2000, April 2001 and August 2001, the USFS conducted investigations on the Blue Ledge Mine facility and collected samples from the onsite run-off channel, Joe Creek, and Elliott Creek. Analytical results indicated that concentrations of cadmium, copper, iron, lead and zinc in Joe Creek increased significantly in surface water downstream of the Blue Ledge Mine facility (Ref. 4, p. 12).

In June 2008, the USFS collected surface water samples from the onsite adits and seeps. Water sampled from Adit 1N exhibited concentrations of cadmium (70.9 ug/l), copper (194,000 ug/l), lead (8.64 ug/l) and zinc (300,000 ug/l). In addition, drainage from Adit 1N exhibited a pH of 2.4 (Ref. 4, 53 and 538).

2.4.1 Hazardous Substances

As part of the June and July 2010 HRS sampling event on the Blue Ledge Mine facility, ground water discharging from Adit 1N was collected and sampled. The sample was collected adjacent to the discharge point and filtered prior to being capped (Ref. 16, p. 5; Ref. 17, p. 20).

The Adit 1N surface water samples were submitted to a laboratory for definitive metals analysis. The samples were analyzed for total metals using EPA test method ILM05.4 (Ref. 29, p. 2). The data validation results are in Reference 29.

Summarized below is analytical evidence of contamination in source samples associated with the Adit 1N Acid Mine Drainage located on the Blue Ledge Mine facility.

Source 2:

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (ug/L)	SQL (ug/L)	References
Arsenic	BLM-SW-6 (MY6ZF9)	7/1/10	18.1 J[1]	1.0	Ref. 16, p. 5; Ref. 29, p. 6, 11; Ref. 33, p. 11, 18, 34, 40, 43, 67, 68, 73, 74, 75; Ref. 40, p. 4
Cadmium	BLM-SW-6 (MY6ZF9)	7/1/10	887	1.0	
Chromium	BLM-SW-6 (MY6ZF9)	7/1/10	37.2	2.0	
Cobalt	BLM-SW-6 (MY6ZF9)	7/1/10	65.8	1.0	
Copper	BLM-SW-6 (MY6ZF9)	7/1/10	160,000	400	
Lead	BLM-SW-6 (MY6ZF9)	7/1/10	186 J[1]	2.0	
Manganese	BLM-SW-6 (MY6ZF9)	7/1/10	3,180 J[1]	2.0	
Nickel	BLM-SW-6 (MY6ZF9)	7/1/10	201	1.0	
Selenium	BLM-SW-6 (MY6ZF9)	7/1/10	5.1 J[1]	5.0	
Silver	BLM-SW-6 (MY6ZF9)	7/1/10	4.0	1.0	
Zinc	BLM-SW-6 (MY6ZF9)	7/1/10	236,000	800	

Notes:

J[1]: The analyte was positively identified, however the internal standard percent relative intensity results are outside the method control limit. However, the presence of the analyte is not in doubt.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$\text{SQL } (\mu g / L) = \text{CRDL } \left(\frac{\mu g}{L}\right) \times \frac{\text{final volume (mL)}}{\text{initial volume (mL)}} \times \text{DF}$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Initial volume (mL) is the volume of sample used
DF is the dilution factor

2.4.2. Hazardous Waste Quantity

Tier A: Hazardous Constituent Quantity

The information available is not sufficient to meaningfully evaluate Tier A, hazardous constituent quantity; therefore it is not possible to adequately determine a hazardous constituent quantity for the Adit 1N Acid Mine Drainage (Ref. 1, Section 2.4.2.1.1). Scoring proceeds to the evaluation of Tier B, hazardous wastestream quantity (Ref. 1, Section 2.4.2.1.2).

Hazardous Constituent Quantity Value: NE

Tier B: Hazardous Wastestream Quantity

Numerous discharge measurements have been calculated for the ground water discharging from Adit 1N. A majority of the measurements were collected during the dry season in the summer months. In the summers of 2007 and 2008, a measurement of approximately 0.5 gallons per minute (gpm) was observed discharging from the adit. The discharge is reportedly higher during the wetter months of the year (Ref. 8, p. 17).

Pete Jones, a geologist with the USFS, has been visiting the Blue Ledge Mine facility since 1995. Mr. Jones has observed ground water discharging from Adit 1N every year for the last 15 years. He stated that the flow has been a consistent one to two gpm during the summer months and has a heavier flow of two to five gpm during the spring months (Ref. 9).

Using a conservative flow rate estimate for the spring and summer seasons, the following hazardous wastestream quantity is calculated:

Month	Conservative Flow Rate	Monthly Discharge Rate*	Quantity**
March (31 days)	2 gpm	2 gallons/minute x 31 days = 89,280 gallons	892,800 pounds
April (30 days)	2 gpm	2 gallons/minute x 30 days = 86,400 gallons	864,000 pounds
May (31 days)	2 gpm	2 gallons/minute x 31 days = 89,280 gallons	892,800 pounds
June (30 days)	1 gpm	1 gallon/minute x 30 days = 43,200 gallons	432,000 pounds

Month	Conservative Flow Rate	Monthly Discharge Rate*	Quantity**
July (31 days)	1 gpm	1 gallon/minute x 31 days = 44,640 gallons	446,400 pounds
August (31 days)	1 gpm	1 gallon/minute x 31 days = 44,640 gallons	446,400 pounds
		Total:	**3,974,400 pounds**
		x 15 years	**59,616,000 pounds**

Notes:

*Calculated using 1 day = 24 hours = 1,440 minutes
**200 gallons = 2,000 pounds (Ref. 1, Table 2-5)

59,616,000 pounds / 5,000 = 11,923.2

Hazardous Wastestream Quantity Value: 11,923.2

Tier C: Volume

The hazardous wastestream quantity was adequately determined for the Adit 1N Acid Mine Drainage; therefore it is not necessary to determine a volume for the Adit 1N Acid Mine Drainage (Ref. 1, Section 2.4.2.1.2).

Volume Assigned Value: NE

Tier D: Area

The hazardous wastestream quantity was adequately determined for the Adit 1N Acid Mine Drainage; therefore it is not necessary to determine an area for the Adit 1N Acid Mine Drainage (Ref. 1, Section 2.4.2.1.2).

Area Assigned Value: NE
SD-Source Hazardous Waste Quantity Value
Source 2: Adit 1N Acid Mine Drainage

Source Hazardous Waste Quantity Value

According to Section 2.4.2.1.5 of the HRS, the highest of the values assigned to the source for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), Volume (Tier C), and Area (Tier D) should be assigned as the source hazardous waste quantity value (Ref. 1, Section 2.4.2.1.5).

Tier Evaluated	Source 2 Values
A	NE
B	11,923.2[1]
C	NE
D	NE

Notes:

[1] Value selected for the source hazardous waste quantity according to the HRS.
NE Not Evaluated.

Source Hazardous Waste Quantity Value: 11,932.2

SITE SUMMARY OF SOURCE DESCRIPTIONS

Source No.	Source Hazardous Waste Quantity Value	Containment			
		Ground Water	Surface Water	Gas	Air Particulate
1	2,800	NE	10[1]	NE	NE
2	11,923.2	NE	10[1]	NE	NE
TOTAL	**14,723.2**				

Notes:
[1] = Ref. 1, Table 4-2
NE = Not Evaluated.

POSSIBLE SOURCES NOT SCORED

- Unnamed adit on WRP-1. In August 2010, the USFS was conducting a removal of the waste rock from the Blue Ledge Mine facility. On August 18, 2010, while removing waste rock from the hillside of WRP-1, an excavator uncovered wet soil, eventually rupturing an unmapped adit. Approximately 250 cubic yards of mine rock was eroded (Ref. 9; Ref. 19). The exact volume of water released is unknown, but was estimated to be 50,000 gallons to 75,000 gallons. The adit was sandbagged following the release; however ground water continues to be discharging from the unnamed adit at a rate of approximately two to five gpm. In addition, three dry adits were uncovered prior to the August 2010 release. Subsequently, a dry shaft and another flowing adit were exposed during the waste rock removal. One of these adits has a pool of standing water but does not appear to be flowing (Ref. 9).

3.0 GROUND WATER PATHWAY

The ground water pathway was not scored during this evaluation. There are no known uses of ground water on the Blue Ledge Mine facility. Residences in the Joe Bar community utilize wells and springs for drinking water that are supplied by ground water beneath their property. Existing analytical data indicate that arsenic, cadmium, copper, lead and zinc were detected in two residences drinking water wells and one spring used for drinking water. Only detections of dissolved arsenic exceeded associated screening criteria with concentrations ranging from 0.22 micrograms per liter (ug/l) to 6.27 ug/l. Although arsenic was detected in all three ground water sources, there was no evidence that the levels were related to concentrations of arsenic detected in surface water adjacent to the Blue Ledge Mine facility, but rather to be due to high levels of arsenic in local soils (Ref. 4, p. 20, 21, 54, 139; Ref. 8, p. 20, 21).

4.0 SURFACE WATER MIGRATION PATHWAY

4.1 OVERLAND/FLOOD MIGRATION COMPONENT

4.1.1 General Considerations

The Blue Ledge Mine facility is located within the Rogue River-Siskiyou National Forest in Siskiyou County, California (Ref. 3). The facility is located on rural patented land approximately 3 miles south of the California-Oregon border. The mine spans in elevation from about 4,000 to 4,800 feet above mean sea level (Ref. 3; Ref. 4, p. 6). A site location map is presented in Figure A-1.

The target distance limit (TDL) for the surface water pathway, which defines the maximum distance over which targets are considered, is 15 miles. During the HRS Sampling conducted in June and July 2010, the most downstream probably point of entry (PPE) evaluated was located in Joe Creek at the base of WRP-1 (See Figure A-2) (Ref. 5, p. 5, 6). The most upstream PPE evaluated was located in the drainage below WRP-3, which drains into an unnamed tributary and then into Joe Creek (See Figure A-2) (Ref. 8, p. 17).

The mine lies at the upper headwaters of the Joe Creek Watershed, on a steep, generally north-facing hillslope. From the facility, Joe Creek flows north for approximately 3.4 miles to its confluence with Elliott Creek. From this confluence, Elliott Creek continues west and discharges to the Middle Fork Applegate River, just upstream of the Applegate Reservoir. The Applegate Reservoir is approximately 8 miles downstream of the Blue Ledge Mine facility (Ref. 4, p. 6, 21).

One-third of the Joe Creek watershed is located within the transient snow zone (above 4,000 feet) and can receive moisture as either rain or snow. Given that most of the precipitation occurs during winter months, rain-on-snow events are not uncommon and are the primary cause of flooding in the Upper Applegate watershed. Pulses of runoff occurring during these times create a high risk of mass wasting and surface erosion (Ref. 10, p. 24).

The Western Regional Climate Center reports that the average total precipitation in the vicinity of the site is approximately 49.46 inches. This average is based on records that span between March 1914 and July 2010 (Ref. 36).

Waste rock and exposed minerals in abandoned underground workings, excavation, etc. are oxidized during all times of the year, except in cases when rock surfaces are submerged. Such processes are greatest during the dry period from July to November. High flow periods in the spring months offer the greatest opportunity to flush the metals that have accumulated from the oxidation of the summer months and transport them downstream (Ref. 10, p. 24, 25).

In June 2008, stream discharge measurements were collected from Joe Creek, Elliott Creek, and the Middle Fork Applegate River as part of an SI investigation. Discharge measurements were made using the Velocity-Area Procedure wherein the mean velocity and flow cross-sectional areas of many increments across a channel were measured using an impeller-style flow meter, from which subtotals of the stream discharge could be calculated. Joe Creek exhibited a stream discharge of 8.0 cubic feet per second (cfs), above its confluence with Elliott Creek; Elliott Creek exhibited a stream discharge of 87 cfs above the

confluence with Joe Creek; Elliott Creek exhibited a stream discharge of 266 cfs above the confluence with the Middle Fork Applegate River; and the Middle Fork Applegate River exhibited a stream discharge of 286 cfs above the confluence with Elliott Creek (Ref. 4, p. 22).

In 2000 and 2001, stream-dwelling amphibians were studied during the fall and spring. Various life stages of tailed frog (*Ascaphus truei*) and Pacific giant salamander (*Dicamptodon tenebrosus*) were found upstream of the Blue Ledge Mine facility in both surveys. No amphibians were counted directly downstream of the mine and a maximum of only three were found further downstream (Ref. 10, p. 34).

The watershed between the mine and Applegate Reservoir hosts resident rainbow trout and cutthroat trout populations; Pacific lamprey and reticulate sculpin may also inhabit the watershed. Elliott Creek contains approximately 20.4 miles of resident rainbow and cutthroat trout fish habitat (Ref. 10, p. 13). Historically, fish such as fall Chinook, Coho salmon, Pacific lamprey, and steelhead migrated to the watershed holding Joe and Elliott Creeks. Since the Applegate Dam was constructed in the late 1970s, these migrations have ceased. Currently, no fish reside in Joe Creek (Ref. 4, p. 12; Ref. 10, p. 13).

Pete Jones of the USFS has been working on the Blue Ledge Mine facility since approximately 1995. Mr. Jones stated that he has observed people fishing in Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir on numerous occasions (Ref. 9). In June and July 2010, during the HRS Sampling event, people were observed fishing in the Middle Fork Applegate River, downstream of its confluence with Elliott Creek, and in the Applegate Reservoir (Ref. 5, p. 11).

The Applegate Reservoir, located approximately 8 miles downstream of the Blue Ledge Mine facility is an active fishery in southern Oregon (Ref. 4, p. 6, 21; Ref. 5, p. 11; Ref. 15, p. 2 through 42). The Applegate Reservoir, commonly referred to as Applegate Lake, was created in 1980 by impounding the Applegate River and several major tributaries including Carberry, Squaw and Elliott creeks. The reservoir is relatively deep, having a maximum depth of 233 feet and a mean depth of 83 feet. The Applegate Reservoir is managed as a two-story recreational fishery with stocked coldwater species (rainbow and steelhead trout, and Chinook and Coho salmon) and naturally produced warmwater species (smallmouth and largemouth bass, bluegill, black crappie, and brown bullhead) (Ref. 15, p. 9, 10).

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

The hazardous substance migration path includes both the overland and the in-water segment that hazardous substances would take as they migrate away from sources at the facility (Ref. 1, Section 4.1.1.1). Hazardous substance migration path overland and in-water segments for the sources are described below.

Overland Segments

(1) **Source 1 – Waste Rock Pile**

As described above, the "toe" of WRP-1 is bounded by Joe Creek. There is no overland migration pathway since hazardous substances migrating from the waste sources would enter directly into this surface water body. WRP-1 extends from two formerly productive adits, Adit 1S and Adit 1N, down to Joe Creek. Waste rock from WRP-1 pile was observed in direct contact with Joe Creek in June and July 2010 (Ref. 5, p. 5, 6). A log dam, constructed during mining operations, is present at the base of the slope where the deepest deposits are located (Ref. 5, p. 10). In addition, an unnamed ephemeral tributary of Joe Creek flows along the western edge of WRP-1 and is completely covered by the waste rock in the area near the log dam (Ref. 5, p. 9; Ref. 8, p. 78, Ref. 11, p. 5).

A seasonal drainage gully runs through the lower portions of WRP-3. The gully drains into an unnamed tributary, which then discharges to Joe Creek (Ref. 8, p. 17).

(2) **Source 2 – Adit 1N Acid Mine Drainage**

The Waste Rock Pile is located on the Blue Ledge Mine facility, and is comprised of a majority of the waste rock on the facility. A portion of the Waste Rock pile extends from two formerly productive adits, Adit 1S and Adit 1N, to Joe Creek (Ref. 5,, p. 3). During a 2008 investigations, ground water from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile to Joe Creek (Ref. 8, p. 94). In June and July 2010, the flow from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile towards Joe Creek until it seeped back into the pile approximately 100 feet downhill of the adit (Ref. 5, p. 7, 8).

In 2006, the Waste Rock pile was terraced and re-graded in an effort to redirect AMD to a channel-lined with marble boulders. A setline basin was constructed behind the log dam to trap sediment eroded from the waste rock piles. The goal was to stabilize the slope, reduce erosion, and provide passive treatment of acidic run-off. In 2007 and 2008, it was observed that the marble boulders became coated with iron precipitates in approximately three weeks after construction and the sedimentation basin quickly filled with sediment (Ref. 8, p. 92 through 94). It was observed that run-off and AMD from higher on the slope flow in an undeveloped and unlined channel until directed into the settling pond by a marble berm. During periods of heavy precipitation, run-off overtops the log dam and drains into Joe Creek (Ref. 8, p. 14, 15). In June 2010, run-off was observed overtopping the log dam and draining into Joe Creek (Ref. 5, p. 10).

There does not appear to be adequate containment to prevent the migration of hazardous substances present in the Adit 1N Acid Mine Drainage (Ref. 5, p. 1, 7).

In-Water Segments

The in-water segment begins at the PPE to an eligible surface water body as defined in the HRS final rule (Ref. 1, Section 4.0.2). Eligible surface water bodies that have been determined to be part of the in-water segment for the Blue Ledge Mine include Joe Creek. Rationale for including these as eligible surface water bodies is provided below.

The TDL for the surface water pathway, which defines the maximum distance over which targets are considered, is 15 miles. The TDL is defined as being 15 miles from the furthest downstream PPE in the in-water segment section. The 15-mile surface water flow path is presented in Figure A-5 and is described below.

(1) **Source 1 –Waste Rock Pile**

In June and July 2010, the "toe" or northeast boundary of WRP-1 pile was observed to be in direct contact with Joe Creek (Ref. 5, p. 5, 6). Once hazardous substances have entered Joe Creek, they migrate downstream (Ref. 29, p. 11). From the facility, Joe Creek flows north for approximately 3.4 miles to its confluence with Elliott Creek. From this confluence, Elliott Creek continues west and discharges to the Middle Fork Applegate River, just upstream of the Applegate Reservoir. The Applegate Reservoir is approximately 8 miles downstream of the Blue Ledge Mine facility (Ref. 4, p. 6, 21; Figure A-5 of the documentation record).

(2) **Source 2 – Adit 1N Acid Mine Drainage**

During investigations conducted in June 2008, groundwater was observed discharging from Adit 1N and flowing over the Waste Rock pile to Joe Creek. It was observed to be flowing down the run-off channel into the settling pond behind the log dam, where it overtopped the dam and discharged into Joe Creek (Ref. 4, p. 22). Once hazardous substances have entered Joe Creek, they migrate downstream (Ref. 29, p. 11). From the facility, Joe Creek flows north for approximately 3.4 miles to its confluence with Elliott Creek. From this confluence, Elliott Creek continues west and discharges to the Middle Fork Applegate River, just upstream of the Applegate Reservoir. The Applegate Reservoir is approximately 8 miles downstream of the Blue Ledge Mine facility (Ref. 4, p. 6, 21; Figure A-5 of the documentation record).

4.1.2.1 LIKELIHOOD OF RELEASE

4.1.2.1.1 Observed Release

Direct Observation

- Basis for Direct Observation:

Observed releases by direct observation are documented below.

Source 1 - Direct Contact

In June and July 2010, waste rock from Source 1 was observed to be in direct contact with Joe Creek (Ref. 5, p. 5, 6). An unnamed ephemeral tributary of Joe Creek flows along the western edge of WRP-1 and is completely covered by the waste rock in the area near the log dam (Ref. 5, p. 9; Ref. 8, p. 78; Ref. 11, p. 5).

Surface water sample BLM-SW-4, collected in Joe Creek directly adjacent to the direct contact, exhibited elevated concentrations of metals (Ref. 29, p. 11). This indicates that metals contamination associated with the Waste Rock Pile is in direct contact with surface water.

All four of the Source 1 samples collected in July 2010 have elevated concentrations of metals for at least one of the following analytes: Antimony (Sb), Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Manganese (Mn), Mercury (Hg), Selenium (Se), Silver (Ag), Thallium (Tl), Vanadium (V), and Zinc (Zn) (Ref. 28, p. 9).

- Hazardous Substances in the Release:

Source 1:

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Antimony	BLM-WR-1 (MY6ZE3)	7/1/10	18.2 J[1,2] (9.19)	7.03	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34,71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.6 J[1,2] (1.82)	6.73	
	BLM-WR-3 (MY6ZE5)	7/1/10	2.2 J[1,2] (1.11)	6.96	
	BLM-WR-4 (MY6ZE6)	7/1/10	2.6 J[1,2] (1.31)	7.01	
Arsenic	BLM-WR-1 (MY6ZE3)	7/1/10	301	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	124	1.12	
	~~BLM-WR-3~~	~~7/1/10~~	~~102~~	~~1.16~~	

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
	(MY6ZE5)				
	BLM-WR-4 (MY6ZE6)	7/1/10	104	1.17	
Cadmium	BLM-WR-1 (MY6ZE3)	7/1/10	3.9	0.59	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.9	0.56	
	BLM-WR-3 (MY6ZE5)	7/1/10	2.5	0.58	
	BLM-WR-4 (MY6ZE6)	7/1/10	2.6	0.59	
Chromium	BLM-WR-1 (MY6ZE3)	7/1/10	2.7 J[1, 3] (2.09)	1.17	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 5-7, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	9.8 J[1, 3] (7.6)	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	7.0 J[1, 3] (5.43)	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	9.2 J[1, 3] (7.13)	1.17	
Copper	BLM-WR-1 (MY6ZE3)	7/1/10	981 J[1, 3] (804.1)	2.93	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 5-7, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	1,290 J[1, 3] (1,057.4)	2.8	
	BLM-WR-3 (MY6ZE5)	7/1/10	314 J[1, 3] (257.38)	2.9	
	BLM-WR-4 (MY6ZE6)	7/1/10	441 J[1, 3] (361.48)	2.93	
Lead	BLM-WR-1 (MY6ZE3)	7/1/10	7,890	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	609	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	201	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	227	1.17	
Manganese	BLM-WR-1 (MY6ZE3)	7/1/10	25.4	1.76	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	182	1.68	
	BLM-WR-3 (MY6ZE5)	7/1/10	146	1.74	
	BLM-WR-4 (MY6ZE6)	7/1/10	162	1.76	
Mercury	BLM-WR-1 (MY6ZE3)	7/1/10	92.8 J[2]	5.85	Ref. 16, p. 6, 7; Ref. 20, p. 8; Ref. 28, p. 5-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 39, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	3.4 J[2]	0.11	
	BLM-WR-3 (MY6ZE5)	7/1/10	1.2 J[2]	0.12	
	BLM-WR-4	7/1/10	0.89 J[2]	0.12	

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
	(MY6ZE6)				
Selenium	BLM-WR-1 (MY6ZE3)	7/1/10	29.3	4.1	Ref. 16, p. 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	9.1	3.92	
Silver	BLM-WR-1 (MY6ZE3)	7/1/10	390	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	18.3	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	3.9	1.16	
Thallium	BLM-WR-1 (MY6ZE3)	7/1/10	6.9	2.93	Ref. 16, p. 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
Vanadium	BLM-WR-1 (MY6ZE3)	7/1/10	49.3	5.9	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	39.6	5.6	
	BLM-WR-3 (MY6ZE5)	7/1/10	40.5	5.8	
	BLM-WR-4 (MY6ZE6)	7/1/10	49.9	5.9	
Zinc	BLM-WR-1 (MY6ZE3)	7/1/10	159 J[2]	7.03	Ref. 16, p. 6, 7; Ref. 20, p. 8; Ref. 28, p. 5-6, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	193 J[2]	6.73	
	BLM-WR-3 (MY6ZE5)	7/1/10	145 J[2]	6.96	
	BLM-WR-4 (MY6ZE6)	7/1/10	138 J[2]	7.01	

Notes:

J[1]: The analyte was positively identified, however the reported value is an estimate due to ICP inter-element interference problems. The result was reported from undiluted analyses that contained iron concentrations above the level present in the interference check sample (ICS) solution, therefore the applied inter-element correction (IEC) factors may not sufficiently compensate.

For chromium: the value reported may be biased low. However, the presence of the analyte in the sample is not in doubt.

For antimony and copper the value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

J[2] The analyte was positively identified, however the reported value is an estimate due to matrix spike recovery results being outside method quantitation control limits. The reported value may be bias low. However, the presence of the analyte in the sample is not in doubt.

J[3] The analyte was positively identified, however the reported value is an estimate due to the serial dilution percent differences being outside the method quantitation control limits. The value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$SQL\left(\frac{mg}{kg\ dry\ wgt}\right) = CRDL\left(\frac{\mu g}{L}\right) \times \frac{1\ mg}{1000\ \mu g} \times \frac{final\ volume\ (mL)}{sample\ weight\ (g\ wet\ wgt)\ \times\ \%S} \times \frac{1L}{1000\ mL} \times \frac{1000\ g}{1\ kg} \times DF$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Sample weight (g wet wgt) is the weight of the sample used for analysis
% S is % solids value divided by 100; % solids is determined as follows: (g dry weight of sample used for analysis)/(g wet weight of sample used for analysis) x100%
DF is the dilution factor for the instrumental analysis

Chemical Analysis

In 2009, the USFS conducted an SI on the Blue Ledge Mine facility. During the sampling event, conducted in June 2008, a continuous overland flow path for ground water discharging from Adit 1N (also referred to as adit AD-01) and seep SP-01 to Joe Creek was observed. Ground water emerging from Adit 1N and seep SP-01 flowed down the runoff channel to the settling pond behind the log dam, where it overtopped the dam and discharged into Joe Creek. The SI field work, which included the collection of waste rock, river sediment, and riparian soil, was conducted in June 2008. In addition, water samples were collected from onsite seeps and adits, the log dam, tributaries to Joe Creek, Joe Creek, Elliott Creek, the Middle Fork Applegate River, and Applegate Reservoir (Ref. 4, p. 12 through 14). A summary of the sampling event is presented below.

Surface Water Sampling

Water samples were collected from 32 locations. In addition, field duplicate samples were collected from sample locations EC-04 and JC-07 (Ref. 4, p. 560, 567). Surface water samples were collected using clean, disposable and dedicated bailers. Clean, disposable 0.45-micron filters were used to collect field filtered samples analyzed for dissolved metals. In-situ water quality measurements at each water sample location included pH, temperature, and specific conductivity. Water samples from the seeps and the log dam could not be collected directly with a bailer. These samples were collected directly into lab-provided bottles and jars for analyses not requiring field filtering. Samples requiring filtering were collected in an unpreserved 1-liter bottle and transferred to a clean dedicated bailer with a clean, disposable 0.45-micron filter attached to its outlet, from which sample containers were filled. Of the seven adits observed at the facility, only Adit 1N and Adit 5 were discharging ground water during the field investigation. A water sample was collected from each of these adits (AD-01 and AD-02). Two seeps were observed during the field investigation. One was on the hillside to the west of WRP-1 (seep #1) and one was near the former Eileen Town site (seep #2). Both seeps were sampled (SP-01 and SP-02). Water was observed flowing over the log dam from the settling pond created as part of the 2006 EPA removal action. A single water sample, DAM-01, was collected from below the log dam (Ref. 4, p. 14). Seven surface water samples were collected from Joe Creek downstream of the facility (JC-01 through JC-04, JC-07 through JC-09). In addition, seven surface water samples were collected from Elliott Creek (EC-01 through EC-07), two surface water samples were collected from Middle Fork Applegate River (AR-01 and AR-02), and one surface water sample was collected from the Applegate Reservoir (ARV-01). Six background surface water samples were collected in Joe Creek upstream of the (JC-10 through JC-15) (Ref. 4, p. 52). All water samples were analyzed for dissolved metals (arsenic, cadmium, copper, iron, lead and zinc), sulfate,

total suspended solids (TSS), total dissolved solids (TDS), alkalinity and hardness (Ref. 4, p. 194, 537 through 573).
Analytical results indicated that dissolved cadmium, iron, lead, and TSS were not detected in any background surface water samples (Ref. 4, p. 258, 269 through 293). The detection limit for cadmium was 0.008 micrograms per liter (ug/l) (Ref. 4, p. 293). Dissolved copper and dissolved zinc were detected in all background surface water samples at concentrations ranging from 0.71 ug/l to 0.84 ug/l for copper and 0.49 ug/l to 1.1 ug/l for zinc. Dissolved cadmium was detected in all downstream surface water samples at concentrations ranging from 0.012 ug/l in ARV-1 to 0.564 ug/l in JC-01. Dissolved copper was detected in all downstream surface water samples, with the exception of AR-01, at concentrations ranging from 0.46 ug/l in EC-07 to 62.8 ug/l in JC-07. Zinc was detected in all downstream surface water samples, with the exception of AR-01, at concentrations ranging from 0.61 ug/l in EC-07 to 88.5 ug/l in JC-07. The Maximum Contaminant Levels (MCLs) for cadmium, copper, and zinc are 5.0 ug/l, 1,300 ug/l and 26,000 ug/l, respectively (Ref. 4, p. 194, 213, 236 through 238, 269 through 293).

Analytical results for the adit and seep samples detected dissolved cadmium concentrations ranging from 0.598 ug/l (AD-02) to 70.9 ug/l (AD-01), dissolved copper concentrations ranging from 4.77 (AD-02) to 194,000 ug/l (AD-01), and dissolved zinc concentrations ranging from 132 ug/l (SP-01) to 300,000 ug/l (AD-01). The log dam sample, DAM-01, exhibited dissolved metal concentrations of 33.7 ug/l cadmium, 4,680 ug/l copper, and 6,180 ug/l zinc (Ref. 4, p. 216 through 220, 290).

Sediment Sampling

Sediment samples were collected from 24 locations in Joe Creek, Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir. In addition, two field duplicates were collected from sample locations EC-04 and EC-05 (Ref. 4, p. 560, 563 through 573). Sediment samples were collected from stream channels using a shovel. Sediment that did not contact the shovel was then placed in sample jars manually while wearing clean, disposable nitrile gloves. Personnel stood downstream during sampling, and sediment sampling was performed after collection of water samples (Ref. 4, p. 15). Six background sediment samples were collected in Joe Creek upstream of the facility (JC-10 through JC-15). All sediment samples were analyzed for total metals (arsenic, cadmium, copper, iron, lead, and zinc) (Ref. 4, ,p. 52, 315, 316). Analytical results indicated that background concentrations for cadmium ranged from 0.097 milligrams per kilogram (mg/kg) to 0.214 mg/kg, concentrations for copper ranged from 34.4 mg/kg to 51.7 mg/kg, and concentrations for zinc ranged from 26.9 mg/kg to 55.6 mg/kg. Cadmium was detected in all downstream samples at concentrations ranging from 0.211 mg/kg (EC-04) to 2.8 mg/kg (JC-02). Copper concentrations ranged from 28.0 mg/kg (EC-07) to 558 mg/kg (JC-04). Zinc concentrations ranged from 59.0 mg/kg (EC-07) to 533 mg/kg (JC-02) (Ref. 4, p. 313 through 316, 370 through 404).

Sediment and surface water samples were collected at three locations during the 2010 HRS Sampling event (Ref. 17, Figure 3). Sample locations are depicted in Figure A-4. The selected samples were analyzed for metals using EPA CLPAS Method ILM05.4 (Ref. 28, p. 2; Ref. 29, p. 2).

- Joe Creek Sediment Background Concentrations:

The surface water sediments were collected within the first six inches of sediment using a dedicated plastic scoop (Ref. 16, p. 1 through 8; Ref. 17, p. 22, 23). The background samples were collected on the same day of collecting the release samples (Ref. 16, p. 8). The background sediment samples, BLM-SD-1 and BLM-SD-2, were homogenized and dewater prior to being transferred to glass jars (Ref. 16, p. 4).

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Copper	BLM-SD-1 (MY6ZE8)	6/30/10	44.2 J[1]	2.76	Ref. 16, p. 4; Ref. 20, p. 8; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 16, 17, 34, 71 - 80; Ref. 40, p. 3
	BLM-SD-2 (MY6ZE9)	6/30/10	44.1 J[1]	3.13	
Lead	BLM-SD-1 (MY6ZE8)	6/30/10	1.4 J[1]	1.11	Ref. 16, p. 4; Ref. 20, p. 8; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 16, 17, 34, 71 - 80; Ref. 40, p. 3
	BLM-SD-2 (MY6ZE9)	6/30/10	1.2 J[1]	1.25	
Mercury	BLM-SD-1 (MY6ZE8)	6/30/10	0.045 J[2] (0.082)	0.11	Ref. 16, p. 4; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9, 10; Ref. 32, p.1, 9, 16, 17, 39, 71 - 80; Ref. 40, p. 3
	BLM-SD-2 (MY6ZE9)	6/30/10	0.081 J[2] (0.148)	0.13	
Zinc	BLM-SD-1 (MY6ZE8)	6/30/10	38.4 J[2] (57.6)	6.66	Ref. 16, p. 4; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 16, 17, 34,71 - 80; Ref. 40, p. 3
	BLM-SD-2 (MY6ZE9)	6/30/10	34.9 J[2] (52.35)	7.5	

Notes:

J[1]: The analyte was positively identified, however the reported value is an estimate due to ICP inter-element interference problems. The result was reported from undiluted analyses that contained iron concentrations above the level present in the interference check sample (ICS) solution, therefore the applied inter-element correction (IEC) factors may not sufficiently compensate.
For copper and lead: the value reported may be biased high. However, the presence of the analyte in the sample is not in doubt.

J[2] The analyte was positively identified, however the reported value is an estimate due to matrix spike recovery results being below the control limits. The reported value may be biased low. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$\text{SQL}\left(\frac{\text{mg}}{\text{kg dry wgt}}\right) = \text{CRDL}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \frac{1\text{ mg}}{1000\ \mu\text{g}} \times \frac{\text{final volume (mL)}}{\text{sample weight (g wet wgt)} \times \%\text{S}} \times \frac{1\text{L}}{1000\text{ mL}} \times \frac{1000\text{ g}}{1\text{ kg}} \times \text{DF}$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Sample weight (g wet wgt) is the weight of the sample used for analysis
% S is % solids value divided by 100; % solids is determined as follows: (g dry weight of sample used for analysis)/(g wet weight of sample used for analysis) x100%
DF is the dilution factor for the instrumental analysis

- Joe Creek Sediment Contaminated Samples:

Sediment samples identified as "contaminated" are those that meet observed release criteria as defined by the HRS (Ref. 1, Table 2-3). Observed release criteria is met when the hazardous substance is attributable to on-site sources, its concentration exceeds the sample quantitation limit (SQL) (including the background SQL), and is at least three times greater than the background concentration for metals (Ref. 1, Table 2-3; Ref. 20, p. 4).

Contaminated samples BLM-SD-3, BLM-SD-4 and BLM-SD-5 were collected using the same procedures as the background sediment samples (Ref. 16, p. 5 through 8). Sediment sample locations are presented in Figure A-4.

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Copper	BLM-SD-4 (MY6ZF1)	6/30/10	289 J[1] (236.89)	2.93	Ref. 16, p. 2, 3; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9, 10; Ref. 32, p.1, 9, 19, 20, 34, 71 -80; Ref. 40, p. 3
	BLM-SD-5 (MY6ZF2)	6/30/10	447 J[1] (366.39)	3.35	
Lead	BLM-SD-4 (MY6ZF1)	6/30/10	40.0 J[1] (27.78)	1.17	Ref. 16, p. 2, 3; Ref. 20, p. 8, 18; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 19, 20, 34, 71 - 80; Ref. 40, p. 3
	BLM-SD-5 (MY6ZF2)	6/30/10	7.8 J[1] (5.42)	1.34	
Mercury	BLM-SD-4 (MY6ZF1)	6/30/10	0.46 J[2]	0.12	Ref. 16, p. 3; Ref. 20, p. 8; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 19, 20, 39, 71 - 80; Ref. 40, p. 3
Zinc	BLM-SD-4 (MY6ZF1)	6/30/10	321 J[2]	7.02	Ref. 16, p. 2, 3; Ref. 20, p. 8; Ref. 28, p. 4-6, 9, 10; Ref. 32, p. 1, 9, 19, 20, 34, 71 - 80; Ref. 40, p. 3
	BLM-SD-5 (MY6ZF2)	6/30/10	176 J[2]	8.04	

Notes:

J[1]: The analyte was positively identified, however the reported value is an estimate due to ICP inter-element interference problems. The result was reported from undiluted analyses that contained iron concentrations above the level present in the interference check sample (ICS) solution, therefore the applied inter-element correction (IEC) factors may not sufficiently compensate.

For copper and lead: the value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

J[2] The analyte was positively identified, however the reported value is an estimate due to matrix spike recovery results being below the control limits. The reported value may be biased low. However, the presence of the analyte in the sample is not in doubt.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$\text{SQL}\left(\frac{\text{mg}}{\text{kg dry wgt}}\right) = \text{CRDL}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \frac{1\text{ mg}}{1000\ \mu\text{g}} \times \frac{\text{final volume (mL)}}{\text{sample weight (g wet wgt)} \times \%\text{S}} \times \frac{1\text{L}}{1000\text{ mL}} \times \frac{1000\text{ g}}{1\text{ kg}} \times \text{DF}$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Sample weight (g wet wgt) is the weight of the sample used for analysis
% S is % solids value divided by 100; % solids is determined as follows: (g dry weight of sample used for analysis)/(g wet weight of sample used for analysis) x100%
DF is the dilution factor for the instrumental analysis

- Surface Water Background Concentrations:

The surface water samples were collected by immersing the sample container beneath the surface and opening the cap. Surface water samples were then filtered into a new sample container. Prior to capping the sample container, nitric acid was added as a preservative with a pH of less than 2 (Ref. 16, p. 4). The background samples were collected on the same day of collecting the release samples (Ref. 16, p. 8).

Contaminated samples BLM-SW-4 and BLM-SW-5 were collected using the same procedures as the background surface water samples (Ref. 16, 5 through 8; Ref 17, p. 17; Ref. 42). Surface water sample locations are presented in Figure A-4.

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Copper	BLM-SW-1 (MY6ZF4)	6/30/10	1.0 J[1]	2.0	Ref. 16, p. 4; Ref. 20, p. 8; Ref. 29, p. 4, 11; Ref. 33, p. 11, 13, 14, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-2 (MY6ZF5)	6/30/10	0.83 J[1]	2.0	
Manganese	BLM-SW-1 (MY6ZF4)	6/30/10	1.7	1.0	Ref. 16, p. 4; Ref. 29, p. 4, 11; Ref. 33, p. 11, 13, 14, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-2 (MY6ZF5)	6/30/10	1.6	1.0	
Zinc	BLM-SW-1 (MY6ZF4)	6/30/10	3.7	2.0	Ref. 16, p. 4; Ref. 29, p.4, 11; Ref. 33, p. 11, 13, 14, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-2 (MY6ZF5)	6/30/10	2.0 U	2.0	

Notes:

J[1]: The analyte was positively identified, however the results are above the method detection limit but below the contract required quantitation limit.

U: The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$\text{SQL } (\mu g / L) = \text{CRDL } \left(\frac{\mu g}{L}\right) \times \frac{\text{final volume (mL)}}{\text{initial volume (mL)}} \times \text{DF}$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Initial volume (mL) is the volume of sample used
DF is the dilution factor

- Surface Water Contaminated Samples:

Surface water samples identified as "contaminated" are those that meet observed release criteria as defined by the HRS (Ref. 1, Table 2-3). Observed release criteria is met when the hazardous substance is attributable to on-site sources, its concentration exceeds the SQL (including the background SQL), and is at least three times greater than the background concentration when the background concentration equals or exceeds the SQL (Ref. 1, Table 2-3; Ref. 20, p. 4).

Joe Creek Contaminated Surface Water Samples:

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Copper	BLM-SW-4 (MY6ZF7)	6/30/10	94.0	2.0	Ref. 16, p. 2, 3; Ref. 29, p. 11; Ref. 33, p. 12, 16, 17, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-5 (MY6ZF8)	6/30/10	62.2	2.0	
Manganese	BLM-SW-4 (MY6ZF7)	6/30/10	8.6	1.0	Ref. 16, p. 2, 3; Ref. 29, p. 11; Ref. 33, p. 12, 16, 17, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-5 (MY6ZF8)	6/30/10	6.4	1.0	
Zinc	BLM-SW-4 (MY6ZF7)	6/30/10	179	2.0	Ref. 16, p. 2, 3; Ref. 29, p. 11; Ref. 33, p. 12, 16, 17, 40, 67, 73; Ref. 40, p. 5
	BLM-SW-5 (MY6ZF8)	6/30/10	111	2.0	

Notes:

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$SQL\ (\mu g / L) = CRDL\ \left(\frac{\mu g}{L}\right) \times \frac{\text{final volume (mL)}}{\text{initial volume (mL)}} \times DF$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Initial volume (mL) is the volume of sample used
DF is the dilution factor

Attribution:

The Blue Ledge Mine facility is located within the Rogue River-Siskiyou National Forest in Siskiyou County, California, approximately 33 miles southwest of Jacksonville, Oregon (Ref. 3; Ref. 4, p. 6; Ref. 10, p. 9). The facility is located on rural patented land approximately three miles south of the California-Oregon border. The mine spans in elevation from approximately 4,000 to 4,800 feet above mean sea level. The mine lies at the upper headwaters of the Joe Creek Watershed, on a steep, generally north-facing hillslope, adjacent to Joe Creek. Joe Creek flows north to Elliott Creek, which is a tributary to the Middle Fork of the Applegate River. The Applegate River flows north across the California-Oregon border to Applegate Reservoir (Ref. 4, p. 6). A site location map is presented in Figure A-1.

The Blue Ledge Mine was discovered by panners in approximately 1898. Inception, initial ownership and significant development of the mine occurred between 1902 and 1909. The mine experienced periods of activity and inactivity over the next 20 years. Extensive excavations were undertaken, and a substantial amount of waste rock was generated as mine workings were developed and ore was removed. Mining cars carried extracted materials from the interior of the mine to a mine adit atop the Blue Ledge Mine. The separated ore was trammed down the hillside via an overhead cable to a location close to Joe Creek. Ore was then trucked out of the state to Washington for further processing. No large scale mining activities have occurred since the 1930s. The facility has had at least 14 owners/leases/operators throughout its existence (Ref. 7, p. 6, Ref. 10, p. 5, 9; Ref. 34, p. 1 through 11).

Ground water discharging from Adit 1N has been identified as a hazardous substance source on the Blue Ledge Mine facility. In 2008, groundwater from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile into Joe Creek (Ref. 4, p. 12). In June 2010, ground water from Adit 1N was observed discharging from the adit and flowing over the Waste Rock pile for approximately 100 feet before it percolated below the waste rock surface. Previous investigations have documented increased sulfate concentrations and acidity emerging from the Blue Ledge Mine adits (Ref. 4, p. 13). In July 2010, the AMD exhibited an acidic pH of 2.6 (Ref. 16, p. 5). The sulfide deposits on the Blue Ledge Mine facility provide a continuing source of AMD. AMD is continually formed by a weathering process that oxidizes sulfur-bearing minerals to sulfate and acidity. The AMD process is further expedited by oxidation of the reduced minerals by microbes. The production of acidity at the Blue Ledge Mine facility causes metals to leach from surrounding waste rock as water percolates through the scattered waste piles. During

periods of higher precipitation, the AMD infiltrates through the waste rock and leaches metals. The finer the waste particle, the more surface area is available for the AMD to leach metals from (Ref. 10, p. 16).

The Waste Rock pile extends from multiple formerly productive adits. Two formerly productive adits, Adit 1N and Adit 1S, located in the central portion of the facility, produced waste rock in the WRP-1 area. Two formerly productive adits, Adit 2A and Adit 2B, and two exploratory adits, Adit 2C and Adit 2D, located in the south-central portion of the facility, produced the waste rock in the WRP-2 area. One formerly productive adit, Adit 3A, located in the southern portion of the facility, produced the waste rock in the WRP-3 area. One productive adit, Adit 4A, and one exploratory adit, Adit 4B, located in the northern portion of the facility, produced the waste rock in the WRP-4 area (Ref. 8, p. 17; Figure A-2).

Although multiple adits exist on the Blue Ledge Mine facility, and previous investigations have considered the waste rock to be in four separate piles, the Waste Rock pile is considered to be one pile based on the geologic makeup of the site. In addition, Pete Jones, a geologist with the USFS, has made visual observations of piles WRP-1 through WRP-4 and concluded that they are comprised of the same material. He stated that all of the waste rock (WRP-1 through WRP-4) on the Blue Ledge Mine property was a product of mining along the same ore body, and therefore the waste rock throughout the property is the same geologic makeup. Mining occurred along the same strike of mineralization. The mineralization zone was approximately 3,000 feet (Ref. 39).

Waste rock was observed in direct contact with Joe Creek in June and July 2010 (Ref. 5, p. 1, 5, 6). A log dam, constructed during mining operations, is present at the base of the slope where the deepest deposits are located. An unnamed ephemeral tributary of Joe Creek flows along the western edge of the Waste Rock pile and is completely covered by the waste rock in the area near the log dam (Ref. 5, p. 9; Ref. 8, p. 78; Ref. 11, p. 5). Over time, the waste rock has eroded and leached acidity and metals to Joe Creek. Previous investigations estimated up to 70,000 tons of sulfide-rich rock were discarded on the hillside below the adits (Ref. 8, p. 11, 12).

There are no alternative non-site-related sources in the vicinity of the Blue Ledge Mine that could be contributing to the elevated concentrations of metals in Joe Creek. The Tin Cup Mine is located to the northeast of the site. The Blue Ledge Mine and Tin Cup Mine claim encompass a total of 540 acres (Ref. 7, p. 31). USFS personnel have visited the Tin Cup Mine property. There is no waste rock present on the property. In addition, there is no evidence that historic or current production activities have occurred on the Tin Cup Mine (Ref. 39).

Evidence of metals contamination associated with Sources 1 and 2 and associated drainages has been established based on chemical analyses of samples as described below.

(1) **Source 1 –Waste Rock Pile**

As part of the June and July 2010 HRS Sampling event on the Blue Ledge Mine facility, waste rock samples were collected from four locations on the Waste Rock Pile (Ref. 17, p. 37). The samples were

submitted to a laboratory for definitive metals analysis (Ref. 28, p. 2).

Samples collected from the Waste Rock pile exhibited concentrations of metals, specifically antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, silver, thallium, vanadium, and zinc. Maximum concentrations are as follows: 18.2 mg/kg antimony (BLM-WR-1), 301 mg/kg arsenic (BLM-WR-1), 3.9 mg/kg cadmium (BLM-WR-1 and BLM-WR-2), 9.8 mg/kg chromium (BLM-WR-2), 1,290 mg/kg copper (BLM-WR-2), 7,890 mg/kg lead (BLM-WR-1), 182 mg/kg manganese (BLM-WR-2), 92.8 mg/kg mercury (BLM-WR-1), 29.3 mg/kg selenium (BLM-WR-1), 390 mg/kg silver (BLM-WR-1), 6.9 mg/kg thallium (BLM-WR-1), 49.9 mg/kg vanadium (BLM-WR-4), and 193 mg/kg zinc (BLM-WR-2) (Ref. 28, p. 9; Figure A-4).

All three surface water samples contained elevated concentrations of at least one of the following metals: copper, manganese and/or zinc. The maximum concentrations are as follows: 94.0 mg/kg copper, 8.6 mg/kg manganese, and 179 mg/kg zinc. Surface water sample BLM-SW-4, located adjacent to the direct contact of the Waste Rock pile and Joe Creek exhibited the maximum concentrations for these metals (Ref. 29, p. 11).

Sediment samples collected adjacent to and downstream of the direct contact of the Waste Rock pile and Joe Creek exhibited elevated concentrations of metals. Mercury was detected in sample BLM-SD-4 at a concentration of 0.46 mg/kg. Copper, lead and zinc were detected in samples BLM-SD-4 and BLM-SD-5 at maximum concentrations of 447 mg/kg copper (BLM-SD-5), 40 mg/kg lead (BLM-SD-4) and 321 mg/kg zinc (BLM-SD-4) (Ref. 28, p. 9 and 10).

Once hazardous substances have entered Joe Creek, they migrate downstream (Ref. 29, p. 11). From the facility, Joe Creek flows north for approximately 3.4 miles to its confluence with Elliott Creek. From this confluence, Elliott Creek continues west and discharges to the Middle Fork Applegate River, just upstream of the Applegate Reservoir. The Applegate Reservoir is approximately 8 miles downstream of the Blue Ledge Mine facility (Ref. 4, p. 6, 21).

(2) **Source 2 – Adit 1N Acid Mine Drainage**

As part of the June and July 2010 HRS Sampling event on the Blue Ledge Mine facility, ground water discharging from Adit 1N was sampled (Ref. 17, Figure 3). The sample was submitted to a laboratory for definitive metals analysis (Ref. 29, p. 2).

Results indicated metals at elevated concentrations. The concentrations for detected metals are as follows: 18.1 ug/l arsenic, 887 ug/l cadmium, 37.2 ug/l chromium, 65.8 ug/l cobalt, 160,000 ug/l copper, 186 ug/l lead, 3,180 ug/l manganese, 201 ug/l nickel, 5.1 ug/l selenium, 4.0 ug/l silver, and 236,000 ug/l zinc (Ref. 29, p. 11).

Once hazardous substances have entered Joe Creek, they migrate downstream (Ref. 29, p. 11). From the facility, Joe Creek flows north for approximately 3.4 miles to its confluence with Elliott Creek. From this

confluence, Elliott Creek continues west and discharges to the Middle Fork Applegate River, just upstream of the Applegate Reservoir. The Applegate Reservoir is approximately 8 miles downstream of the Blue Ledge Mine facility (Ref. 4, p. 6, 21).

Analyses of surface water and sediment samples collected from Joe Creek during the EPA 2010 HRS Sampling event indicate that concentrations of metals are significantly above surface water and sediment background levels. Contaminated samples had metals concentrations at levels three times their respective designated background concentration. In addition, an observed release by direct observation has been established as described under section 4.1.2.1.1 (Observed Release Direct Observation).

According to the HRS, if an observed release can be established for the watershed, an observed release factor value of 550 is assigned (Ref. 1, Section 4.1.2.1.1).

Surface Water Observed Release Factor Value: 550

4.1.2.1.2 POTENTIAL TO RELEASE - Not Evaluated (NE)

Potential to release by overland flow was not evaluated because an observed release was established (Ref. 1, Section 4.1.2.1.1).

Potential to Release Factor Value: NE

4.1.2.2 DRINKING WATER THREAT WASTE CHARACTERISTICS

There are no known uses of ground water on the Blue Ledge Mine facility. Residences in the Joe Bar community, located approximately 3 miles north-northeast of the facility, utilize ground water wells for drinking water. Existing analytical data indicate that arsenic, cadmium, copper, lead and zinc were detected in two residences drinking water wells and one spring used for drinking water. Only detections of dissolved arsenic exceeded associated screening criteria with concentrations ranging from 0.22 micrograms per liter (ug/l) to 6.27 ug/l. Although arsenic was detected in all three ground water sources, there was no evidence that the levels were related to concentrations of arsenic detected in surface water adjacent to the Blue Ledge Mine facility, but rather to be due to high levels of naturally-occurring arsenic in local soils (Ref. 4, p. 20, 21, 34, 54, 139; Ref. 8, p. 20, 21). Therefore, the drinking water threat was not evaluated.

Drinking Water Threat Factor Value: NE

4.1.3.2 Human Food Chain Threat Waste Characteristics

Evidence of contamination associated with the Waste Rock Pile (Source 1) and the Adit 1N Acid Mine Drainage (Source 2) has been established based on chemical analyses of samples collected from these sources (refer to the Attribution section and Section 2.2 for each source).

4.1.3.2.1 Toxicity/Persistence/Bioaccumulation

Hazardous Substance	Source No.	Toxicity Factor Value	Persistence Factor Value[1]	Bioaccumulation Value[2]	Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-16)	Reference
Antimony	1	10,000	1	5	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 1
Arsenic	1, 2	10,000	1	5	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 1
Cadmium	1, 2	10,000	1	5,000	50,000,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 2
Chromium	1, 2	10,000	1	500	5,000,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 3
Cobalt	2	10	1	5,000	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 3
Copper	1, 2	0	1	500	0	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 3
Lead	1, 2	10,000	1	5	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 8
Manganese	1, 2	10,000	1	50,000	500,000,000	Ref. 1, Tables 4-12 and 4-16;

Hazardous Substance	Source No.	Toxicity Factor Value	Persistence Factor Value[1]	Bioaccumulation Value[2]	Toxicity/ Persistence/ Bioaccumulation Factor Value (Table 4-16)	Reference
						Ref. 2, p. 8
Mercury	1	10,000	1	50,000	500,000,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 8
Nickel	2	10,000	1	0.5	5,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 9
Selenium	1, 2	100	1	50	5,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 10
Silver	1, 2	100	1	50	5,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 10
Thallium	1	100	1	500	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 11
Vanadium	1	100	1	500	50,000	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 11
Zinc	1, 2	10	1	5	50	Ref. 1, Tables 4-12 and 4-16; Ref. 2, p. 12

Notes:

[1] The surface water category that includes rivers, oceans, coastal tidal waters, and great lakes was utilized to assign the hazardous substances persistence factor value (Ref. 1, Sect. 4.1.2.2.1.2). A persistence value of 1 was assigned (Ref. 2, p. 6).

[2] Bioaccumulation factor values are assigned for the type of water body "Fresh Water", in which the fisheries are located (Ref. 1, Sect. 4.1.3.2.1.3; Ref. 2; Ref. 15, p. 9).

Toxicity/Persistence/Bioaccumulation Factor Value: 500,000,000

4.1.3.2.2 Hazardous Waste Quantity

Source No.	Source Type	Source Hazardous Waste Quantity
1	Pile	2,800
2	Other	11,923.2

Sum of Values: **14,723.2**

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

4.1.3.2.3 Waste Characteristics Factor Category Value

Toxicity/Persistence Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 10,000
Bioaccumulation Potential Factor Value: 50,000

(Toxicity/Persistence Factor Value) x
(Hazardous Waste Quantity Factor Value) = 1×10^8
Subject to a maximum of 1×10^8 (Ref. 1, Section 3.2.3)

(Toxicity/Persistence Factor Value x Hazardous Waste Quantity Factor Value) x
(Bioaccumulation Potential Factor Value) = 5×10^{12}

A hazardous waste quantity factor of 10,000 is assigned from Reference 1, Table 2-6 for a source hazardous waste quantity value of 14,723.2. From Reference 2 and Table 4-12 of the HRS, manganese and mercury have a toxicity/persistence value of 10,000 and a bioaccumulation potential factor of 50,000. The waste characteristics factor category value from Reference 1, Table 2-7 for a waste characteristics product of 5×10^{12} (subject to a maximum product of 1×10^{12}) is 1,000.

Hazardous Waste Quantity Assigned Value: 10,000
Waste Characteristics Factor Category Value: 1,000
(Ref. 1, Tables 2-6 and 2-7)

4.1.3.3 HUMAN FOOD CHAIN THREAT-TARGETS

Level I and Level II concentrations for the human food chain threat can be established based on aqueous samples, sediment samples, or tissue samples which meet the criteria for actual contamination but are less than specific health-based benchmarks (or if health-based benchmarks do not exist) (Ref. 1; Sect. 4.1.3.3). According to the HRS, actual contamination begins either at the point of direct observation or at or between the PPE and the most distant sampling point establishing the observed release (Ref. 1, Sect. 4.1.3.3).

4.1.3.3.1 Food Chain Individual

Pete Jones of the USFS has been working on the Blue Ledge Mine facility since approximately 1995. Mr. Jones stated that he has observed people fishing in Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir on numerous occasions (Ref. 9). In June and July 2010, during the HRS Sampling event, people were observed fishing in the Middle Fork Applegate River, downstream of its confluence with Elliott Creek, and in the Applegate Reservoir (Ref. 5, p. 11).

The Applegate Reservoir, located approximately 8 miles downstream of the Blue Ledge Mine facility is an active fishery in southern Oregon (Ref. 4, p. 6, 21; Ref. 5, p. 11). The Applegate Reservoir, commonly referred to as Applegate Lake, was created in 1980 by impounding the Applegate River and several major tributaries including Carberry, Squaw and Elliott creeks. The reservoir is relatively deep, having a maximum depth of 233 feet and a mean depth of 83 feet (Ref. 15, p. 9). The Applegate Reservoir is managed as a two-story recreational fishery with stocked coldwater species (rainbow and steelhead trout, and Chinook and Coho salmon) and naturally produced warmwater species (smallmouth and largemouth bass, bluegill, black crappie, and brown bullhead) (Ref. 15, p. 9).

Although the Rainbow Trout and Steelhead trout are designated as the same species, the two forms do have differences. The average length of a Rainbow Trout is 12 to 18 inches, whereas the Steelhead is 20 to 30 inches. The major difference between the two is that the Steelhead is a sea-going fish and the Rainbow Trout inhabits fresh water (Ref. 37, p. 1).

In 2003, Ian Reid, a Fisheries Biologist with the Rogue River-Siskiyou National Forest, conducted a fishery assessment for the Applegate Reservoir. During the study period, anglers caught an estimated 40,728 trout (30,933 rainbow, 9,635 chinook, 156 brook, and 156 steelhead); 9,791 bass (9,518 smallmouth and 273 largemouth); and 3,199 sunfish (2,067 black crappie and 1,131 bluegill). Harvest rates for all combined size classes ranged from 64% for chinook salmon to 0% for largemouth bass and brook trout (Ref. 15, p. 29 and 31). Mr. Reid stated that it is his assumption that a majority of the fish harvested from the Applegate Reservoir are used for human consumption (Ref. 27). In addition, the 2003 fishery assessment noted that approximately 59 percent of survey respondents used a fish-cleaning station located adjacent to the Applegate Reservoir, implying that the fish would be used for human consumption (Ref. 15, p. 38).

The fisheries are not within the zone of contamination, but within the TDL. A release of hazardous substances has been attributable to the Blue Ledge Mine, a value of 20 is assigned to food chain individual (Ref. 1; Sect. 4.1.3.3.1).

Identity of Fishery	Type of Surface Water Body	Dilution Weight (Ref. 1, Table 4-13)	Refs.

Identity of Fishery	Type of Surface Water Body	Dilution Weight (Ref. 1, Table 4-13)	Refs.
Elliott Creek	Moderate Stream	0.01	Ref. 4, p. 22
Middle Fork Applegate River	Moderate Stream	0.01	Ref. 4, p. 22
Applegate Reservoir	Lake	0.01	Ref. 4, p. 22

Food Chain Individual Factor Value: 20

4.1.3.3.2 Population

4.1.3.3.2.1 Level I Concentrations

Level I concentrations have not been established. Therefore, the Level I concentrations factor value receives an assigned value of 0.

Level I Concentrations Factor Value: 0

4.1.3.3.2.2 Level II Concentrations

Level II concentrations have not been established. Therefore, the Level II concentrations factor value receives an assigned value of 0.

Level II Concentrations Factor Value: 0

4.1.3.3.2.3 Potential Human Food Chain Contamination

Pete Jones of the USFS has been working on the Blue Ledge Mine facility since approximately 1995. Mr. Jones stated that he has observed people fishing in Elliott Creek, the Middle Fork Applegate River, and the Applegate Reservoir on numerous occasions (Ref. 9). In June and July 2010, during the HRS Sampling event, people were observed fishing in the Middle Fork Applegate River, downstream of its confluence with Elliott Creek, and in the Applegate Reservoir (Ref. 5, p. 11).

The Applegate Reservoir, located approximately 8 miles downstream of the Blue Ledge Mine facility, is an active fishery in southern Oregon (Ref. 4, p. 6, 21; Ref. 5, p. 11). The Applegate Reservoir, commonly referred to as Applegate Lake, was created in 1980 by impounding the Applegate River and several major tributaries including Carberry, Squaw and Elliott creeks. The reservoir is relatively deep, having a maximum depth of 233 feet and a mean depth of 83 feet (Ref. 15, p. 9). The Applegate Reservoir is managed as a two-story recreational fishery with stocked coldwater species (rainbow and steelhead trout, and Chinook and Coho salmon) and naturally produced warmwater species (smallmouth and largemouth bass, bluegill, black crappie, and brown bullhead) (Ref. 15, p. 9).

In 2003, Ian Reid, a Fisheries Biologist with the Rogue River-Siskiyou National Forest, conducted a fishery assessment for the Applegate Reservoir. During the study period, anglers caught an estimated 40,728 trout (30,933 rainbow, 9,635 chinook, 156 brook, and 156 steelhead); 9,791 bass (9,518 smallmouth and 273 largemouth); and 3,199 sunfish (2,067 black crappie and 1,131 bluegill). Harvest rates for all combined size classes ranged from 64% for chinook salmon to 0% for largemouth bass and brook trout (Ref. 15, p. 29 and 31). Mr. Reid stated that it is his assumption that a majority of the fish harvested from the Applegate Reservoir are used for human consumption (Ref. 27). In addition, the 2003 fishery assessment noted that approximately 59 percent of survey respondents used a fish-cleaning station located adjacent to the Applegate Reservoir, implying that the fish would be used for human consumption (Ref. 15, p. 38).

Using these data, the estimated amount of fish caught within the Applegate Reservoir fishery can be calculated:

Fish Species	Number Caught	Harvest Rate	Number Harvested	Average weight*	Total weight harvested
Chinook Salmon	9,635	64%	6,166.4	0.351 pounds	2,164.41
Rainbow Trout	30,933	59%	18,250.47	0.048 pounds	876.02
Bluegill	1,131	38%	429.78	0.489 pounds	210.16
Black Crappie	2,067	34%	702.78	0.362 pounds	254.41
Steelhead	156	25%	39	0.048 pounds	1.87
Smallmouth Bass	9,518	11%	1,046.98	0.250 pounds	261.75
Largemouth Bass	273	0%	0	Not applicable	0
Brook Trout	156	0%	0	Not applicable	0
				Total fish harvested in 2006	**3,768.62**

*Average weight was determined by calculating the weight based on fish length size (Ref. 21; Ref. 22; Ref. 23; Ref. 24; Ref. 25; Ref. 27). Although the study indicated a large range of fish lengths were harvested, a conservative estimate of the average smallest legal limit (8 to 10 inches) was used for the calculation (Ref. 15, p. 32 and 33). The following table presents the measurements and calculations.

Fish Species	Smallest average legal length	Weight	Reference
Chinook Salmon	9 inches = 22.86 cm	159.24 grams = 0.351 pounds	Ref. 23; Ref. 27
Rainbow Trout	9 inches = 22.86 cm	21.62 grams = 0.048 pounds	Ref. 24; Ref. 27
Bluegill	9 inches = 22.86 cm	221.8 grams = 0.489 pounds	Ref. 22; Ref. 27
Black Crappie	9 inches = 22.86 cm	164.18 grams = 0.362 pounds	Ref. 21; Ref. 27
Steelhead	9 inches = 22.86 cm	21.62 grams = 0.048 pounds	Ref. 24; Ref. 27
Smallmouth Bass	9 inches = 22.86 cm	133.19 grams = 0.250 pounds	Ref. 25; Ref. 27

Although the Rainbow Trout and Steelhead trout are designated as the same species, the two forms do have differences. The average length of a Rainbow Trout is 12 to 18 inches, whereas the Steelhead is 20 to 30 inches. The major difference between the two is that the Steelhead is a sea-going fish and the Rainbow Trout inhabits fresh water (Ref. 37, p. 1).

The three fisheries within the target distance limit are Elliott Creek, Middle Fork Applegate River, and the Applegate Reservoir. In June 2008, stream discharge measurements were collected from Elliott Creek and the Middle Fork Applegate River. Discharge measurements were made using the Velocity-Area Procedure wherein the mean velocity and flow cross-sectional areas of many increments across a channel were measured using an impeller-style flow meter, from which subtotals of the stream discharge could be calculated. Elliott Creek exhibited a stream discharge of 266 cfs above the confluence with the Middle Fork Applegate River; and the Middle Fork Applegate River exhibited a stream discharge of 286 cfs above the confluence with Elliott Creek (Ref. 4, p. 22).

Potential Population Targets

Identity of Fishery	Annual Production (pounds)	Type of Surface Water Body	Average Annual Flow (cfs)	Refs.	Population Value (P_i) (Ref. 1, Table 4-18)	Dilution Weight (D_i) (Ref. 1, Table 4-13)	P_i x D_i
Elliott Creek	>0	Moderate Stream	266	Ref. 4, p. 22	0.03	0.01	0.0003
Middle Fork Applegate River	>0	Moderate Stream	286	Ref. 4, p. 22	0.03	0.01	0.0003
Applegate Reservoir	3,768.62	Moderate Stream	286	Ref. 4, p. 22	3	0.01	0.03

Sum of P_i x D_i: 0.0306
(Sum of P_i x D_i)/10: 0.00306

Potential Human Food Chain Contamination Factor Value: 0.00306

4.1.4.2 ENVIRONMENTAL THREAT WASTE CHARACTERISTICS

There are no known sensitive environments in the surface water pathway. In 2000 and 2001, stream-dwelling amphibians were studied during the fall and spring. Various life stages of tailed frog (*Ascaphus truei*) and Pacific giant salamander (*Dicamptodon tenebrosus*) were found upstream of the Blue Ledge Mine facility in both surveys. No amphibians were counted directly downstream of the mine and a maximum of only three were found at further downstream (Ref. 10, p. 34). The tailed frog and the Pacific giant salamander are not considered sensitive environments; therefore the environmental threat was not scored.

Environmental Threat Factor Value: NS

5.0 SOIL EXPOSURE PATHWAY

5.0.1 GENERAL CONSIDERATIONS

The Blue Ledge Mine facility is located within the Rogue River-Siskiyou National Forest in Siskiyou County, California, approximately 33 miles southwest of Jacksonville, Oregon (Ref. 3). The facility is located on rural patented land approximately three miles south of the California-Oregon border. The mine spans in elevation from approximately 4,000 to 4,800 feet above mean sea level. The mine lies at the upper headwaters of the Joe Creek Watershed, on a steep, generally north-facing hillslope, adjacent to Joe Creek. Joe Creek flows north to Elliott Creek, which is a tributary to the Middle Fork of the Applegate River. The Applegate River flows north across the California-Oregon border to Applegate Reservoir (Ref. 4, p. 6). A site location map is presented in Figure A-1.

The Blue Ledge Mine was discovered by panners in approximately 1898. Inception, initial ownership and significant development of the mine occurred between 1902 and 1909. The mine experienced periods of activity and inactivity over the next 20 years. Extensive excavations were undertaken, and a substantial amount of waste rock was generated as mine workings were developed and ore was removed. Mining cars carried extracted materials from the interior of the mine to a mine adit atop the Blue Ledge Mine. The separated ore was trammed down the hillside via an overhead cable to a location close to Joe Creek. Ore was then trucked out of the state to Washington for further processing. No large scale mining activities have occurred since the 1930s. The facility has had at least 14 owners/leases/operators throughout its existence (Ref. 7, p. 6; Ref. 10, p. 14, 15).

Source 1 consists of the Waste Rock pile, and is comprised of a majority of the waste rock on the facility. Previous investigations have separated the Waste Rock pile into four separate piles; WRP-1, WRP-2, WRP-3 and WRP-4 (Ref 8, p. 1-2, 2-3). Figure A-2 presents the Waste Rock pile.

Although multiple adits exist on the Blue Ledge Mine facility, and previous investigations have considered the waste rock to be in four separate piles, the Waste Rock pile is considered to be one pile based on the geologic makeup of the site. In addition, Pete Jones, a geologist with the USFS, has made visual observations of piles WRP-1 through WRP-4 and concluded that they are comprised of the same material. He stated that all of the waste rock (WRP-1 through WRP-4) on the Blue Ledge Mine property was a product of mining along the same ore body, and therefore the waste rock throughout the property is the same geologic makeup. Mining occurred along the same strike of mineralization. The mineralization zone mined was approximately 2,000 feet in length (Ref. 39).

The Blue Ledge Mine facility lies in within the terrestrial sensitive environments of the Siskiyou Mountains salamander, the Black Salamander, the Blue-gray taildropper, and the Traveling sideband snail (Ref. 13, p. 2; Ref. 14, p. 24 through 28).

Area of Observed Contamination: Waste Rock Pile

Location of area: The Waste Rock pile extends from multiple formerly productive adits. Two formerly productive adits, Adit 1N and Adit 1S, located in the central portion of the facility, produced waste rock in the WRP-1 area. Two formerly productive adits, Adit 2A and Adit 2B, and two exploratory adits, Adit 2C and Adit 2D, located in the south-central portion of the facility, produced the waste rock in the WRP-2 area. One formerly productive adit, Adit 3A, located in the southern portion of the facility, produced the waste rock in the WRP-3 area. One productive adit, Adit 4A, and one exploratory adit, Adit 4B, located in the northern portion of the facility, produced the waste rock in the WRP-4 area (Ref. 8, p. 17; Figure A-2). The pile can be observed from National Forest System Road 1060 and extends from an elevation of approximately 4,100 feet to 4,800 feet (Ref. 11, p. 5).

Observed Release

Soil samples identified as "contaminated" are those that meet observed release criteria as defined by the HRS final rule (Ref. 1, Table 2-3). Observed release criteria is met when the hazardous substance is attributable to on-site sources, its concentration exceeds the sample quantitation limit (SQL) (including the background SQL), and is at least three times greater than the background concentration, when the background concentration equals or exceeds the SQL (Ref. 1, Table 2-3).

In 2009, the USFS conducted an SI on the Blue Ledge Mine facility. During the sampling event, conducted in June 2008, two background riparian soil samples were collected adjacent to Joe Creek from two locations upstream of the Blue Ledge Mine facility (Ref. 4, Figure 5). The riparian soil samples were collected from above the normal high water line alongside Joe Creek. The samples were collected from the top 12 inches of soil after the removal of organic debris present on the ground surface. A stainless steel shovel was used to perform in-situ homogenization prior to placing the material into a laboratory provided container. This was performed manually while wearing clean, disposable nitrile gloves (Ref. 4, p. 15).

The waste rock pile samples were submitted to a laboratory for definitive metals analysis. The samples were analyzed for total metals using EPA test method 6010B/6020 (Ref. 38, p. 93, 96; Ref. 41, p. 1 through 6). The data validation results are provided in Reference 41.

Background Soil Samples:

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	MDL (mg/kg)	References
Arsenic	JC-12-RS-080627-URS	6/27/08	3.16	0.05	Ref. 4, p. 570, 571; Ref. 38, p. 11, 93, 96; Ref. 41, p. 3 through 6
	JC-14-RS-080627-URS	6/27/08	1.24	0.05	
Cadmium	JC-12-RS-080627-URS	6/27/08	0.166	0.004	Ref. 4, p. 570, 571; Ref. 38, p. 11, 93, 96; Ref. 41, p. 3 through 6
	JC-14-RS-080627-URS	6/27/08	0.092	0.004	
Copper	JC-12-RS-080627-URS	6/27/08	67.1	2.1	Ref. 4, p. 570, 571; Ref.

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	MDL (mg/kg)	References
	JC-14-RS-080627-URS	6/27/08	45.2	2.0	38, p. 11, 93, 96; Ref. 41, p. 3 through 6
Lead	JC-12-RS-080627-URS	6/27/08	5.29	0.02	Ref. 4, p. 570, 571; Ref. 38, p. 11, 93, 96; Ref. 41, p. 3 through 6
	JC-14-RS-080627-URS	6/27/08	1.83	0.02	

MDL Method detection limit. (Ref. 39, p. 2, 3. 93, 96)

As part of the June and July 2010 HRS sampling event on the Blue Ledge Mine facility, surface samples were collected from four locations within the Waste Rock Pile. Sample BLM-WR-1 was collected from light brown silty sand located on the northern portion of WRP-1, sample BLM-WR-2 was collected from light to medium brown silty sand with subangular gravel with clasts up to 0.5 inches in diameter located on the central eastern portion of WRP-1; sample BLM-WR-3 was collected from reddish-brown clayey silt with little sub-angular gravel located on the central portion of WRP-1; and sample BLM-WR-4 was collected from medium brown silty sand with subangular gravel located on the central western portion of WRP-1. All four samples were collected using clean and dedicated plastic scoops at depths between 0.5 and 1 foot bgs (Ref. 16 p. 6, 7; Ref. 17, p. 23). Sample locations are presented in Figure A-4.

The waste rock pile samples were submitted to a laboratory for definitive metals analysis. The samples were analyzed for total metals using EPA test method ILM05.4 (Ref. 28, p. 2). The data validation results are in Reference 28.

All four of the Waste Rock Pile samples exhibited concentrations of metals for at least one of the following analytes: arsenic, cadmium, copper, and lead (Ref. 28, p. 9).

Summarized below is analytical evidence of contamination in source samples associated with the Waste Rock Pile located on the Blue Ledge Mine facility.

Area of Observed Contamination – Waste Rock Pile

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
Arsenic	BLM-WR-1 (MY6ZE3)	7/1/10	301	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 11, 12, 13, 14, 34, 71 – 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	124	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	102	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	104	1.17	
Cadmium	BLM-WR-1 (MY6ZE3)	7/1/10	3.9	0.59	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13,

Hazardous Substance	Sample ID (CLP ID)	Sample Date	Hazardous Substance Concentration (mg/kg)	SQL (mg/kg)	References
	BLM-WR-2 (MY6ZE4)	7/1/10	3.9	0.56	14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-3 (MY6ZE5)	7/1/10	2.5	0.58	
	BLM-WR-4 (MY6ZE6)	7/1/10	2.6	0.59	
Copper	BLM-WR-1 (MY6ZE3)	7/1/10	981 $J^{1,2}$ (804.1)	2.93	Ref. 16, p. 6, 7; Ref. 20, p. 8, 18; Ref. 28, p. 5-7, 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	1,290 $J^{1,2}$ (1,057.4)	2.8	
	BLM-WR-3 (MY6ZE5)	7/1/10	314 $J^{1,2}$ (257.38)	2.9	
	BLM-WR-4 (MY6ZE6)	7/1/10	441 $J^{1,2}$ (361.48)	2.93	
Lead	BLM-WR-1 (MY6ZE3)	7/1/10	7,890	1.17	Ref. 16, p. 6, 7; Ref. 28, p. 9; Ref. 32, p. 1, 9, 11, 12, 13, 14, 34, 71 - 80; Ref. 40, p. 2
	BLM-WR-2 (MY6ZE4)	7/1/10	609	1.12	
	BLM-WR-3 (MY6ZE5)	7/1/10	201	1.16	
	BLM-WR-4 (MY6ZE6)	7/1/10	227	1.17	

Notes:

J^1: The analyte was positively identified, however the reported value is an estimate due to ICP inter-element interference problems. The result was reported from undiluted analyses that contained iron concentrations above the level present in the interference check sample (ICS) solution, therefore the applied inter-element correction (IEC) factors may not sufficiently compensate.

For copper the value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

J^2 The analyte was positively identified, however the reported value is an estimate due to the serial dilution percent differences being outside the method quantitation control limits. The value reported may be biased high. However, the presence of the analyte in the sample is not in doubt. The adjusted value is presented in parentheses.

SQL: Sample Quantitation Limit. The SQLs provided in this table are CLP contract-required detection limits (CRDLs) for that analyte with any dilution factors, volume adjustments, or percent solids for that analysis taken into account. SSQLs were calculated as follows:

$$\text{SQL}\left(\frac{\text{mg}}{\text{kg dry wgt}}\right) = \text{CRDL}\left(\frac{\mu\text{g}}{\text{L}}\right) \times \frac{1\ \text{mg}}{1000\ \mu\text{g}} \times \frac{\text{final volume (mL)}}{\text{sample weight (g wet wgt)} \times \%\text{S}} \times \frac{1\text{L}}{1000\ \text{mL}} \times \frac{1000\ \text{g}}{1\ \text{kg}} \times \text{DF}$$

Where:

Final volume (mL) is the final extract volume following sample preparation
Sample weight (g wet wgt) is the weight of the sample used for analysis
% S is % solids value divided by 100; % solids is determined as follows: (g dry weight of sample used for analysis)/(g wet weight of sample used for analysis) x100%
DF is the dilution factor for the instrumental analysis

Attribution

The Blue Ledge Mine facility is located within the Rogue River-Siskiyou National Forest in Siskiyou County, California, approximately 33 miles southwest of Jacksonville, Oregon (Ref. 3). The facility is located primarily on rural patented land approximately three miles south of the California-Oregon border. The mine spans in elevation from approximately 4,000 to 4,800 feet above mean sea level. The mine lies at the upper headwaters of the Joe Creek Watershed, on a steep, generally north-facing hillslope, adjacent to Joe Creek. Joe Creek flows north to Elliott Creek, which is a tributary to the Middle Fork of the Applegate River. The Applegate River flows north across the California-Oregon border to Applegate Reservoir (Ref. 4, p. 6). A site location map is presented in Figure A-1.

The Blue Ledge Mine was discovered by panners in approximately 1898. Inception, initial ownership and significant development of the mine occurred between 1902 and 1909. The mine experienced periods of activity and inactivity over the next 20 years. Extensive excavations were undertaken, and a substantial amount of waste rock was generated as mine workings were developed and ore was removed. Mining cars carried extracted materials from the interior of the mine to a mine adit atop the Blue Ledge Mine. The separated ore was trammed down the hillside via an overhead cable to a location close to Joe Creek. Ore was then trucked out of the state to Washington for further processing. No large scale mining activities have occurred since the 1930s. The facility has had at least 14 owners/leases/operators throughout its existence (Ref. 7, p. 6; Ref. 10, p. 5, 9, 14, 15).

Source 1 consists of the Waste Rock pile, and is comprised of a majority of the waste rock on the facility. Previous investigations have separated the Waste Rock pile into four separate piles; WRP-1, WRP-2, WRP-3 and WRP-4 (Ref 8, p. 1-2, 2-3). Figure A-2 presents the Waste Rock pile.

The Waste Rock pile extends from multiple formerly productive adits. Two formerly productive adits, Adit 1N and Adit 1S, located in the central portion of the facility, produced waste rock in the WRP-1 area. Two formerly productive adits, Adit 2A and Adit 2B, and two exploratory adits, Adit 2C and Adit 2D, located in the south-central portion of the facility, produced the waste rock in the WRP-2 area. One formerly productive adit, Adit 3A, located in the southern portion of the facility, produced the waste rock in the WRP-3 area. One productive adit, Adit 4A, and one exploratory adit, Adit 4B, located in the northern portion of the facility, produced the waste rock in the WRP-4 area (Ref. 8, p. 17; Figure A-2).

Although multiple adits exist on the Blue Ledge Mine facility, and previous investigations have considered the waste rock to be in four separate piles, the Waste Rock pile is considered to be one pile based on the geologic makeup of the site. In addition, Pete Jones, a geologist with the USFS, has made visual observations of piles WRP-1 through WRP-4 and concluded that they are comprised of the same material. He stated that all of the waste rock (WRP-1 through WRP-4) on the Blue Ledge Mine property was a product of mining along the same ore body, and therefore the waste rock throughout the property is the same geologic makeup. Mining occurred along the same strike of mineralization. The mineralization zone mined was approximately 2,000 feet in length (Ref. 39).

The Joe Creek area lies in what is approximately the center of the known range from the Siskiyou Mountains salamander (*Plethodon stormi*), a California State Threatened species (Ref. 13, p. 2; Ref. 14, p. 24). The species have been observed within the watershed and in the area of the Blue Ledge Mine itself

(Ref. 14, p. 24, 25). Field visits conducted in 2009 documented that the area in the immediate vicinity of the Waste Rock Pile consisted of large areas of bedrock outcrops and cliffs with small area of associated talus that is suitable for the species (Ref. 14, p. 25). In addition, the Blue Ledge Mine facility lies in within the terrestrial sensitive environments of the Black Salamander (*Aneides flavipunctatus*), the Blue-gray taildropper slug (*Prophysaon coeruleum)*, and the Traveling sideband snail (*Monadenia fidelis celeuthia*) (Ref. 14, p. 26 through 28). These species are considered USFS sensitive species (Ref. 14, p. 5, 6).

There are no alternative non-site-related sources in the vicinity of the Blue Ledge Mine that could be contributing to the elevated concentrations of metals in Joe Creek. The Tin Cup Mine is located to the northeast of the site. The Blue Ledge Mine and Tin Cup Mine claim encompass a total of 540 acres (Ref. 7, App. C). USFS personnel have visited the Tin Cup Mine property. There is no waste rock present on the property. In addition, there is no evidence that historic or current production activities have occurred on the Tin Cup Mine (Ref. 39).

Evidence of metals contamination associated with the Waste Rock pile has been established based on chemical analyses of samples. In June and July 2010, EPA tasked WESTON to conduct sampling in order to investigate contamination in the vicinity of the Blue Ledge Mine facility. To demonstrate the presence of a hazardous substances source, samples were collected from the waste rock. All four of the Waste Rock Pile samples exhibited concentrations of metals for at least one of the following analytes: arsenic, cadmium, copper, and lead (Ref. 29, p. 9).

Based on the sampling conducted during the HRS Sampling event conducted in June and July 2010, contaminants from the Blue Ledge Mine facility have migrated to areas known to be used by endangered species. Samples collected from the Waste Rock pile exhibited concentrations of metals. Maximum concentrations are as follows: 301 mg/kg arsenic (BLM-WR-1), 3.9 mg/kg cadmium (BLM-WR-1 and BLM-WR-2), 1,290 mg/kg copper (BLM-WR-2), and 7,890 mg/kg lead (BLM-WR-1) (Ref. 29, p. 9; Figure A-4).

5.0.2 Hazardous Waste Quantity

Tier A: Hazardous Constituent Quantity - Not Evaluated (NE)

The information available is not sufficient to meaningfully evaluate Tier A, hazardous constituent quantity; therefore it is not possible to adequately determine a hazardous constituent quantity for the Waste Rock Pile (Ref. 1, Section 2.4.2.1.1). Scoring proceeds to the evaluation hazardous wastestream quantity (Ref. 1, Section 2.4.2.1.2).

Hazardous Constituent Quantity Assigned Value: NE

Tier B - Hazardous Wastestream Quantity

The information available is not sufficient to meaningfully evaluate Tier B, hazardous constituent quantity; therefore it is not possible to adequately determine a hazardous constituent quantity for the Waste Rock Pile (Ref. 1, Section 2.4.2.1.1). Scoring proceeds to the evaluation of Tier C (Ref. 1, Section 2.4.2.1.2).

Hazardous Wastestream Quantity Assigned Value: NE

Tier C: Volume

The Waste Rock Pile is characterized as a Pile. Table 5-2 of the HRS directs for the soil exposure pathway to evaluate volume measure only for surface impoundments. (Ref. 1, Table 5-2):

Volume Assigned Value: NE

Tier D: Area

In November 2008, a geotechnical investigation was conducted on the Blue Ledge Mine facility. During the investigation, the area of waste rock piles WRP-1 through WRP-4 was calculated. WRP-1 was estimated to have an area of 5.4 acres, WRP-2 was estimated to have an area of 1.3 acres, WRP-3 was estimated to have an area of 0.8 acres, and WRP-4 was estimated to have an area of 0.6 acres (Ref. 8, p. 16).

In July and August 2010, removal activities occurred under USFS oversight on the Blue Ledge Mine facility. A total of 54,700 cubic yards of waste rock was removed from WRP-1 and WRP-2. WRP-2 was removed in its entirety and approximately 95 percent of WRP-1 was removed. In addition, 2,100 cubic yards of waste rock was removed from WRP-4, with an estimated 2,000 cubic yards remaining. There was no removal conducted on WRP-3. The USFS estimates that WRP-3 is approximately 11,600 cubic yards (Ref. 35).

The table below summarizes the area of the remaining Waste Rock Pile:

Waste Rock Pile	Original Area	Percentage removed in 2010	Remaining Area (acres)	Remaining Area* (square feet)
WRP-1	5.4 acres	95 percent	0.27	11,761.2
WRP-2	1.3 acres	100 percent	0	0
WRP-3	0.8 acre	0 percent	0.8	34,848
WRP-4	0.6 acre	48.8 percent	0.31	13,503.6

* 1 acre = 43,560 square feet

A total of 60,112.8 square feet of waste rock remains on the Blue Ledge Mine site.

The Waste Rock Pile is characterized as a Pile. This provides a Hazardous Waste Quantity Value of (Ref. 1, Table 5-2):

60,112.8 square feet / 34 = **1,768.02**

Area: 60,112.8 square feet

Area Assigned Value: 1,768.02

Source Hazardous Waste Quantity Value

According to Section 2.4.2.1.5 of the HRS, the highest of the values assigned to the source for hazardous constituent quantity (Tier A), hazardous wastestream quantity (Tier B), Volume (Tier C), and Area (Tier D) should be assigned as the source hazardous waste quantity value (Ref. 1, Sections 2.4.2.1.5 and 5.1.2.2).

Tier Evaluated	Source 1 Values
A	NE
B	NE
C	NE
D	1,768.02[1]

Notes:

1 Value selected for the area of observed contamination hazardous waste quantity according to the HRS.

NE Not Evaluated.

Source Hazardous Waste Quantity Value: 1,768.02

5.1 RESIDENT POPULATION THREAT

5.1.1 LIKELIHOOD OF EXPOSURE

Sample ID	Distance of Population/Resource from Area of Observed Contamination	Reference
BLM-WR-1	> 0 feet	Ref. 14, p. 24 and 25
BLM-WR-2	> 0 feet	Ref. 14, p. 24 and 25
BLM-WR-3	> 0 feet	Ref. 14, p. 24 and 25
BLM-WR-4	> 0 feet	Ref. 14, p. 24 and 25

Resident Population Threat Likelihood of Exposure Factor Category Value: 550

5.1.2 WASTE CHARACTERISTICS

5.1.2.1 Toxicity

Hazardous Substance	Toxicity Factor Value	Reference
Arsenic	10,000	Ref. 2, p. 1
Cadmium	10,000	Ref. 2, p. 2
Copper	0	Ref. 2, p. 3
Lead	10,000	Ref. 2, p. 8

Toxicity Factor Value: 10,000

5.1.2.2 Hazardous Waste Quantity

Area	Source Type	Area Hazardous Waste Quantity
Waste Rock Pile	Pile	1,768.02

Hazardous Waste Quantity Factor Value: **100**
(Table 2-6)

5.1.2.3 Calculation of Waste Characteristics Factor Category Value

Toxicity Factor Value: 10,000
Hazardous Waste Quantity Factor Value: 100

Toxicity Factor Value x Hazardous Waste Quantity Factor Value: 1,000,000

Waste Characteristics Factor Category Value: **32**
(Table 2-7)

5.1.3 TARGETS

5.1.3.1 Resident Individual

There is no Resident Individual on the Blue Ledge Mine facility. The Resident Individual Factor Value is 0.

Resident Individual Factor Value: 0

5.1.3.2 Resident Population

There are no residents occupying the Blue Ledge Mine facility. The Resident Population was not evaluated.

5.1.3.3 Workers

The Blue Ledge Mine has been inactive since the 1930s (Ref. 7, p. 6). There are no workers on the Blue Ledge Mine facility.

Workers Factor Value: 0
(Table 5-4)

5.1.3.4 Resources

There is no evidence of commercial agriculture, commercial silviculture, or commercial livestock production of commercial livestock grazing on the Blue Ledge Mine facility.

Resources Factor Value: 0

5.1.3.5 Terrestrial Sensitive Environments

The Joe Creek area lies in what is approximately the center of the known range from the Siskiyou Mountains salamander (*Plethodon stormi*), a California State Threatened species (Ref. 13, p. 2; Ref. 14, p. 6, 24). The species have been observed within the watershed and in the area of the Blue Ledge Mine itself (Ref. 14, p. 24). Field visits conducted in 2009 documented that the area in the immediate vicinity of the Waste Rock Pile consisted of large areas of bedrock outcrops and cliffs with small area of associated talus that is suitable for the species (Ref. 14, p. 25). In addition, the Blue Ledge Mine facility lies in within the terrestrial sensitive environments of the Black Salamander (*Aneides flavipunctatus*), the Blue-gray taildropper slug (*Prophysaon coeruleum)*, and the Traveling sideband snail (*Monadenia fidelis celeuthia*) (Ref. 14, p. 26 through 28). These species are considered USFS sensitive species (Ref. 14, p. 5, 6).

Terrestrial Sensitive Environment	Assigned Value (Table 5-5)	References
Siskiyou Mountains salamander (*Plethodon stormi*),	50	Ref. 13, p. 2; Ref. 14, p. 5, 6, 24 and 25

The soil pathway is based solely on terrestrial sensitive environments. Based on this, the terrestrial sensitive environment factor value is calculated as follows (Ref. 1, Section 5.1.3.5):

$$(LE \times WC \times ES)/82{,}500$$

Where:
LE = Resident population threat for likelihood of exposure
WC = Waste characteristics
ES = Value for terrestrial sensitive environments

$$(550 \times 32 \times 50)/82{,}500 = 10.667$$

Terrestrial Sensitive Environments Factor Value: **10.66**

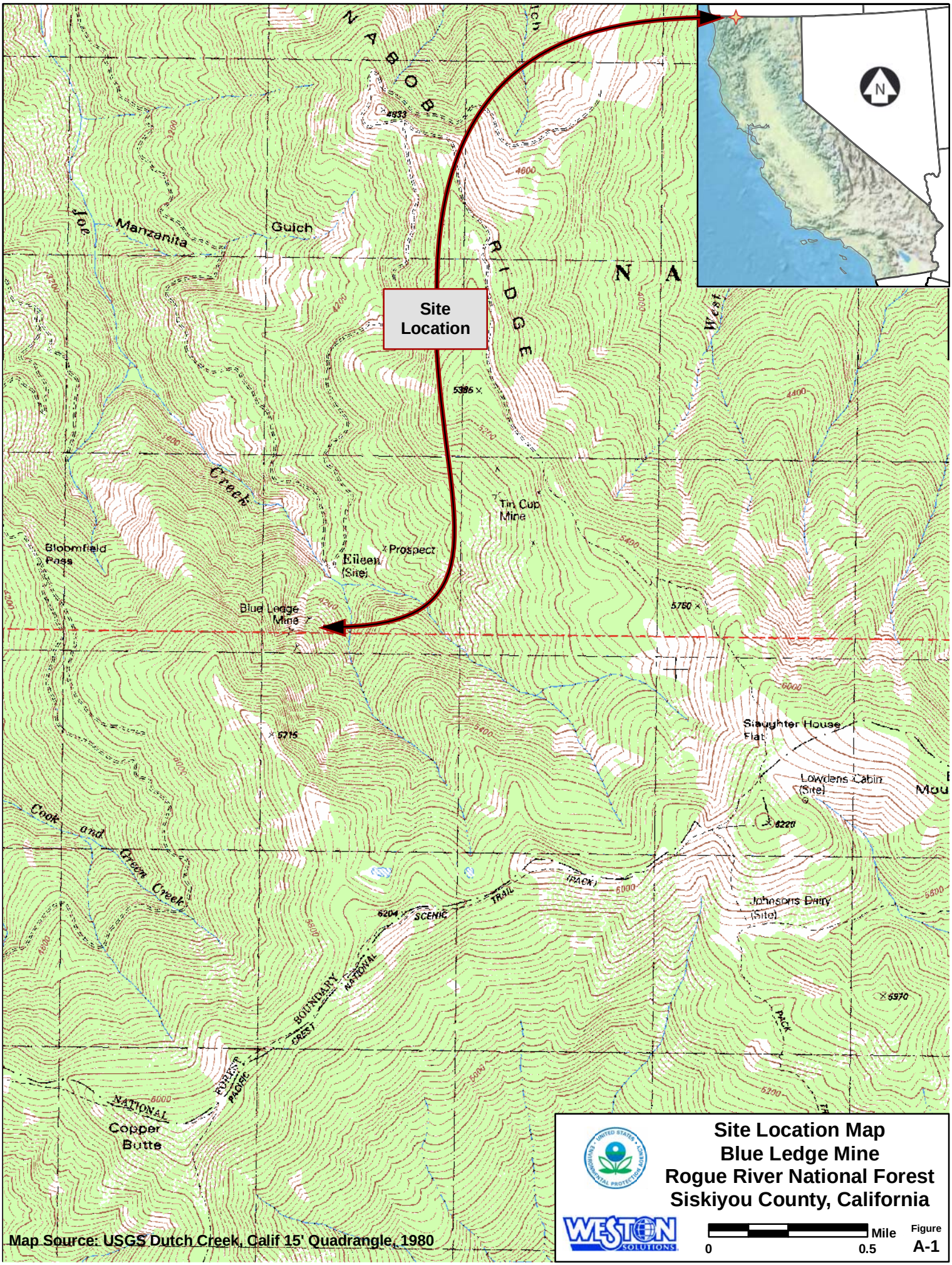
5.2 NEARBY POPULATION THREAT

The nearby population threat was evaluated, but not scored. The nearby population threat would not significantly impact the overall site score.

6.0 AIR MIGRATION PATHWAY

The air migration pathway was evaluated, but not scored. The Blue Ledge Mine facility is not paved, so potential exists for hazardous substances to become airborne (Ref. 5, p. 1).

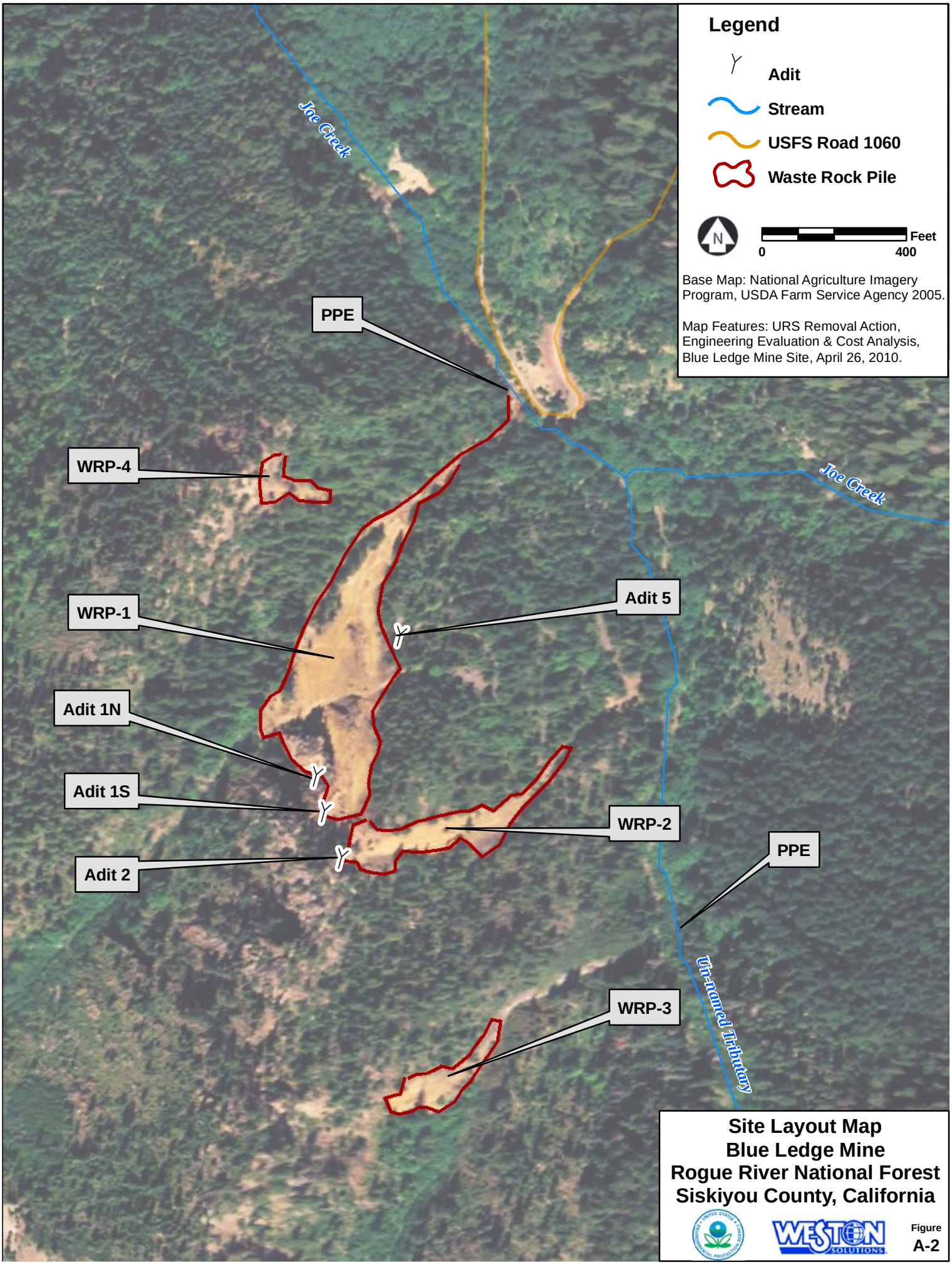
Without analytical data, only potential to release can be scored for this pathway. Scoring potential to release will not affect the listing decision.



Site Location Map
Blue Ledge Mine
Rogue River National Forest
Siskiyou County, California

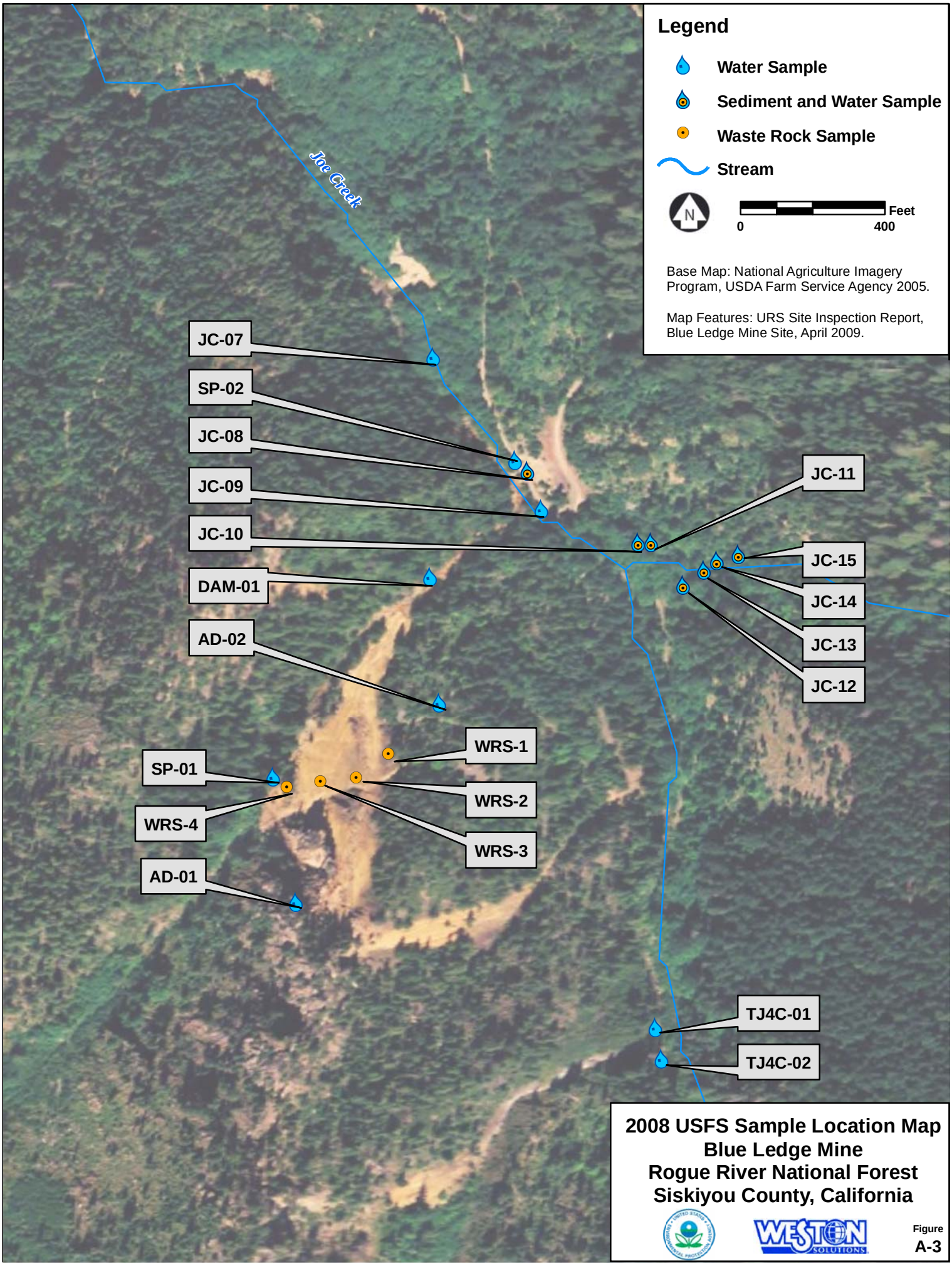
0 0.5 Mile

Figure A-1



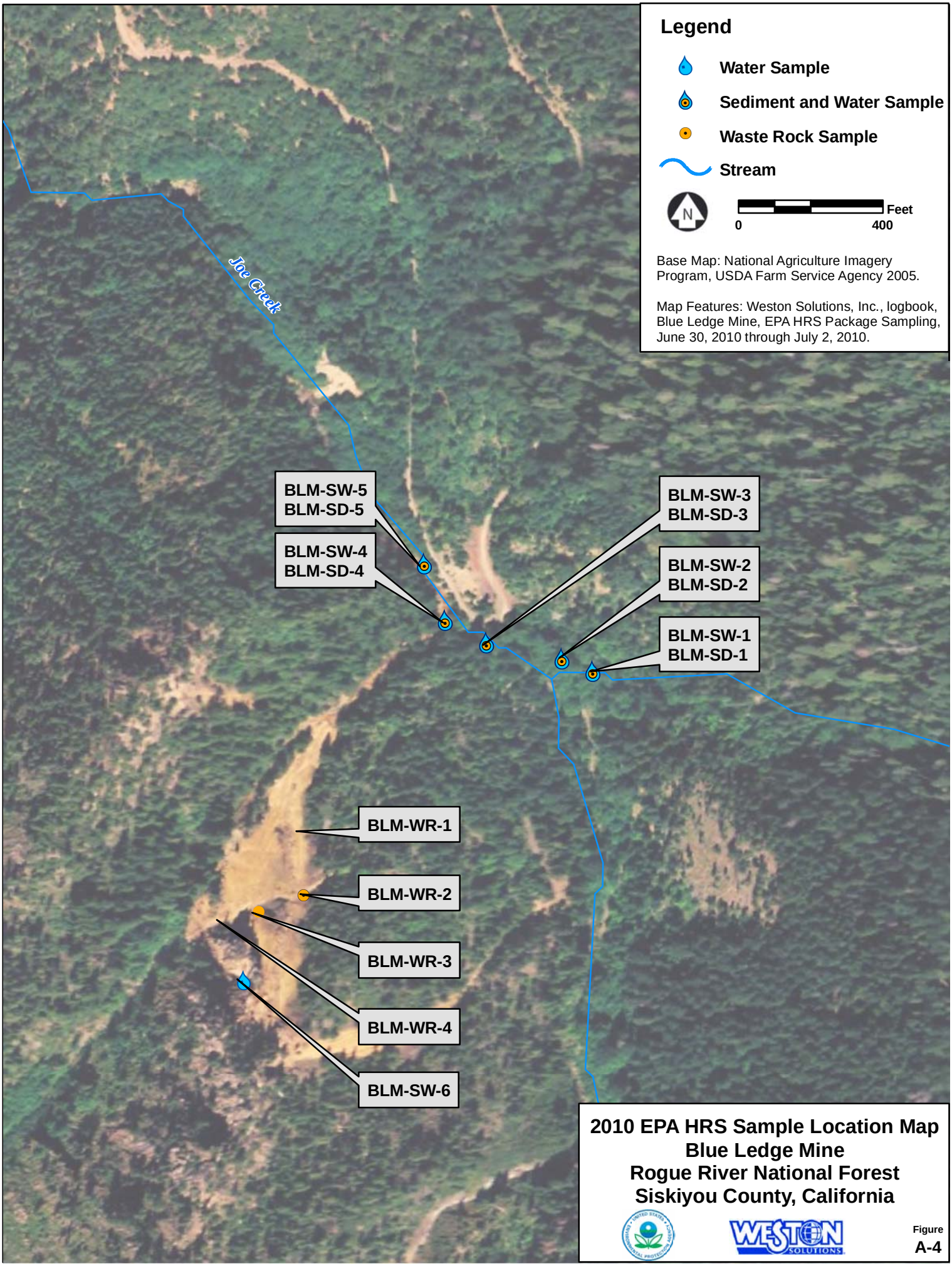
Site Layout Map
Blue Ledge Mine
Rogue River National Forest
Siskiyou County, California

Figure
A-2



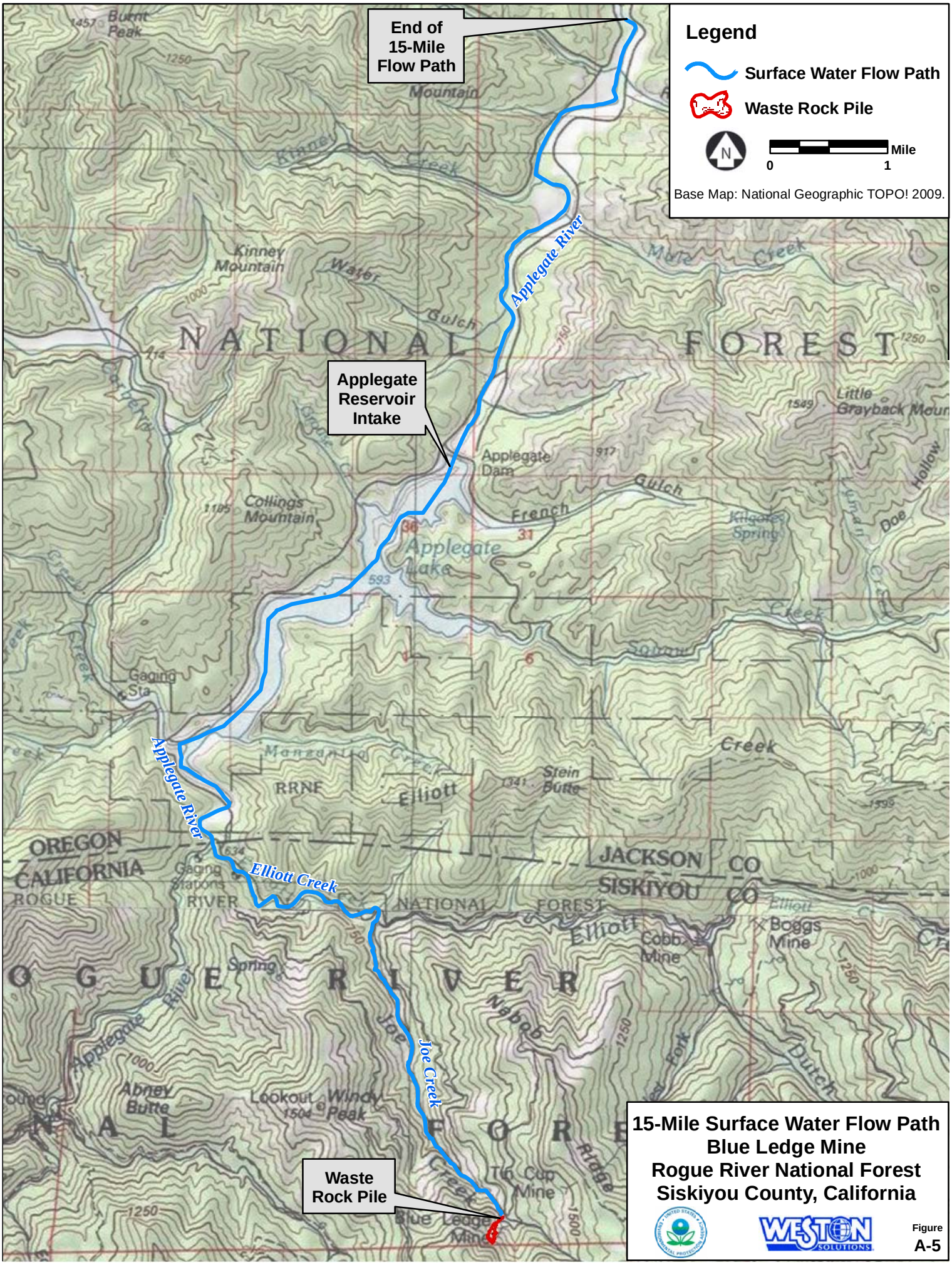
2008 USFS Sample Location Map
Blue Ledge Mine
Rogue River National Forest
Siskiyou County, California

Figure
A-3



2010 EPA HRS Sample Location Map
Blue Ledge Mine
Rogue River National Forest
Siskiyou County, California

Figure
A-4


End of 15-Mile Flow Path
Legend
Surface Water Flow Path
Waste Rock Pile
N
0
1
Mile
Base Map: National Geographic TOPO! 2009.
Applegate River
Applegate Reservoir Intake
Applegate Dam
Applegate Lake
Elliott Creek
Joe Creek
Waste Rock Pile
NATIONAL FOREST
OREGON
CALIFORNIA
JACKSON CO
SISKIYOU CO
ROGUE RIVER NATIONAL FOREST
Kinney Mountain
Collings Mountain
Little Grayback Mountain
Stein Butte
Abney Butte
Lookout
Windy Peak
Tin Cup Mine
Blue Ledge Mine
Cobb Mine
Boggs Mine
Gaging Sta
Gaging Stations
Spring
Burnt Peak
Mountain
Water Gulch
French Gulch
Kilgore Spring
Doe Hollow
Dutch Ridge
Ngbob
Joe Creek
Applegate River
Elliott Creek
Blue Ledge Mine
15-Mile Surface Water Flow Path
Blue Ledge Mine
Rogue River National Forest
Siskiyou County, California
Figure
A-5