Site Inspection Report
Oriole Mine
Colville National Forest

March 2005

Natural Solutions for Water

Cascade Earth Sciences
12720 East Nora Avenue, Suite A
Spokane, Washington 99216
(509) 921-0290
www.cascade-earth.com

SITE INSPECTION REPORT
Oriole Mine
Colville National Forest

Principal Authors and Investigators:

Dustin G. Wasley, PE, Managing Engineer II
Robert H. Lambeth, PE, PG, Senior Engineer
Ryan Tobias, Staff Wildlife Biologist

Reviewed By:

John D. Martin, RG, Principal Geologist

Prepared for:

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Colville National Forest

Site Location:

Oriole Mine
Colville National Forest
Pend Oreille County, Washington

Prepared by:

Cascade Earth Sciences
P.O. Box 14725
Spokane, Washington 99214
(509) 921-0290

PN: 2323024/March 2005

Cover Photo: Collapsed Ore Bin (upper left) and Upper Adit (lower right)

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EXECUTIVE SUMMARY

A Site Inspection (SI) was performed at the Oriole Mine (Site), located in the Colville National Forest, near Metaline, Washington. The Site is an abandoned lead and zinc mine with associated waste rock piles, ore piles, and several adits and mine workings. The Site is situated adjacent to Linton Creek, a tributary of the Pend Oreille River. The SI was conducted to assess if the Site poses an immediate and potential threat to human health and the environment, and to collect sufficient information to support a decision regarding the need for further action. The SI consisted of the following tasks (1) background information research and file review, (2) onsite and offsite site reconnaissance and ecological assessment, and (3) collection of soil, waste rock, plant tissue, surface water, sediment, and benthic macroinvertebrate samples. Based on the information gathered during these tasks, the results indicate the following:

Groundwater Pathway: The groundwater pathway does not appear to be complete for both human and ecological receptors and further assessment is not recommended.

Surface Water Pathway: The surface water pathway is complete due to elevated concentrations of metals in stream sediment samples, and further assessment is warranted. Data indicates that elevated concentrations of metals in Linton Creek sediments may have originated from the Site. Surface water in Linton Creek does not appear to be impacted by the Site because all metal concentrations were either below the lowest comparison criteria or the background concentrations in the unnamed creek. State and federal aquatic rare, threatened and endangered (RTE) species are not expected to be impacted by the Site. The benthic macroinvertebrate enumeration results suggest the Site is not impacting the invertebrate populations in Linton Creek. These conclusions are based on water and sediment samples collected during presumed low flow conditions when background samples could not be collected from Linton Creek.

Soil Pathway: The soil pathway is complete for both human and ecological receptors and further assessment is warranted. Concentrations of 15 metals in waste rock and ore exceeded both the average background soil concentration and the lowest comparison criteria. Antimony, arsenic, cadmium, copper, lead, mercury, and zinc appear to be the metals of concern. Two samples exceeded Washington Department of Ecology toxicity characterization leaching procedure (TCLP) limit for lead; and one sample exceeded the cadmium limit, thus a Dangerous Waste is present at the Site. Samples were also analyzed using the synthetic precipitation leaching procedure (SPLP), a more accurate leachability test for mining waste. None of the SPLP samples exceeded the TCLP criteria. Onsite vegetation does not appear to be impacted by activities associated with the Site. One state terrestrial candidate species (Pileated woodpecker) was observed, and several other federal and state RTE mammals, birds, and herpetiles have potential habitat in the vicinity of the Site.

Air Pathway: This pathway is complete because metal impacted waste rock and ore is concentrated at the surface where human and ecological receptors could be exposed. Risks from the air pathway will be addressed when assessing the soil pathway.

Based on the information gathered as part of the SI and presented in this report, CES recommends the following be completed in a two-phased approach. First, a spring sampling event is recommended to collect additional samples and determine true background concentrations in Linton Creek and the impact from the Site on Linton Creek. CES anticipates that Linton Creek above the Site may contain water during expected higher flow spring conditions. Additional surface water and sediment samples should simultaneously be collected from the adit drainage, the remainder of Linton Creek, and the unnamed creek in order to help correlate and evaluate the new data at high flow conditions. Following collection of these data, a risk assessment should be performed to assess if human and ecological impacts exist at the Site and in Linton Creek. Second, if the risk assessment indicates that risks are present, a streamlined Engineering Evaluation / Cost Analysis should be prepared to establish removal cleanup standards and applicable removal action alternatives.

SITE INSPECTION DATA SUMMARY SHEET

Project Name: Oriole Mine Site Inspection
Project Location: Section 19 Township 6 South, Range 7 East of the Willamette Meridian **Latitude:** N 48° 51' 37" **Longitude:** W 117° 24' 50"
Nearest Surface Water Body: Linton Creek
Area of Disturbance: 2 acres

SUMMARY OF ANALYTICAL/DOCUMENTED CONTAMINATION

Media	Sample Location	Rate of Discharge/Volume (cfs, gpm, or CY)	Contaminant	Highest Concentration	Lowest Criteria Eco – Ecological HH – Human Health	Background Concentration
Surface Water	LC-SW-02	0.2 cfs	Chromium VI, total	10 ug/L (est)	2 ug/L - Eco	Not Detected
	LC-SW-03	0.5 cfs	Chromium VI, total	10 ug/L (est)	2 ug/L – Eco	Not Detected
	LC-SW-05	2.5 cfs	Lead, TR	1.1 ug/L	0.66 ug/L – Eco	<0.1 ug/L
Adit Drainage	OM-AS-01 OM-AS-02	0.02 cfs – AS-01 0.015 cfs – AS-02	Barium, TR Chromium VI, total Copper, TR Lead, TR Zinc, TR	28 ug/L 10 ug/L (est) 2B ug/L 8.2 ug/L 120 ug/L	4 ug/L – Eco 2 ug/L – Eco 0.2 ug/L – Eco 0.66 ug/L – Eco 30 ug/L – Eco	14 ug/L Not Detected <1 ug/L <0.1 ug/L <10 ug/L
Sediment	LC-SS-02	0.2 cfs – surface water	Antimony Cadmium	1.2 mg/kg 1.56 mg/kg	0.6 mg/kg – Eco 0.596 mg/kg – Eco	0.3B mg/kg 0.37 mg/kg
	LC-SS-03	0.5 cfs – surface water	Antimony Arsenic Cadmium Lead Nickel Zinc	2.2 mg/kg 15 mg/kg 2.26 mg/kg 1,880 mg/kg 28 mg/kg 1,880 mg/kg	0.6 mg/kg – Eco 5.9 mg/kg – Eco 0.596 mg/kg – Eco 35 mg/kg – Eco 18 mg/kg – Eco 123.1 mg/kg – Eco	0.3B mg/kg 4.8 mg/kg 0.37 mg/kg 868 mg/kg 14.1 mg/kg 108 mg/kg
	LC-SS-04	0.8 cfs – surface water	Cadmium Mercury Zinc	1.19 mg/kg 0.64 mg/kg 1,970 mg/kg	0.596 mg/kg – Eco 0.174 mg/kg – Eco 123.1 mg/kg – Eco	0.37 mg/kg <0.4 mg/kg 108 mg/kg
	LC-SS-05	2.5 cfs – surface water	Zinc	265 mg/kg	123.1 mg/kg – Eco	108 mg/kg
Waste Rock – WR1	OM-WR1-1 (2) OM-WR1-3 (2) OM-WR1-4	4,400 CY	Antimony Arsenic V Arsenic Cadmium Chromium Copper Lead Mercury Nickel Silver Thallium Zinc	1,150 mg/kg 30.987 mg/kg 211 mg/kg 390 mg/kg 24 mg/kg 2,800 mg/kg 103,000 mg/kg 3.44 mg/kg 50.4 mg/kg 330 mg/kg 30B mg/kg 62,500 mg/kg	5 mg/kg – Eco 10 mg/kg – Eco 1.6 mg/kg – HH 2 mg/kg – Eco 0.4 mg/kg – Eco 50 mg/kg – Eco 40.5 mg/kg – Eco 0.00051 mg/kg – Eco 30 mg/kg – Eco 2 mg/kg – Eco 1 mg/kg – Eco 8.5 mg/kg – Eco	0.50 mg/kg NA 4.07 mg/kg 2.91 mg/kg 12.7 mg/kg 27 mg/kg 65.8 mg/kg 0.02 mg/kg 20.2 mg/kg 0.43 mg/kg 0.18 mg/kg 307 mg/kg

SUMMARY OF ANALYTICAL/DOCUMENTED CONTAMINATION (cont.)

Media	Sample Location	Rate of Discharge/Volume (cfs, gpm, or CY)	Contaminant	Highest Concentration	Lowest Criteria Eco – Ecological HH – Human Health	Background Concentration
Waste Rock – WR2	OM-WR2-1	11,000 CY	Antimony	145 mg/kg	5 mg/kg – Eco	0.50 mg/kg
	OM-WR2-2		Arsenic V	10.783 mg/kg	10 mg/kg – Eco	NA
	OM-WR2-3		Arsenic	60.1 mg/kg	1.6 mg/kg – HH	4.07 mg/kg
			Cadmium	52 mg/kg	2 mg/kg – Eco	2.91 mg/kg
			Chromium	34 mg/kg	0.4 mg/kg – Eco	12.7 mg/kg
			Cobalt	37 mg/kg	20 mg/kg – Eco	12.3 mg/kg
			Copper	900 mg/kg	50 mg/kg – Eco	27 mg/kg
			Lead	7,790 mg/kg	40.5 mg/kg – Eco	65.8 mg/kg
			Mercury	1.37 mg/kg	0.00051 mg/kg – Eco	0.02 mg/kg
			Nickel	47.3 mg/kg	30 mg/kg – Eco	20.2 mg/kg
			Selenium	7.1 mg/kg	0.21 mg/kg – Eco	NC
			Silver	111 mg/kg	2 mg/kg – Eco	0.43 mg/kg
			Zinc	14,400 mg/kg	8.5 mg/kg – Eco	307 mg/kg
Ore Piles	OM-OP1-1	830 CY	Antimony	550 mg/kg	5 mg/kg – Eco	0.50 mg/kg
	OM-OP1-2		Arsenic V	84.116 mg/kg	10 mg/kg – Eco	NA
	OM-OP2-1		Arsenic	173 mg/kg	1.6 mg/kg – HH	4.07 mg/kg
	OM-OP3-1		Cadmium	430 mg/kg	2 mg/kg – Eco	2.91 mg/kg
			Copper	2,020 mg/kg	50 mg/kg – Eco	27 mg/kg
			Lead	42,900 mg/kg	40.5 mg/kg – Eco	65.8 mg/kg
			Mercury	3.45 mg/kg	0.00051 mg/kg – Eco	0.02 mg/kg
			Selenium	20 mg/kg	0.21 mg/kg – Eco	NC
			Silver	203 mg/kg	2 mg/kg – Eco	0.43 mg/kg
			Thallium	10B mg/kg	1 mg/kg – Eco	0.18 mg/kg
			Zinc	93,000 mg/kg	8.5 mg/kg – Eco	307 mg/kg
Exploration Workings Waste Rock	OM-WR3-1	725 CY	Antimony	90 mg/kg	5 mg/kg – Eco	0.50 mg/kg
	OM-WR4-1		Arsenic V	11.079 mg/kg	10 mg/kg – Eco	NA
	OM-WR5-1		Arsenic	64.1 mg/kg	1.6 mg/kg – HH	4.07 mg/kg
			Cadmium	112 mg/kg	2 mg/kg – Eco	2.91 mg/kg
			Cobalt	55 mg/kg	20 mg/kg – Eco	12.3 mg/kg
			Copper	1,910 mg/kg	50 mg/kg – Eco	27 mg/kg
			Lead	15,100 mg/kg	40.5 mg/kg – Eco	65.8 mg/kg
			Mercury	0.59 mg/kg	0.00051 mg/kg – Eco	0.02 mg/kg
			Selenium	3 mg/kg	0.21 mg/kg – Eco	NC
			Silver	86 mg/kg	2 mg/kg – Eco	0.43 mg/kg
			Thallium	4B mg/kg	1 mg/kg – Eco	0.18 mg/kg
			Zinc	17,300 mg/kg	8.5 mg/kg – Eco	307 mg/kg

Notes: Water samples collected in Linton Creek were analyzed for total receoverable and dissolved metals, however, only total recoverable results are presented because they represent the worst case scenario.
This table only lists sample concentrations that are at least 1.5 times higher than the lowest criteria and background concentration. These exceedances are considered the major contaminants of concern (COCs) and not a complete list of all COCs.
Highest background concentration in waters and sediments used since only one sample was collected; background soil concentrations listed are the average of three samples.
TR = Total Recoverable Metals; Diss. = Dissolved Metals; ug/L = micrograms per liter; mg/kg = milligrams per kilogram; B = concentration between the PQL and MDL;
est. = chromium V results were estimated using field test kit

1.0 INTRODUCTION AND OBJECTIVES

The United States Forest Service (USFS) retained Cascade Earth Sciences (CES) to perform a Site Inspection (SI) at the Oriole Mine (Site). The SI was performed in accordance to the U.S. Environmental Protection Agency (EPA) publication, *Guidance for Performing Site Inspections under CERCLA* (EPA, 1992). The purpose of the SI is to determine the potential threat to human health and the environment from issues identified during the Abbreviated Preliminary Assessment (APA) conducted by the USFS at the Site. The work was performed under our existing 5-year USFS Contract (#10181-1-D007) and in accordance with the Task Order #53-05G1-3-0310.

The primary objectives of the SI were to (1) assess the immediate or potential threat that (mining) wastes pose to human health and/or the environment, and (2) collect sufficient information to support a decision regarding the need for further action. The information was collected in general accordance with CERCLA protocols and documentation requirements for assessments involving hazardous substances. Specifically, as outlined in the EPA CERCLA guidance document (EPA, 1992), "the sampling locations are strategically planned to identify the substances present, determine whether hazardous substances are being released to the environment, and determine whether hazardous substances have impacted specific targets."

The SI field activities included sampling and analysis of soil, waste rock, plant tissue, surface water, and sediment samples from the Site and vicinity. This SI was performed following the Field Operation Plan (FOP) developed by CES, and approved by the USFS. The FOP was developed based on the Preliminary Assessment and Site Investigation (PA/SI) of the Lower Pend Oreille River Mines and Mills completed by the EPA (EPA, 2002) and the Statement of Work (SOW) provided by the USFS in the request for proposals.

2.0 SITE DESCRIPTION AND OPERATIONAL HISTORY

The following sections give a specific description of the Site and an operational history of the Site. Photographs of the Site and sampling locations are included in Appendix A. No regulatory removal actions have been undertaken at the Site. In addition, no permits, violations, and/or regulatory inspections specific to the Site have been documented. However, the Site was examined by the EPA through its START-2 contractor, Ecology & Environment as part of a broader investigation of several mines in the Lower Pend Oreille River (EPA, 2002).

2.1 Description and Location

The Site is located in the Colville National Forest in Pend Oreille County, approximately 1.5 miles northeast of Metaline, Washington (Figure 1 and Plate 1). According to the USGS 7 ½ Minute Quadrangle Map - Metaline (USGS, 1992), the Site location is described as:

- Section 19, Township 39 North, Range 43 East of the Willamette Principal Meridian
- Latitude – 48° 51' 37"
- Longitude – 117° 24' 50"
- Elevation – 2,760 to 3,000 feet above mean seal level (AMSL).

Figure 2 provides a general layout of the Site, including 2-foot contours and pertinent features. The Site is accessed from the City of Metaline and State Highway 20 by following Boundary Road to Oriole Road, then following Oriole Road west on Linton Creek across the powerline clearing to Forest Road (FR) 2740. The remaining ¼ mile access to the Site on FR 2740 is extremely rough and requires a 4-wheel drive vehicle.

Three main adits are associated with the Site (Figure 2). The caved uppermost adit appears to be the Discovery Adit. There are two exploration trenches and two short unnamed adits on contour with the Discovery Adit. The two lower adits (referred to as Upper Adit and Lower Adit) appear to be the primary production workings; the Lower Adit appears to be the primary haulage route. A 3-foot diameter corrugated metal culvert was observed

at the Discovery Adit and the Lower Adit; all three main adits are blocked with bat gates. Several other trenches and a small unnamed adit are located on the south side of Linton Creek, which appear to be exploration workings. Small waste rock piles are associated with these workings. A dilapidated building, which appears to be the former office or residence, is located 800 feet northeast of the Site on FR 2740.

Waste rock pile 1 (WR1) is located adjacent to the Upper Adit and is 80 feet wide and 110 feet long, with an estimated volume of 4,400 cubic yards (CY). Waste rock pile 2 (WR2) is located adjacent to the Lower Adit and is 150 feet wide and 100 feet long, with an estimated volume of 11,000 CY. A short overgrown access road is located on the north side of WR2, which appears to be the haul road to the dilapidated log ore bin. Ore Pile 1 (OP1) consists of ore that was spilled during transport and the log ore bin, and measures 35 feet wide by 75 feet long, with an estimated volume of 800 CY. Located immediately northeast of OP1 is Ore Pile 2 (OP2), which is small and appears to be a mixture of ore and debris. The estimated volume of OP2 is 30 CY.

Water discharges from the Lower Adit, over WR2 and eventually infiltrates into soil near the access road. During the SI field activities, there was no evidence of historical flow from the Upper Adit or any of the exploration workings. Linton Creek, which originates 1 mile above the Site, flows through the Site and eventually discharges to the Pend Oreille River 1.5 miles downstream. An unnamed creek discharges into Linton Creek 0.5 miles from the confluence with the Pend Oreille River. During the SI field activities, portions of Linton Creek were not flowing, while other portions appear to be perennial. In addition, the City of Metaline drinking water intact structure is located upstream in the unnamed creek.

2.1.1 Operational History and Waste Characteristics

Little information is available regarding the operational history of the Site. However, the following information was taken from *Inventory of Washington Minerals* (Huntting, 1956) and *Metal Mines of Washington* (Derkey, 1990). The following information is a chronological listing of the mine ownership.

- 1907 - Oriole Mining & Milling Co.
- 1911 -1922 - Metaline Oriole Mining Co.
- 1922 -1924 - Metaline Minerals Co.
- 1935 - Frank Schultz
- 1942 -W.L. Schultz
- 1953 - Arthur Betchart and E.O. Dressel, Jr.

The first recorded production of zinc in Washington was from the Site in 1911 (Huntting, 1956). There is recorded production for following years 1911, 1912, 1925, 1926, and 1953. However, production for each year is not reported in the referenced reports, but rather totaled as " up to 2,000 tons up to 1942 with assays on smelter returns on a carload of picked ore: 42.1 oz/ton silver; 21.9% zinc; 15.3% lead, 1.12% copper" (Huntting, 1956).

2.1.2 Previous Investigations

In 2002, the EPA conducted PA/SIs on 21 mines/mills, which included the Site, located near the lower reaches of the Pend Oreille River. As part of the investigation, one surface water and two sediment samples were collected from the adit drainage at the Site. In addition, two surface water samples were collected from the unnamed creek, one at the source and one at the confluence with Linton Creek. In addition, one sediment samples was collected from Linton Creek, near the confluence with the Pend Oreille River. No waste rock or ore samples were collected. Sample results are summarized in the following two tables and are consistent with the sample results presented in this report.

Surface Water Results of Selected Metals from the EPA PA/SI of the Oriole Mine and Linton Creek
(Results in ug/L)

Sample ID	Location	As	Cd	Cr	Cu	Mg	Ni	Pb	Zn
ORSP01SW	Adit drainage, at Lower Adit	<2.6	1.3B	<0.60	<1.0	9,530	<1.1	3.0B	102
MFSW01	Source of Metaline Drink Water Intake	<2.6	<0.6	<0.6	<1	8,900	<1.1	<2.8	3.9JB
MFSW02	Conf. of Metaline Drink Water Intake and Linton Creek	<2.6	<0.6	<0.6	<1	9,560	<1.1	<2.8	0.65JB

Note: B = concentration is between the PQL and MDL; J = concentration is estimated
As = arsenic; Cd = cadmium; Cr = chromium; Cu = copper; Mg = magnesium; Ni = nickel; Pb = lead; and Zn = zinc

Sediment Results of Selected Metals from the EPA PA/SI of the Oriole Mine and Linton Creek
(Results in mg/kg)

Sample ID	Location	As	Cd	Cr	Cu	Mg	Ni	Pb	Zn
ORSP01SD	Adit drainage, at Lower Adit	4.6	8.5	14.2	32.3J	36,400	15.7	301	784
ORSP02SD	Adit drainage, below WR2	13.8	27	14.8	71.7J	33,200	21.1	714	5,740
PRTB09SD	Linton Creek, at conf. with Pend Oreille River	6.0	0.8JB	14.4	16.0J	18,700	14.2	86.8	261

Note: B = concentration is between the PQL and MDL; J = concentration is estimated

2.1.3 Climate

The following climate data was compiled from the Metaline Falls, Washington monitoring station, located approximately 6 miles northwest of the Site at an elevation of 1100 feet AMSL. The Site, located approximately 1800 feet higher in elevation than Metaline Falls, receives more total precipitation and has lower minimum and maximum temperatures. The annual prevailing wind direction is to the south-southeast.

- Total average precipitation is approximately 28 inches/year and falls as snow November through April.
- The average minimum temperature of approximately 17° F occurs in January.
- The average maximum temperature of approximately 84° F occurs in July.

3.0 PATHWAYS AND ENVIRONMENTAL HAZARD ASSESSMENT

3.1 Groundwater Exposure Pathway

3.1.1 Targets

Targets are defined as receptors that are located within a specified distance from the Site. As outlined in the SI CERCLA guidance (UPEPA, 1992), the target distance for the groundwater pathway is 4-miles, and example targets are drinking water wells and wellhead protection areas. There are an estimated 486 residents within 4 miles of the Site (Metaline Falls = 223, Metaline = 163, rural ~ 100). Drinking water for the Town of Metaline, located on the west side of the Pend Oreille River, is supplied by a sand filter collection system on the unnamed creek that discharges to Linton Creek (Figure 1). Drinking water for rural residences is most likely supplied by wells. The Washington Department of Ecology (Ecology) Water Resources Department well log database indicates that over 100 wells are located within a 4-mile radius of the Site. A vast majority of these wells are located east of the Pend Oreille River, and are not considered targets because the Pend Oreille River is acting as a hydrologic barrier. Only three wells were identified within 4 miles of the Site on the west side of the Pend Oreille River. The locations of the three target wells are shown on Plate 1. The closest well (Green well) is located approximately 0.5 miles east of the Site and appears to be associated with a residence; the two other wells are located outside the 1 mile radius (Duncan and Bright wells). There are no known wellhead protection areas within 4 miles of the Site.

3.1.2 Geologic Setting

Regional geologic information presented in this section was obtained from Orr and Orr (2002). Site-specific geology was compiled from Bancroft (1911 and 1914), Park and Cannon (1943) and McClung et. al., as well as site-specific reconnaissance performed by a CES Professional Geologist.

3.1.2.1 Regional Geology

The Site is located in the Omineca-Intermontane physiographic province (Orr and Orr, 2002). Basment rocks of the region consist of the Proterozoic Belt Supergroup metasediments and the Late Proterzoic Windemere Group metasediments and metavolcanics. In the Metaline district, Early Cambrian Gypsy Quartzite conformably overlies the earlier formation. The Gypsy Quartzite grades upward into the Maitlen Phyllite. The Middle Cambrian to Early Ordovician Metaline Formation conformably overlies the Maitlen Phyllite and is subdivided into three units: bedded limestone, bedded dolomite and grey limestone. The Middle to Late Ordovician Ledbetter Slate conformably overlies the Metaline Formation. Silurian-Devonian argillites cap the Paleozoic sequence. Cretaceous quartz monzonite and granodiorite intrusive rocks cut the section throughout the Metaline district. Numerous Pleistocene glacial fluvial and lake deposits, as well as Quaternary alluvial deposits overlie the district.

3.1.2.2 Site Specific Mining Geology

The following site-specific geology is summarized from Bancroft, (1914) and Park and Cannon (1942). The reader is directed to the full reports for more details. The country rock is fine to medium grained grayish-blue dolomite of the Monk Formation, just below the base of the Gypsy Quartzite. The beds strike north 25° east and dip 30° - 45° northwest. The carbonate rocks have undergone intense hydrothermal alteration before, during, and after lead-zinc sulfide mineralization. Ore bodies are a series of elongate down-dip lenses along the fault plane and are connected by narrow quartz stringers (Park and Cannon, 1942). The ore is apparently along a gouge-breccia seam that trends approximately north 65° west and dips 60° northeast.

According to Durkey (1990), three known adits were associated with the Site, and were driven in the northwest direction and are about 40 vertical feet apart. An estimated 1,600 feet of working were reportedly developed in the mine. The Site includes total workings of about 1,600 feet of drifts and raises among the three adits. Commodities include lead, zinc, copper, silver and gold. The primary minerals are sphalerite, galena, tetrahedrite, chalcopyrite, pyrite, malachite, azurite, smithsonite, cerussite, and bornite. Gangue is quartz, calcite and dolomite.

3.1.3 Hydrogeology

The Site is located within the Linton Creek sub-watershed of the Pend Oreille River watershed. As mentioned in Section 3.1.1, three drinking water wells are located within a 4-mile radius of the Site, on the west side of the Pend Oreille River. Depths of completed wells range from 35 feet below ground surface (BGS) to 540 feet BGS. Static water levels in the wells were observed to be between 18 to 180 feet BGS. A review of the well logs indicates the shallow geology consists of sand and gravel and clay from the surface to depths of 16 feet to 135 feet BGS. These sediments likely originated from glacier deposits from the Pend Oreille Lobe. Bedrock below the glacial sediments consists of gray to black dolomite or limestone. Copies of the well logs reviewed are available in the USFS Project File. None of the wells were observed or sampled during the SI field activities.

During the SI field activities, groundwater flowed from the Lower Adit across WR2, and infiltrated into native soil near the access road. No erosion channels were observed that would indicate that the adit drainage discharges directly into Linton Creek; the adit drainage appears to infiltrate into the shallow groundwater. The shallow groundwater in the vicinity of the Site likely flows in the unconsolidated sediments and daylights to surface water (Linton Creek) around and downgradient of the Site during gaining stream conditions.

3.1.4 Groundwater Exposure Pathway Summary

The adit drainage likely infiltrates into the shallow groundwater at the Site; the shallow groundwater appears to discharge to Linton Creek during certain times of the year (i.e., when Linton Creek is gaining). The only known target well (Green well) that could potentially be impacted by the Site is located approximately 0.5 miles east of the Site. The static water level in the Green well is 18 feet BGS; Linton Creek in the vicinity of the Green well is approximately 60 lower in elevation than the static water level. Based on this, the well appears to be upgradient from Linton Creek (in the vicinity of the well) and cross-gradient to the Site. Thus it is highly unlikely that shallow groundwater from the Site would impact the Green well. Based on this, the groundwater pathway does not appear to be complete for both human and ecological receptors. Groundwater that discharges to surface water during gaining stream conditions is addressed in the surface water pathway.

3.2 Surface Water Exposure Pathway

3.2.1 Targets

For the surface water pathway, the target distance has been defined as 15-miles, and example targets are surface water intakes supplying drinking water, sensitive environments (i.e., wetlands), and aquatic organisms. As Linton Creek empties into the Pend Oreille River approximately 1.5 river miles downstream from the Site, only points above the confluence are considered targets because of the high flow rate and dilution of the Pend Oreille River when compared to Linton Creek.

3.2.1.1 Local Surface Water Use

Plate 1 shows the 1- and 4-mile radii from the Site. As mentioned above, there are 483 year round residents within a 4-mile radius. The City of Metaline (163 residents) drinking water is supplied from the unnamed drainage that flows into Linton Creek (Figure 1). Drinking water is collected via a sand filter intake structure; water then flows to a storage tank where it is chlorinated before distribution. Surface water uses of Linton Creek were not field-verified as part of the SI; however; surface water in or around the Site are likely limited to recreational purposes such as camping (washing dishes, cooking).

3.2.1.2 Wetlands

Maps outlining designated wetland areas were prepared by the National Wetlands Inventory (NWI), a division of the U.S. Fish and Wildlife Service. Wetlands were identified based on vegetation, visible hydrology, and geography in accordance with Classification of Wetlands and Deepwater Habitats of the United States (USDI, 1979). The following are considered "listed" on the NWI map (USFWS, 1994):

- The headwaters of Linton Creek to approximately 1 mile downstream of the Site is designated as Riverine, Intermittent, Streambed, Seasonally Flooded (R4SBC);
- Approximately one mile downstream of the Site along Linton Creek to the confluence with the Pend Oreille River is classified as Riverine, Upper Perennial, Open Water/Unknown Bottom, Permanently Flooded (R3OWH);
- Areas located approximately ½ mile northeast of the Site are designated as Palustrine, Emergent, Persistent, Seasonally Flooded (PEM1C);
- Areas located south of Linton Creek near the confluence with the Pend Oreille River are identified as PEMC1 and Palustrine, Open Water/Unknown Bottom, Permanently Flooded (POWH); and
- Areas to the north of the confluence of Linton Creek and the Pend Oreille River are classified as Palustrine, Unconsolidated Shore, Seasonally Flooded, Excavated (PUSCX), Palustrine Emergent, Persistent, Temporarily Flooded (PEM1AH), Lacustrine, Littoral, Unconsolidated Shore, Seasonally Flooded (L2USCH), and Lacustrine, Limnetic, Open Water/Unknown Bottom, Permanently Flooded (L1OWHH).

3.2.1.3 Aquatic Ecological Survey

Aquatic surveys were conducted in five stream reaches within Linton Creek to assess the potential impacts of the Site on the instream habitat, benthic macroinvertebrate community, and presence of fish species due to the potential for site-related physical impacts or chemical contamination. Refer to Appendix B for supplemental text, figures and tables. The rare, threatened, or endangered (RTE) species known or expected to inhabit the area surrounding the Site are listed in Appendix B.

Overall instream physical habitat conditions (Barbour 1999) were optimal for all reaches, although there were suboptimal and poor ratings for some individual habitat parameters at different stations. Riparian habitat differences were also noted. Two pool substations, and five riffle substations, were assessed within the five reaches. The number and types of species present at each of the two pool stations were quite similar. It seems likely that noticeable differences in invertebrate abundance, diversity, and comparative indices are due to different habitat conditions in the two pools. The benthic invertebrate survey results for pool habitats provide no clear evidence that the Site is impacting Linton Creek.

Differences in invertebrate abundance and diversity in the riffle substations suggest there are different conditions at LC-02R and LC-03R, compared to the other three stations. However, the consistency of species diversity, Shannon-Weaver index, and metals tolerance index do not suggest Site impacts. It seems likely that these different habitat conditions are resulting in differences in invertebrate abundance and functional feeding groups. A previously undiscovered invertebrate species was identified at LC-02 and LC-05. This species is of the genus Euryhapsis. Additional sampling is planned for the spring of 2005 to obtain and then hatch examples of this species in captivity, for species description and documentation.

No fish were noted in Linton Creek. The culverts above and below LC-05R are likely barriers to upstream fish migration. Through communications with regional biologists, the Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species Program (PHSP), and the Washington Natural Heritage Program (WNHP) it was documented that rainbow trout, a state priority species, are present in the downstream portions of Linton Creek (Appendix B). In addition, westslope cutthroat trout, a federal species of concern, are present in nearby Flume Creek and may also be present in Linton Creek, downstream of LC-05.

3.2.2 Hydrologic Setting

The Site is bordered on the southwest by Linton Creek (Plate 1 and Figure 1). According to the USGS 7½ minute quadrangle maps (USGS, 1992) of the area, the Linton Creek watershed above the Site is approximately 480 acres or 0.75 square miles (Plate 1). In the vicinity of the Site, Linton Creek is a very small, first order stream (Armantrout 1998). Linton Creek, which originates approximately 1 mile above the Site, flows through the Site and eventually discharges to the Pend Oreille River approximately 1.5 miles downstream. Approximately 600 feet downstream from the Site (vicinity of the powerline corridor), the streambed of Linton Creek becomes dry and flows subsurface until approximately 0.5 miles downstream from the Site. An unnamed creek discharges into Linton Creek approximately 0.5 miles from the confluence with the Pend Oreille River. The City of Metaline has a drinking water intake structure located upstream in the unnamed creek, which does not draw from Linton Creek.

The flow rates were measured on July 27 and 28, 2004 in Linton Creek, the adit drainage, and the unnamed creek (Table 1). Flow rates in Linton Creek ranged from 0.2 cubic feet per second (cfs) adjacent to the Site to 2.5 cfs immediately below the confluence with the unnamed creek. The flow rate of the adit drainage was 0.02 cfs near the discharge from the Lower Adit and 0.015 cfs downgradient of WR2. The flow rate in the unnamed creek was 2.4 cfs upstream of the City of Metaline drinking water structure. The flow rate of the Pend Oreille River measured at USGS Station 12396500, located approximately 6 miles upstream of Linton Creek (below Box Canyon) was measured at approximately 15,000 cfs.

Overland flow (i.e., sheet flow) originating at the Site has the potential to flow south down the slope and across the waste rock piles and ultimately into Linton Creek. The adit drainage from the Lower Adit flows across WR2 and infiltrates into surrounding soil near FR 2740. There was no evidence (i.e., no channels or erosion patterns) that the adit drainage discharged directly into Linton Creek. The adit drainage likely infiltrates into the shallow groundwater, which, as mentioned in Section 3.1.3, appears to daylight to Linton Creek downgradient from the Site.

3.2.3 Site Inspection Analytical Results

This section presents the surface water and stream sediment analytical results for the SI conducted at the Site. Sample locations are shown on Figure 1, analytical results are tabulated in Tables 1 and 2; the original laboratory reports are available in the USFS Project File. Photographs of selected sampling locations are included in Appendix A. A complete report of the quality assurance / quality control (QA/QC) procedures and results is available in the USFS Project File. Field activities were conducted from July 27 through 29, 2004; the reader is referred to the FOP (CES, 2004) for sampling procedure, protocols, and analyses.

A total of seven water samples (five surface water and two adit drainage) and five sediment samples were collected from Linton Creek during the SI field activities (Figures 1 and 2). Surface water and sediment results are summarized in the following:

- Surface water wet chemistry results are summarized as follows: pH ranged from 7.1 standard units (su) to 7.9 su; conductivity ranged from 73 to 200 microsiemans per centimeter (uS/cm); hardness as $CaCO_3$ ranged from 36 to 106 milligrams per liter (mg/L); TDS ranged from 40 to 120 mg/L; TSS was not detected above the method detection limit (MDL) of 5 mg/L in any sample; and sulfate was not detected above the MDL of 10 mg/L.
- The adit drainage wet chemistry results are summarized as follows: pH ranged 6.4 su to 7.2 su; conductivity ranged from 163 to 167 uS/cm; hardness as $CaCO_3$ ranged from 91 to 92 mg/L; TDS ranged from 100 to 110 mg/L; TSS was only detected above the MDL in one sample at 6 mg/L; and sulfate was not detected above the MDL of 10 mg/L.
- Surface water field parameters ranges included: temperature (7.5 to 9.4 ^{o}C); pH (7.20 to 7.76 su); conductivity (62 to 170 uS/cm); DO (9.30 to 10.28 mg/L); and Eh (171 to 194 millivolts [mv]).
- Adit drainage field parameters ranges included: temperature (9.52 to 10.64 ^{o}C); pH (8.05 to 8.38 su); conductivity (21 to 43 uS/cm); DO (12.02 to 12.35 mg/L); and Eh (110 to 120 mv).
- The sediment grain size was between 90% and 99% silt and sand, with minor amounts of clay.
- The mineral composition of clay particle was very similar for all samples. Generally, clay fraction percentages (by weight) were, illite at 63 to 72%, chlorite at 20 to 34%, smectite at 2 to 8%, and kaolinite at <1%.
- Results of the metals analyses for surface water, adit drainage, and sediment are discussed in the following table and presented in Tables 1 and 2, respectively. Surface water samples were analyzed for both dissolved and total recoverable metals; however, only the total recoverable results are presented in the following table because they represent the worst case scenario.

Summary of Surface Water, Adit Drainage and Sediment Metals Results

SAMPLE TYPE	TABLE / SAMPLE ID	METALS EXCEEDING ONE OR MORE COMPARISON CRITERIA	TRENDS OBSERVED AND COMMENTS
Surface Water	**Table 1**	**Total Recoverable metals (ug/L)**	
In the unnamed creek, upstream of the Drinking Water Intake (Background)	UD-SW-01	Arsenic (1.1B), barium (14), copper (<1), selenium (<1), and silver (<0.05)	Highest arsenic and barium detected in surface water.
Adjacent to the Site in Linton Creek	LC-SW-02	Arsenic (<0.5), barium (11), chromium VI (10), copper (<1), selenium (<10), and silver (<0.05)	Chromium VI was above background at SW-02 and SW-03, and was not detected in farthest downstream samples. Lead highest in farther downstream sample. Arsenic and barium lower than background. All other metals similar to background.
Downstream from the Site in Linton Creek	LC-SW-03	Arsenic (<0.5), barium (12), chromium VI (10), copper (<1), selenium (<1), and silver (<0.05)	
In Linton Creek, upstream of confluence with unnamed creek	LC-SW-04	Arsenic (0.5B), barium (12), copper (<1), selenium (<1), and silver (<0.05)	
In Linton Creek, downstream of confluence with unnamed creek	LC-SW-05	Arsenic (0.9B), barium (12), copper (<1), lead (1.1), selenium (<1), and silver (<0.05)	
Adit Drainage Water	**Table 1**	**Total Recoverable metals (ug/L)**	
Drainage from Lower Adit, near adit portal	OM-AS-01	Arsenic (0.5B), barium (21), cadmium (1), chromium VI (10), copper (2B), lead (4.8), selenium (<1), and zinc (110).	Barium, cadmium, chromium VI, copper, lead, and zinc are higher than background concentrations. Arsenic is lower than background.
Drainage from Lower Adit, downslope from WR2	OM-AS-02	Arsenic (0.5B), barium (21), cadmium (1), copper (2B), lead (8.2), selenium (<1), and zinc (120).	
Sediment	**Table 2**	**Total Metals (mg/kg)**	**All criteria listed are Ecological**
In the unnamed creek, upstream of the Drinking Water Intake (Background)	UD-SS-01	Lead (868)	Lead greater than SS-03 and SS-04.
Adjacent to the Site in Linton Creek	LC-SS-02	Antimony (1.2), cadmium (1.56), lead (290), nickel (26.9), silver (2.01), and zinc (162).	Antimony, cadmium, lead (SS-03 and SS-04), mercury, nickel, silver, and zinc all above lowest criteria and background concentrations.
Downstream from the Site in Linton Creek	LC-SS-03	Antimony (2.2), arsenic (15), cadmium (2.26), lead (1,880), mercury (0.21), nickel (28), and zinc (1,880).	
In Linton Creek, upstream of confluence with unnamed creek	LC-SS-04	Antimony (0.6), arsenic (8.8), cadmium (1.19), lead (147), mercury (0.64), nickel (19.7), and zinc (1,970).	
In Linton Creek, downstream of confluence with unnamed creek	LC-SS-05	Lead (1,130) and zinc (265).	Lead and zinc are higher than background; however, remaining metals are all below lowest criteria.

3.2.4 Surface Water Exposure Pathway Summary

Based on field observations and analytical results from the SI field activities, surface water in Linton Creek is not impacted from Site during presumed low flow conditions. All concentrations of metals (except chromium VI and lead) in surface water samples collected from Linton Creek were equal to, or below, the concentrations in the background station in the unnamed creek. Chromium VI was detected at LC-SW-02 and -03 (near the Site) and not in UD-SW-01. However, analysis was conducted in the field using a colorimetric method because of the short laboratory holding time (<24 hours) and the differences between not detected and 10 ug/L is subject to interpretation. The highest concentration of lead was detected in the farthest downstream station (LC-SW-05), which is downstream of the unnamed creek and large culvert; therefore, it is unlikely that the elevated lead concentration is Site related. There are also numerous other anthropogenic sources of lead at LC-SW-05 related to road construction and vehicle traffic.

Sediment in Linton Creek appears to be impacted by the Site; numerous metals (antimony, arsenic, cadmium, lead, mercury, nickel, silver, and zinc) were detected in Linton Creek samples that were above several comparison criteria and the concentrations detected in the unnamed creek.

The benthic macroinvertebrate survey results suggest that the Site is not impacting Linton Creek. Rainbow trout (state priority species) have been documented in the lower portions of Linton Creek (below LC-05) and there is the potential that the westslope cutthroat trout (federal species of concern) may be present; however, the fine-grained organic substrate and high gradient would make it unlikely that these fish use Linton Creek for spawning habitat.

The surface water pathway as a whole is complete. The conclusions presented are based on samples collected from Linton Creek and the adit drainage during presumed low flow conditions. Furthermore, because background water and sediment samples could not be collected directly from Linton Creek, these conclusions are based on comparison to an alternative background station not located in Linton Creek. An additional sampling event is recommended to determine true background concentrations in Linton Creek and the impact from the Site on Linton Creek during presumed high flow conditions. Additional surface water and sediment samples should be simultaneously collected from the adit drainage, the remainder of Linton Creek, and the unnamed creek for comparison purposes. CES anticipates that Linton Creek above the Site may contain water during higher flow spring conditions.

3.3 Soil Exposure Pathway

3.3.1 Targets

3.3.1.1 Local Use

There are no onsite workers or persons living within 200 feet of the Site. Public use of the Site and vicinity is most likely minimal, though public access records are not maintained**.** Access is currently not restricted by fencing, nor were any "No Trespassing" signs noted during the SI. In general, land uses in this area are limited to timber harvesting, firewood cutting, recreation (hiking, fishing, camping, hunting, etc.) and some minerals prospecting. There is an estimated 486 residents within a 4-mile radius. The nearest residence is located approximately 0.5 miles east of the Site. During field activities, the residence had several outbuildings and a small lumber mill that did not appear to be in operation. The next closest residence is near the cemetery and drinking water tower (designated as "WT" and a cross on Figure 1 and Plate 1).

3.3.1.2 Terrestrial Ecological Survey

Terrestrial habitats and animals that are present or likely at, and surrounding, the Site were documented during the ecological survey and via communication with regional biologists. Lists of RTE plants and animals likely or known to be present in the vicinity of the Site were obtained from the USFS, WDFW PHSP, and the WNHP (See Appendix B). Full results of the terrestrial ecological survey are provided in Appendix B.

The Site is primarily within a Douglas fir/trembling aspen forested community and immediately adjacent to a wetland/riparian community. The disturbed mine areas were primarily waste rock or excavated gravelly soil with numerous colonizing and weedy species, no canopy layer, with patchy shrub and herbaceous layers. The vegetation within close proximity to the Site is clearly different from both of these two vegetation communities. There was some evidence that the wetland/riparian community was also disturbed by past activities near the Site. However, the presence of moisture and organic rich soils has allowed the development of a dense but likely successional community of plants. A full listing of the plant species documented during the survey is presented in Table B-3, none of which are RTE species.

Game trails were not clearly present, but deer tracks and elk pellets were noted, suggesting that whitetail deer or mule deer and elk are present near the Site. Other mammals observed are present in Table B-5. Townsend's big-eared bats, a state candidate species and federal species of concern, have been documented in the mine workings. Other RTE mammal species may inhabit the region, but are unlikely at the Site.

The birds identified at the site represent an assemblage common among mixed coniferous and deciduous forests; observed species are outlined in Table B-6. Pileated woodpeckers were observed and are a state candidate for listing as a threatened or endangered species. Other RTE bird species may inhabit the forest surrounding the Site, but are unlikely to forage in the disturbed mine area.

No reptiles or amphibians were found during the survey. Those likely to be present are outlined in Table B-7. Red-legged frogs and western toads are RTE species that may be found in the vicinity of the Site, but are unlikely within the disturbed mine habitat. Invertebrates noted on and near the Site are listed in Table B-4. None of these or any other invertebrates in the vicinity of the Site are known RTE species.

Overall, relatively few species were identified during the ecological survey. This is likely the result of there being only one dominant vegetation community: mature forest. The wetland/riparian community is very small and thus does not support numerous other species that might be expected in a similar, but larger habitat. Of the invertebrates and wildlife documented or likely to inhabit the Site, ground-dwelling invertebrates such as ants are the species most likely to be exposed to Site related contamination. Invertivorous species that forage frequently on invertebrates within or near the waste rock piles may also be relatively highly exposed to Site related contamination.

3.3.2 Site Inspection Analytical Results

The following sections present the background soil, waste rock, ore, and vegetation tissue analytical results for the Site. Sample locations for soils, waste rock, and tissue samples are shown on Figure 2 and Plate 1. Analytical results for background soils are tabulated in Table 3, and waste rock, ore, and native soil in Table 4. Vegetation tissue results are tabulated in Table 6. The complete laboratory analytical results and a discussion of QA/QC procedures and results are available in the USFS Project File. Field activities were conducted from July 27 through 29, 2004; the reader is referred to the FOP (CES, 2004) for sampling procedure, protocols, and analyses.

3.3.2.1 Background Soil, Site Soil, and Waste Source Analytical Results

Background soil samples were collected from three locations upgradient of the Site to provide representative chemistry of undisturbed areas around the Site (Figure 2). Laboratory results are summarized in Table 3. A total of 17 waste rock, ore, and soil samples were collected and submitted for laboratory analysis. As outlined in the SOW, the USFS requested that samples be collected at various depths at each sampling location, including from native soil beneath the piles (if possible). Therefore, CES used a small excavator to dig through the WR1 and WR2, where native soils were encountered. The following table presents the average concentrations of selected metals in waste source samples and the enrichment value relative to average concentrations in background soils. As the table shows, antimony, arsenic, cadmium, copper, lead, mercury, thallium, and zinc are the metals that are most enriched when compared to background soils.

Avereage Concentrations of Selected Metals in Waste Rock / Ore Samples as Compared to Background Soil Concentrations (Results in mg/kg)

	As	Cd	Cr	Cu	Hg	Mg	Ni	Pb	Sb	Th	Zn
Average Background	4.1	2.91	12.7	27.0	0.023	6,117	20.2	65.8	0.5	0.18	307
Average Waste Source	61.3	121.3	15.6	890	1.251	54,385	30.2	16,297	200	5.13	23,421
Enrichment Value	***15.1x***	***41.7x***	***1.2x***	***32.9x***	***53.6x***	***8.9x***	***1.5x***	***247.5x***	***400x***	***29x***	***76.2x***

Note: The enrichment value is equal to the number of times ("x") Site waste source samples are greater or less than the background soils (i.e. the average concentration of arsenic in waste source is 15.1 times greater than average background soils). Values greater than 1 times the background are bolded.

Background soil, Site soil, and waste source laboratory analytical results are summarized in the following:

- Background soil pH ranged from 6.2 to 7.2 su; waste source and native soil ranged from 6.2 to 8.1 su.
- ABAs were analyzed on eight waste rock and ore samples, acid base potential (ABP) ranged from 2 to 965 t $CaCO_3$/Kt (ABP units are presented as tons of calcium carbonate needed to neutralize a kiloton of waste). ABP is the result of the acid neutralizing potential (ANP) minus the acid generating potential (AGP). A negative ABP indicates that the acid generating potential is greater than the acid neutralization potential, and thus the material has the potential to produce acid rock drainage (ARD). Based on this, the waste rock and ore at the Site does not have the potential to produce ARD.

- Total sulfur in the nine waste source samples analyzed ranged from below MDL to 3.04%.
- Eight waste rock and ore samples were submitted for SPLP and TCLP analyses for the eight Resource Conservation Recovery Act (RCRA) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). The cadmium TCLP limit (1.0 mg/L) was exceeded in one sample (OP1-1 = 3.22 mg/L); and the lead TCLP limit (5.0 mg/L) was exceeded in two samples (OP1-1 = 39.2 mg/L and WR1-3 = 13.2 mg/L). None of the samples analyzed for SPLP exceeded any of the TCLP limits. TCLP is not considered a valid test for mining waste because it significantly exaggerates metals mobility in a non landfill environment.
- The volume of waste rock and ore piles was estimated by measuring the base of the pile, height and slopes of sides and with the use of AutoCAD and the prismoidal formula. Based on these calculations, the total volume of WR1 is 4,400 CY, WR2 is 11,000 CY, OP1 is 800 CY, and OP2 is 30 CY. The total estimated volume of the waste rock associated with the various exploration workings is 725 CY.
- Results of the metals analyses are discussed in the following table:

Summary of Background Soil, Site Soil, and Waste Source Metals Results

Sample Type	Table / Sample ID	Metals Exceeding at Least One Criteria	Metals Exceeding One Criteria and Average Background	Trends Observed and Comments
Background Soil	**Table 4**	**Total metals (units in mg/kg)**		
Background Soil	BGS-1, BGS-2, and BGS-3	Aluminum, arsenic, barium, cadmium, chromium, lead, manganese, mercury, selenium, vanadium, and zinc.	Not Applicable (NA)	NA
Oriole Mine	**Table 5**	**Total metals (units in mg/kg) / Criteria: Eco = Ecological, HH = Human Health**		
Waste Rock Pile 1	WR1-1, WR1-2, WR1-3, and WR1-4	Aluminum, antimony, arsenic, arsenic V, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, thallium, and zinc.	Antimony (1,150), arsenic (211), arsenic V (31), cadmium (390), chromium (24), cobalt (25), copper (2,800), lead (103,000), mercury (3.44), nickel (50.4), selenium (25), silver (330), thallium (30B), and zinc (62,500).	Antimony, arsenic, cadmium, copper, lead, mercury, silver, and zinc are the metals of concern when compared to the lowest criteria (antimony = 5-Eco, arsenic =1.6-HH, cadmium = 2-HH, copper = 50-Eco, lead = 40.5-Eco, mercury = 0.00051-Eco, silver = 2-Eco, and zinc = 8.5-Eco) and average background concentrations. In general, all other metals were slightly above the average background concentrations and/or the lowest comparison criteria.
Waste Rock Pile 2	WR2-1, WR2-2, and WR2-3	Aluminum, antimony, arsenic, arsenic V, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc.	Antimony (145), arsenic (60.1), arsenic V (10.8), cadmium (52), chromium (34), cobalt (37), copper (900), lead (7,790), mercury (1.37), nickel (47.3), selenium (7.1), silver (111), vanadium (25.5), and zinc (14,400).	
Native Soil	WR1-1 and WR2-3	Aluminum, arsenic, barium, cadmium, chromium, lead, manganese, nickel, silver, vanadium, and zinc.	Arsenic (12.9), cadmium (7.4), chromium (25), lead (501), manganese (6,820), nickel (34.1), silver (3.07), vanadium (47.9), and zinc (1,130).	
Ore Piles	OP1-1, OP1-2, OP2-1, and OP3-1	Aluminum, antimony, arsenic, arsenic V, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.	Antimony (550), arsenic (173), arsenic V (84.11), cadmium (430), chromium (19), cobalt (25), copper (2,020), lead (42,900), mercury (3.45), nickel (38.5), selenium (9.4), silver (203), thallium (10B), vanadium (31.5), and zinc (93,000).	
Exploration Workings	WR3-1, WR4-1, and WR5-1	Aluminum, antimony, arsenic, arsenic V, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.	Antimony (90), arsenic (64.1), arsenic V (11.08), cadmium (112), chromium (14), cobalt (55), copper (1,910), lead (15,100), mercury (0.59), nickel (42.9), selenium (3), silver (86), thallium (4B), vanadium (26.2), and zinc (17,300).	

Notes: For multiple samples, the concentration listed is the highest detected concentration in the sample set. Concentrations listed are "total" concentrations, unless indicated (i.e. methyl mercury, arsenic III, etc.)

3.3.2.2 Plant Tissue Analytical Results

Five vegetation samples, co-located with background soil and waste rock samples, were collected around the Site (Figure 2). Laboratory results are presented in Table 6. As the waste piles are not well vegetated, a reconnaissance was first performed to determine which species of plant was abundant and widespread enough for the sampling program, and one that would likely be foraged on by ecological receptors. Based on the reconnaissance, thimbleberry was sampled. No stressed vegetation was observed during the SI field activities. Samples OM-V2, OM-V4, and OM-V5 were collected to represent background plant tissue concentrations at the same location as background soil sample locations (BGS-1, BGS-2, and BGS-3, respectively). Samples OM-V1 and OM-V3 were collected to represent waste rock plant tissue concentrations and were sampled from WR2 and WR1, respectively.

Comparison criteria do not exist for plant tissue concentrations; however, they do exist for soil concentrations that are used to assess impacts to plant growth and the subsequent exposure to wildlife receptors that forage on plants. These criteria are included under the waste rock discussion. Based on a review of the results, the concentration of metals in waste rock vegetation are equal to or below the background vegetation concentrations.

3.3.3 Soil Exposure Pathway Summary

Metal concentrations in background soils are elevated; 11 metals are present at concentrations exceeding one or more comparison criteria. However, 15 metals were detected in waste rock and ore samples at concentrations exceeding both the average background soil concentration and one or more comparison criteria. In comparing waste rock and ore concentrations to average background soil concentrations, antimony, arsenic, cadmium, copper, lead, mercury, and zinc are the metals of concern.

Analyses of ABAs for waste rock and ore samples indicates the Site does not have the potential to produce ARD. One ore pile sample exceeded the Ecology TCLP limit for cadmium and lead, and one waste rock sample exceeded the TCLP limit for lead. However, none of the samples analyzed for SPLP exceeded any of the TCLP limits. It may be necessary to invoke a CAMU designation to preclude treatment of the material as a Dangerous Waste, because TCLP is not considered a valid leaching test for mining waste.

Onsite vegetation does not appear to be impacted by activities associated with the Site; background vegetation concentrations were equal to or above vegetation samples collected from WR1 and WR2. The soil exposure pathway is considered complete for both human and ecological receptors, and a release of hazardous substances has been documented in this SI. The USFS may want to consider collecting additional background soil samples (3 or 4 samples) in order to calculate a statistically significant 90 percent upper confidence limit.

3.4 Air Exposure Pathway

3.4.1 Targets

The target distance for the air pathway has been defined as 1 and 4 miles from the Site, only one resident is located within one mile of the Site. The nearest year-round residence is located approximately 0.5 miles east of the Site (Plate 1). Sensitive environments, including wetlands, which are located within 4 miles from the Site, are also outlined in Section 3.2.2.

3.4.2 Air Exposure Pathway Summary

Air samples were not collected as part of the field activities. Metals were likely released to the air during extraction and processing; however, processing is currently not occurring at the Site and has not occurred for over 50 years. The most likely air pathway is due to inhalation of particulate matter. As with soil exposure, this

pathway is considered complete because metal impacted waste rock and ore is concentrated at the surface where human and ecological receptors could be exposed to particulate matter. The air pathway is linked to the soil exposure pathway; therefore, addressing and/or eliminating the soil exposure pathway will address the air exposure pathway. Further assessment of the air pathway is not recommended.

4.0 CONCLUSIONS

Groundwater Pathway

The groundwater pathway does not appear to be complete and no further assessment is warranted. The adit drainage infiltrates into the shallow groundwater and likely discharges to Linton Creek during certain times of the year (i.e., when Linton Creek is gaining). The only known well that could potentially be impacted by the Site is located approximately 0.5 miles east of the Site. The well appears to be crossgradient or upgradient to Linton Creek, and thus shallow groundwater from the Site would not impact the well. Groundwater that discharges to surface water during gaining stream conditions is addressed in the surface water pathway discussion.

Surface Water Pathway

The surface water pathway is complete due to elevated concentrations of metals in stream sediment samples, and further assessment is warranted. This is based on data that indicates erosion from the Site may have caused elevated concentrations of metals in Linton Creek sediments. Elevated metal concentrations in surface water were detected in the adit drainage from the Site. However, surface water in Linton Creek does not appear to be impacted by the Site, as all metal concentrations were either below the lowest comparison criteria or the background concentrations in the unnamed creek. The conclusions presented are based on samples collected during presumed low flow conditions. Furthermore, because background water and sediment samples could not be collected directly from Linton Creek, these conclusions are based on comparison to a background station not in Linton Creek. During SI field activities, the reach was dry; therefore the alternative station was used.

Rainbow trout (state priority species) have been documented in the lower portions of Linton Creek (below LC-05) and there is the potential that the westslope cutthroat trout (federal species of concern) may be present; however, the fine-grained organic substrate and high gradient would make it unlikely that these fish use Linton Creek for spawning habitat. The benthic macroinvertebrate enumeration results suggest little or no difference in invertebrate populations between pool Stations upstream, adjacent to and downstream of the Site.

Soil Pathway

The soil exposure pathway is considered complete for both human and ecological receptors, and a release of hazardous substances has been documented in this SI. This is based on concentrations of 15 metals in waste rock and ore exceeding both the average background soil concentration and the lowest comparison criteria. Antimony, arsenic, cadmium, copper, lead, mercury, and zinc appear to be the metals of concern. Two samples exceeded Ecology TCLP limit for lead; and one sample exceeded the cadmium limit, thus a Dangerous Waste (as defined by Ecology) is present at the Site. TCLP is an inappropriate test for mining waste, and it greatly exaggerates metal mobility. None of the SPLP samples exceeded TCLP criteria; SPLP is a more accurate leachability test for mining waste. Waste rock and ore at the Site do not have the potential to produce ARD. Onsite vegetation does not appear to be impacted by activities associated with the Site; metals concentrations in background vegetation samples were equal to or above those detected in vegetation samples collected from WR1 and WR2. One state terrestrial candidate species (Pileated woodpecker) was observed, and several other federal and state RTE mammals, birds, and herpetiles have potential habitat in the vicinity of the Site.

Air Pathway

This pathway is considered complete because metal impacted soil and waste rock is concentrated at the surface where human and ecological receptors could be exposed. The most likely air pathway is due to inhalation of particulate matter. However, addressing and/or eliminating the soil exposure pathway will likely render the air exposure pathway incomplete. Therefore, further assessment of the air pathway is not recommended.

5.0 RECOMMENDATIONS

Based on the information gathered as part of the SI and presented in this report, CES recommends the following be completed in a two-phased approach. First, a spring sampling event is recommended to collect additional samples and determine true background concentrations in Linton Creek and the impact from the Site on Linton Creek. CES anticipates that Linton Creek above the Site may contain water during expected higher flow spring conditions. Additional surface water and sediment samples should simultaneously be collected from the adit drainage, the remainder of Linton Creek, and the unnamed creek in order to help correlate and evaluate the new data at high flow conditions. Following collection of these data, a risk assessment should be performed to assess if human and ecological impacts exist at the Site and in Linton Creek. Second, if the risk assessment indicates that risks are present, a streamlined Engineering Evaluation / Cost Analysis (EECA) should be prepared to establish removal cleanup standards and applicable removal action alternatives.

USFS Disclaimer: This abandoned mine/mill site was created under the General Mining Law of 1872 and is located solely on National Forest System (NFS) lands administered by the USDA Forest Service. The United States has taken the position and courts have held that the United States is not liable as an "owner" under CERCLA Section 107 for mine contamination left behind on NFS lands by miners operating under the 1872 Mining Law. Therefore, USDA Forest Service believes that this site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this site should be included on EPA's CERCLIS database. Consistent with the June 24, 2003 OECA/FFEO "Policy on Listing Mixed Ownership Mine or Mill Sites Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this site on the Federal Agency Hazardous Waste Compliance Docket.

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TABLES

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Table 2. **Sediment Analytical Results**
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Table 1. Surface Water Analytical Results
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample I.D.	Sample Date	Aluminum, TR*	Aluminum, Diss.	Antimony, TR	Antimony, Diss.	Arsenic III, TR	Arsenic V, TR	Arsenic Total, TR	Arsenic Total, Diss.	Barium, TR*	Barium, Diss.*	Beryllium, TR	Beryllium, Diss.	Cadmium, TR	Cadmium, Diss.	Calcium, TR	Calcium, Diss.	Chromium III, TR	Chromium VI, TR	Chromium, TR	Chromium, Diss.	Cobalt, TR	Cobalt, Diss.	Copper, TR	Copper, Diss.	Iron, TR*+
		Results in µg/L																								
OM-AS-01	7/27/2004	30 B	NA	1.6	NA	< 0.007	< 0.4965	**0.5 B**	NA	**21**	NA	< *2*	NA	**1.1**	NA	20,000	NA	ND	**10**	< 10	NA	< 10	NA	**1.9 B**	NA	30 B
OM-AS-02	7/27/2004	50 B	NA	1.7	NA	< 0.007	< 0.4965	**0.5 B**	NA	**28**	NA	< *2*	NA	**1.2**	NA	19,800	NA	<10	ND	< 10	NA	< 10	NA	**2.1 B**	NA	80
LC-SW-02	7/28/2004	< 30	< 30	< 0.20	< 2	< 0.007	< 0.4965	< ***0.5***	< ***5***	**11**	**11**	< *2*	< *2*	< 0.1	< ***1***	8,400	8,700	ND	**10**	< 10	< 10	< 10	< 10	< ***0.5***	**17 B**	10 B
LC-SW-03	7/28/2004	< 30	< 30	< 0.20	< 0.4	< 0.007	< 0.4965	< ***0.5***	< ***1***	**12**	**13**	< *2*	< *2*	< 0.1	< ***0.2***	8,000	8,200	ND	**10**	< 10	< 10	< 10	< 10	< ***0.5***	**4 B**	< 10
LC-SW-04	7/28/2004	30 B	< 30	< 0.20	< 0.4	0.014 B	0.486 B	**0.5 B**	< ***1***	**12**	**12**	< *2*	< *2*	< 0.1	< ***0.2***	20,600	20,400	<10	ND	< 10	< 10	< 10	< 10	< ***0.5***	< ***1***	60
LC-SW-05	7/27/2004	< 30	< 30	< 0.20	< 1	0.024 B	0.876 B	**0.9 B**	< ***3***	**12**	**14**	< *2*	< *2*	< 0.1	< ***0.5***	24,500	25,100	<10	ND	< 10	< 10	< 10	< 10	< ***0.5***	< ***3***	40 B
UD-SW-01	7/28/2004	< 30	< 30	< 0.20	< 0.4	0.036	1.064	**1.1 B**	**1 B**	**14**	**14**	< *2*	< *2*	< 0.1	< ***0.2***	27,300	27,800	<10	ND	< 10	< 10	< 10	< 10	< ***0.5***	**1 B**	20 B
Standards, corrected for hardness where applicable (used				77	**mg/L average for surface water samples, excluding portal seeps)**																					
Washington - Aquatic Life [1]		NS	NS	NS	NS	NS	NS	*190*	190	NS	NS	NS	NS	*0.92*	0.85	NS	NS	*167.1*	*10*	NS	NS	NS	NS	*9.5*	9.1	NS
Washington - Human Health [2]		NS	NS	14	*14*	NS	NS	0.018	*0.018*	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Washington Drinking Water Criteria [3]		NS	NS	6	*6*	NS	NS	10	*10*	2,000	*2,000*	4	*4*	5	*5*	NS	NS	NS	NS	100	*100*	NS	NS	1,300	*1,300*	300
EPA - Aquatic Life [4]		87	87	NS	NS	NS	NS	150	*150*	NS	NS	NS	NS	*0.22*	*0.21*	NS	NS	69.6	11	NS	NS	NS	NS	*7.5*	*7.2*	1,000
EPA - Human Health [5]		NS	NS	5.6	NS	NS	NS	*0.14*	0.14	1,000	NS	NS	NS	5	NS	NS	NS	NS	NS	100	NS	NS	NS	1,300	NS	300
ORNL - Surface Water PRGs [6]		87	87	30	30	190	3.1	NS	NS	4	4	0.66	0.66	0.15	0.15	116,000	116,000	44	2	NS	NS	23	NS	0.2	0.23	158

Sample I.D.	Sample Date	Lead, TR	Lead, Diss.	Magnesium, TR	Magnesium, Diss.	Manganese, TR*+	Manganese, Diss.*+	Mercury, TR	Nickel, TR	Nickel, Diss.	Potassium, TR	Potassium, Diss.	Selenium, TR	Selenium, Diss.	Silver, TR*	Silver, Diss.+	Sodium, TR	Sodium, Diss.	Thallium, TR	Thallium, Diss.	Vanadium, TR	Vanadium, Diss.	Zinc, TR+	Zinc, Diss.+
		Results in ug/L																						
OM-AS-01	7/27/2004	**4.8**	NA	10,200	NA	8 B	NA	0.00366	< 10	NA	600 B	NA	< ***1***	NA	0.07 B	NA	1,100	NA	< 0.1	NA	< 5	NA	**110**	NA
OM-AS-02	7/27/2004	**8.2**	NA	10,000	NA	11 B	NA	0.0051	< 10	NA	500 B	NA	< ***1***	NA	0.07 B	NA	1,100	NA	< 0.1	NA	< 5	NA	**120**	NA
LC-SW-02	7/28/2004	< 0.5	< **10**	4,300	4,400	< 5	< 5	0.000275	< 10	< 10	400 B	400 B	< ***10***	< ***1***	< **0.05**	< **0.5**	800 B	800 B	< 0.1	< 0.5	< 5	< 5	< 10	< 10
LC-SW-03	7/28/2004	< 0.1	0.3 B	4,000	4,100	< 5	< 5	0.00016 B	< 10	< 10	< 300	500 B	< ***1***	< ***2***	< **0.05**	< 0.1	700 B	700 B	< 0.1	< 0.1	< 5	< 5	10 B	20 B
LC-SW-04	7/28/2004	0.3 B	< 0.2	8,500	8,500	< 5	< 5	0.000335	< 10	< 10	500 B	600 B	< ***1***	< ***2***	< **0.05**	< 0.1	1,100	1,100	< 0.1	0.1 B	< 5	< 5	< 10	10 B
LC-SW-05	7/27/2004	**1.1**	**0.8 B**	9,000	9,300	6 B	< 5	0.000412	< 10	< 10	500 B	700 B	< ***1***	< ***5***	< **0.05**	< 0.3	1,100	1,100	< 0.1	**1.8**	5	< 5	< 10	< 10
UD-SW-01	7/28/2004	< 0.1	< 0.2	9,700	9,900	< 5	< 5	0.000511	< 10	< 10	800 B	800 B	< ***1***	< ***2***	< **0.05**	< 0.1	1,200	1,200	< 0.1	0.2 B	< 5	< 5	< 10	< 10
Standards, corrected for hardness where applicable (used				77	**mg/L average for surface water samples, excluding portal seeps)**																			
Washington - Aquatic Life [1]		*2.28*	1.89	NS	NS	NS	NS	0.012	*204.4*	203.7	NS	NS	5	5	NS	NS	NS	NS	NS	NS	NS	NS	*84.94*	83.75
Washington - Human Health [2]		NS	NS	NS	NS	NS	NS	0.14	610	*610*	NS	NS	170	*170*	NS	NS	NS	NS	1.7	*1.7*	NS	NS	NS	NS
Washington Drinking Water Criteria [3]		15	*15*	NS	NS	50	*50*	2	100	*100*	NS	NS	50	*50*	100	*100*	20,000	*20,000*	2	*2*	NS	NS	50,000	*50,000*
EPA - Aquatic Life [4]		2.28	*1.89*	NS	120	NS	NS	0.91	41.8	*41.7*	NS	NS	5	5	NS	NS	NS	NS	NS	NS	NS	NS	96.02	*94.67*
EPA - Human Health [5]		15	NS	NS	NS	50	NS	2	610	NS	NS	NS	50	NS	100	NS	NS	NS	1.7	NS	NS	NS	NS	NS
ORNL - Surface Water PRGs [6]		0.66	0.66	82,000	82,000	120	120	0.23	160	160	53,000	53,000	0.39	0.39	0.36	0.36	680,000	680,000	9	9	20	20	30	30

Sample I.D.	Sample Date	Flow Rate	Temperature (Field)	pH (Field)*	pH (Lab)*	Turbidity*	Conductivity (Field)	Conductivity @ 25C (Lab)	Dissolved Oxygen (Field)*	Oxygen Reduction Potential (Field)	Hardness as $CaCO_3$, TR*	Field TDS*	Residue, Filterable (TDS) @180*	Residue, Non- Filterable (TSS) @105° C*	Sulfate+
		cfs	°C	su	su	NTU	µS/cm	µS/cm	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L
OM-AS-01	7/27/2004	0.02	9.52	8.05	6.4	80	43	163	12.02	110	92	110	100	< 5	< 10
OM-AS-02	7/27/2004	0.015	10.64	8.38	7.2	150	21	167	12.35	120	91	130	110	6 B	< 10
LC-SW-02	7/28/2004	0.2	7.52	7.20	7.1	121	66	80	9.30	186	39	43	50	< 5	< 10
LC-SW-03	7/28/2004	0.5	8.99	7.46	7.5	20.2	62	73	9.82	171	36	41	40	< 5	< 10
LC-SW-04	7/28/2004	0.8	7.64	7.76	7.9	22.8	138	200	9.71	176	106	90	120	< 5	< 10
LC-SW-05	7/27/2004	2.5	9.40	7.62	7.8	80.9	159	189	10.28	185	98	103	110	< 5	< 10
UD-SW-01	7/28/2004	2.4	8.40	7.74	7.9	14.2	170	200	10.00	194	106	111	120	< 5	< 10
Standards															
Washington - Aquatic Life [1]		NS	12	6.5-8.5	6.5-8.5	5>Bkg	NS	NS	9.5	NS	NS	NS	NS	NS	NS
Washington - Human Health [2]		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Washington Drinking Water Criteria [3]		NS	NS	6.5-8.5	6.5-8.5	NS	700	700	NS	NS	NS	500	500	NS	250
EPA - Aquatic Life [4]		NS	9-19	6.5-9	6.5-9	NS	NS	NS	9.5	NS	NS	NS	NS	NS	NS
EPA - Human Health [5]		NS	NS	5-9	5-9	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:

All analyses except Arsenic III & Mercury were conducted by ACZ Laboratories, Inc., Steamboat Springs, CO per EPA Method 200 series
Arsenic III and mercury anlyses were conducted by Brooks Rand, Seattle, WA per EAP Methods 1631 & 1632, respectively
Arsenic V was calculated from difference between Arsenic, TR and Arsenic III
Chromium VI was determied in the field
Chromium III was calculated from difference between Chromium, TR and Chromium VI
mg/L = milligrams per liter
µg/L = micrograms per liter
Bolded values indicate that the value exceeds one or more standard
Italic values indicate that the MDL exceeds the lowest standard
NM = Not Measured
NA = Not analyzed
* = Non-Priority Pollutant under NTR
+ = Secondary Drinking Water Criteria
ND = Not Detected

STANDARD NOTES:

1 - State of Washington Aquatic Life criteria (WAC 173-201A),underline - corrected for hardness,*italics* - expressed as dissolved
3 - State of Washington drinking water criteria (WAC 246-290),underline - action level or level of concern,*italics* - expressed as Total Recoverable
4 - EPA recommended chronic ambient water quality criteria for freshwater aquatic life used (EPA, 2002),underline - corrected for hardness,*italics* - expressed as dissolved
5 - EPA recommended ambient water quality criteria for protection of human consumption of water and fish (EPA, 2002 NTR),*italics* - expressed as dissolved
6 - ORNL Preliminary Remediation Goals for Ecological Endpoints (ORNL, 1997)

Table 2. Sediment Analytical Results
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample ID	Sample Date	Aluminum, Total	Antimony, Total	Arsenic III, Inorganic	Arsenic V, Inorganic	Arsenic - Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
		mg/kg																								
LC-SS-2	7/28/2004	11,550	**1.2**	< 0.103	5.1	5.2	114	0.6 B	**1.56**	4,510	18	14	26.9	17,100	**290**	4,250	1,530	0.09 B	**26.9**	670	0.9 B	**2.01**	60 B	0.17	16.8	**162**
LC-SS-3	7/28/2004	7,170	**2.2**	< 0.038	15.3	**15.3**	64	0.8 B	**2.26**	1,950	19	13	21.2	86,300	**1,880**	2,440	2,570	**0.21**	**28**	310	0.5 B	0.3 B	< 60	0.95	23	**1,880**
LC-SS-4	7/28/2004	9,910	**0.6**	0.124 B	8.7	**8.8**	47	0.3 B	**1.19**	6,420	20	10	13.5	33,600	**147**	6,850	524	**0.64**	**19.7**	640	< 0.5	0.19	60 B	0.1	23.4	**1,970**
LC-SS-5	7/27/2004	7,460	0.4 B	0.057 B	5.4	5.5	47	0.2 B	0.56	7,350	16	5 B	9.6	18,000	**1,130**	5,970	497	< 0.04	17	630	< 0.5	< 0.3	110	0.18	24.6	**265**
UD-SS-1	7/28/2004	7,280	0.3 B	0.124 B	4.7	4.8	47	< 0.2	0.37	3,760	17	5 B	9.3	16,400	**868**	4,840	434	< 0.4	14.1	610	< 0.5	0.1 B	150	0.12	30.4	108
Standards																										
WA - Freshwater (under development) [1]		NS	0.6	NS	NS	51	NS	NS	1	NS	100	NS	830	NS	430	NS	NS	0.75	70	NS	NS	2.5	NS	NS	NS	160
WA - Marine [2]		NS	NS	NS	NS	57	NS	NS	5.1	NS	260	NS	390	NS	450	NS	NS	0.41	NS	NS	NS	6.1	NS	NS	NS	410
EPA - Freshwater TEL [3]		NS	NS	NS	NS	5.9	NS	NS	0.596	NS	37	NS	35.7	NS	35	NS	NS	0.174	18	NS	NS	NS	NS	NS	NS	123.1
EPA - Freshwater PEL [4]		NS	NS	NS	NS	17	NS	NS	3.53	NS	90	NS	197	NS	91.3	NS	NS	0.486	35.9	NS	NS	NS	NS	NS	NS	315
ORNL - Freshwater [5]		NS	NS	NS	NS	42	NS	NS	4.2	NS	159	NS	77.7	NS	110	NS	NS	0.7	38.5	NS	NS	1.8	NS	NS	NS	270

Sample ID	Sample Date	Total Organic Carbon	Size Fraction by Hydrometer			Solids (ACZ)	Solids (BR)	Texture Classification	Clay Analysis (XRD)			
			Clay	Sand	silt				Smectite	Illite	Kaolinite	Chlorite
		%							%			
LC-SS-2	7/28/2004	7.5	10	65	25	46.9	29.1	SL	7	72	1*	20
LC-SS-3	7/28/2004	2.5	5	78.8	16.3	77.2	79.1	LS	NA	NA	NA	NA
LC-SS-4	7/28/2004	1.2	2.5B	81.3	16.3	81.6	79.3	LS	NA	NA	NA	NA
LC-SS-5	7/27/2004	1.0	2.5B	88.8	8.8	83.2	84.3	S	8	65	1*	26
UD-SS-1	7/28/2004	1.0	1.3B	91.3	7.5	81.1	77.6	S	2	63	1*	34

NOTES:

Analysis (except AsIII) was conducted by ACZ Laboratories, Inc. in Steamboat Springs, CO, per EPA Method 6010/7000 series.
As III analyses by Brooks Rand in Portland, OR, per EPA Method 1631
Digestion (except AsIII) by EPA Method 3050B
mg/kg = milligrams per kilogram
< value = analyte not detected above Method Detection Limit (MDL, shown)
B = analyte detected between MDL and Practical Quantification Limit (PQL, not shown)
MDL and PQL are not consistent among samples
Chromium III was calculated by subtracting Chromium VI from Total Chromium
Bolded values indicate that the value exceeds one or more standard

STANDARD NOTES:

1 - State of Washington, Development of Freshwater Sediment Quality Values (DOE, Sept 2003)
2 - State of Washington, Marine Sediment Management Standards (DOE, 1995)
3 - EPA Threshold Effects Level (NOAA, 1999)
4 - EPA Probable Effects Level (NOAA, 1999)
5 - ORNL ecological screening level values for freshwater, lowest chronic value used (ORNL, 1996)
NS = No Standard

Table 3. Background Soil Analytical Results
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample ID	Sample Date	Sample Depth (feet)	% Solids	pH	Aluminum, Total	Antimony, Total	Arsenic III, Total	Arsenic V, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total
				su	mg/kg																								
OM-BGS-1	7/28/2004	0.5-1	88.1	6.2	**34,600**	0.2 B	NA	NC	**3.9**	**327**	0.9 B	0.82	1,970	**11**	10	17.6	17,500	17.5	1,770	848	< **0.1**	18	870	< **0.5**	0.19	280	0.15	**23**	**80**
OM-BGS-2	7/28/2004	0.5-1	98.7	7.2	**9,510**	0.9	0.055 B	4.045	**4.1**	**160**	0.5 B	**3.31**	11,600	**12**	15	34	13,500	**116**	14,300	**4,920**	< **0.05**	16	700	< **0.5**	0.77	40 B	0.09 B	**17.7**	**169**
OM-BGS-3	7/28/2004	0.5-1	65.3	6.3	**32,000**	0.4 B	0.07 B	4.13	**4.2**	**880**	0.9 B	**4.6**	10,200	**15**	12	29.5	19,400	**64**	2,280	**4,240**	< **0.04**	26	1,160	< **1**	0.34	280	0.29 B	**22.9**	**673**
AVERAGE				6.6	25,370	0.5	NC	NC	4.1	456	0.77	2.91	7,923	12.7	12.3	27.0	16,800	65.8	6,117	3,336	0.023	20.2	910	NC	0.43	200	0.18	21.2	307
Standards																													
WA - Method A Indust. Soil Cleanup Levels - Human Receptors[1]					NS	NS	NS	NS	20	NS	NS	2	NS	19	NS	NS	NS	1,000	NS	NS	2	NS	NS	NS	NS	NS	NS	NS	NS
WA - Ecological Receptors (p=plant, b=soil biota, w=wildlife)[2]					50 p	5 p	7 w	10 p	NS	102 w	10 p	4 p	NS	42 bp	20 p	50 b	NS	50 p	NS	1,100 p	0.1 b	30 p	NS	0.3 w	2 p	NS	1 p	2 p	86 p
EPA Indust. PRGs - Human Receptors[3]					100,000	410	NS	NS	1.6	67,000	1,900	7.4	NS	64	1,900	41,000	100,000	750	NS	19,000	310	20,000	NS	5,100	5,100	NS	67	7,200	100,000
EPA - Ecological Receptors (m=mammal, b=bird, i = invertebrate, p=plant)[4]					NS	21 m	NS	NS	37 p	NS	NS	29 p	NS	5 p	32 b	61 i	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	120 i
ORNL - Ecological Receptors[5]					NS	5	NS	NS	9.9	283	10	4	NS	0.4	20	60	NS	40.5	NS	NS	0.00051	30	NS	0.21	2	NS	1	2	8.5

NOTES:
Analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, CO using EPA Method 6000 Series & Method 7471.
mg/kg = milligrams per kilogram
su = standard units
< value = analyte not detected above indicated Method Detection Limit (MDL).
B = analyte detected between MDL and practical quantification limit (PQL).
NC = Not Calculated
Bolded values indicate that the value exceeds one or more standard
Mean values calculated using one half the MDL if results were below the MDL.

STANDARD NOTES:
1 = Wasington Department of Ecology MTCA (WAC 173-340) Industial criteria, Table 745-1 (Ecology, 2001).
2 = Wasington Department of Ecology MTCA (WAC 173-340) Industial criteria, Table 749-2 (Ecology, 2001).
3 - EPA Region 9 Industrial Preliminary Remediation Goals - (EPA, 2002).
4 - EPA Ecological Soil Screening Levels - Lowest Criteria Listed (EPA, 2000)
5 - ORNL = Oak Ridge National Laboratory Preliminary Remediation Goals for Ecological Endpoints August 1997
NS = No standard

Table 4. Ore Stockpiles and Waste Rock Analytical Results
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample ID	Sample Date	Sample Depth (feet)	Waste Rock (WR), Ore, or Native Soil	% Solids	Paste pH	Aluminum, Total	Antimony, Total	Arsenic III, Total	Arsenic V, Total	Arsenic, Total	Barium, Total	Beryllium, Total	Cadmium, Total	Calcium, Total	Chromium, Total	Cobalt, Total	Copper, Total	Iron, Total	Lead, Total	Magnesium, Total	Manganese, Total	Mercury, Total	Nickel, Total	Potassium, Total	Selenium, Total	Silver, Total	Sodium, Total	Thallium, Total	Vanadium, Total	Zinc, Total	Total Sulfur	Sulfur Forms: Organic Sulfur	Sulfur Forms: Pyritic Sulfur	Sulfur Forms: Sulfate Sulfur	ABAs: Acid Generation Potential	ABAs: Acid Neutralization Potential	ABAs: Acid-Base Potential
					su	mg/kg																									%	%			t $CaCO_3$/Kt	
OM-OP1-1	7/27/2004	2-4	Ore	93.5	6.2	**4,290**	**170**	0.184	**84.116**	**84.3**	50.8	0.4 B	**222**	109,000	**19**	**25**	**1,740**	27,600	**16,300**	66,100	**2,200**	**1.66**	**38.5**	390	**20**	**100**	< 30	**10 B**	**19.4**	**37,400**	3.04	1.55	1.13	0.36	95	618	523
OM-OP1-2	7/28/2004	0.5	Ore	95.7	7.0	**2,570**	**280**	NA	NC	**173**	36.5	0.2 B	**260**	97,500	**15**	20	**1,640**	34,000	**42,900**	57,900	**2,260**	**3.45**	**36.4**	450	**2.5 B**	**203**	< 30	**10 B**	**31.5**	**55,600**	NA	NA	NA	NA	NA	NA	NA
OM-OP2-1	7/27/2004	1-2	Ore	89.4	6.3	**11,000**	**550**	NA	NC	**164**	125	0.4 B	**204**	50,000	**13**	16	**2,020**	20,500	**20,300**	35,300	**2,280**	**1.91**	27	420	**9.4**	**199**	80 B	**6 B**	**17.2**	**33,300**	NA	NA	NA	NA	NA	NA	NA
OM-OP3-1	7/28/2004	0.5	Ore	95.3	6.6	**2,320**	**160**	NA	NC	**76.8**	30.7	0.2 B	**430**	78,800	**12**	9	**700**	27,800	**39,100**	51,900	**1,880**	**3.2**	23.1	480	**5.1**	**143**	30 B	**10 B**	**24.1**	**93,000**	NA	NA	NA	NA	NA	NA	NA
OM-WR1-1	7/27/2004	2-5	WR	73.1	7.1	**6,010**	**382**	NA	NC	**65.7**	49.1	0.5 B	**76.2**	113,000	**24**	**24**	**1,560**	19,800	**14,300**	71,400	**2,630**	**1.56**	**50.4**	340	**7.3**	**298**	< 30	1 B	**19.1**	**33,100**	NA	NA	NA	NA	NA	NA	NA
OM-WR1-1	7/27/2004	6.0	Native	87.6	7.7	**16,000**	3.1	NA	NC	**12.9**	164	0.7 B	**7.38**	20,900	**25**	19	49.2	19,900	**501**	26,000	**4,170**	< 0.04	**34.1**	680	< 0.5	**3.07**	60 B	0.2 B	**47.9**	**1,310**	NA	NA	NA	NA	NA	NA	NA
OM-WR1-2	7/27/2004	9.0	WR	93.4	7.8	**2,300**	**70**	< 0.035	**29.483**	**29.5**	27.1	0.3 B	**91.9**	136,000	**12**	**25**	**440**	14,300	**7,640**	79,400	**1,840**	**1.63**	**35.1**	390	**2.7**	**48**	< 30	**7 B**	**11.9**	**19,900**	0.37	0.25	0.06B	0.06B	12	816	804
OM-WR1-3	7/27/2004	1.0	WR	99.2	7.6	**1,530**	**110**	0.113	**30.987**	**31.1**	20.4	< 0.2	**116**	166,000	**3 B**	11	**500**	11,600	**3,400**	92,400	**2,210**	**0.9**	18.7	150	**10.8**	**38**	< 30	1 B	**6.3**	**15,400**	0.23	0.19	0.04B	<0.01	7	972	965
OM-WR1-3	7/27/2004	2.0	WR	93.7	6.9	**1,320**	**1,150**	NA	NC	**211**	17.3	< 0.2	**390**	90,600	**5 B**	7	**2,800**	11,500	**103,000**	54,300	**1,690**	**3.44**	14	120	**25**	**330**	< 30	**30 B**	**6.6**	**62,500**	NA	NA	NA	NA	NA	NA	NA
OM-WR1-4	7/27/2004	7.0	WR	98.1	8.0	**3,320**	**67**	NA	NC	**29.1**	35.6	0.3 B	**63**	150,000	**10**	**25**	**550**	14,100	**3,060**	86,000	**2,360**	**2.25**	**34.9**	290	**1.9 B**	**36**	< 30	1 B	**16.0**	**9,760**	NA	NA	NA	NA	NA	NA	NA
OM-WR2-1	7/27/2004	0-1	WR	97.8	7.6	**6,460**	**12**	0.055 B	9.745	**9.8**	95.2	0.3 B	**17.1**	112,000	**14**	11	**163**	10,900	**736**	66,200	**2,750**	**0.7**	23.1	390	< 0.5	**5.93**	40 B	< 0.3	**13.3**	**2,470**	0.04B	0.03B	0.01B	<0.01	1	699	698
OM-WR2-2	7/27/2004	4-10	WR	94.7	8.1	**7,860**	9 B	< 0.035	**10.783**	**10.8**	94.1	0.4 B	**13**	107,000	**34**	11	**94.2**	11,600	**1,560**	62,500	**2,720**	**0.32**	**38.1**	460	< 0.5	**9.66**	30 B	< 0.5	**16.8**	**1,190**	0.03B	0.03B	<0.01	<0.01	1	639	638
OM-WR2-3	7/27/2004	0.5-3	WR	97.4	7.5	**6,330**	**145**	NA	NC	**60.1**	48.1	0.5 B	**52.4**	152,000	**32**	**37**	**900**	22,200	**7,790**	89,800	**2,720**	**1.37**	**47.3**	480	**7.1**	**111**	< 30	< 1	**25.5**	**14,400**	NA	NA	NA	NA	NA	NA	NA
OM-WR2-3	7/27/2004	3.0	Native	84.5	7.7	**14,400**	4.8	NA	NC	**3.7**	**269**	0.5 B	**6.92**	22,700	**14**	14	31	20,000	**121**	20,000	**6,820**	< 0.05	18.4	520	< 0.5	**0.79**	80 B	0.1 B	**25.1**	**667**	NA	NA	NA	NA	NA	NA	NA
OM-WR3-1	7/28/2004	1.0	WR	95.7	7.2	**6,040**	**90**	NA	NC	**64.1**	46	0.4 B	**112**	104,000	**10**	**55**	**1,910**	22,100	**15,100**	64,800	**2,450**	**0.59**	**42.9**	490	**3**	**86**	30 B	**4 B**	**26.2**	**17,300**	0.02B	0.03B	<0.01	<0.01	1B	685	684
OM-WR4-1	7/28/2004	0.5	WR	86.9	6.6	**4,130**	0.7	< 0.042	5.182	**5.2**	29.8	0.6 B	0.4	420	**14**	8	18.5	32,700	**191**	240	**1,740**	< 0.05	12.3	550	< 0.5	0.05 B	< 30	0.45	**20.4**	**294**	<0.01	<0.01	<0.01	<0.01	0	3B	3
OM-WR5-1	7/28/2004	0.5	WR	85.0	6.3	**5,830**	< 1	< 0.042	**11.079**	**11.1**	54.5	0.5 B	0.55	590	**10**	17	18.9	34,100	**1,050**	300	900	0.12 B	19	430	< 0.5	0.05	< 30	0.5 B	**25.8**	**560**	<0.01	<0.01	<0.01	<0.01	0	2B	2
AVERAGE						5,983	200	0.0613	25.91	61.31	70.2	0.40	121.3	88,854	15.6	19.6	890	20,865	16,297	54,385	2,566	1.251	30.2	414	5.73	94.8	31.3	5.13	20.8	23,421	NC	NC	NC	NC	NC	NC	NC
Standards																																					
WA - Method A Indust. Soil Cleanup Levels - Human Receptors[1]						NS	NS	NS	NS	20	NS	NS	2	NS	19	NS	NS	NS	1,000	NS	NS	2	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
WA - Ecological Receptors (p=plant, b=soil biota, w=wildlife)						50 p	5 p	7w	10 p	NS	102 w	10 p	4 p	NS	42 pb	20 p	50 b	NS	50 p	NS	1,100 p	0.1 b	30 p	NS	0.3 w	2 p	NS	1 p	2 p	86 p	NS	NS	NS	NS	NS	NS	NS
EPA Indust. PRGs - Human Receptors[2]						100,000	410	NS	NS	1.6	67,000	1,900	7.4	NS	64	1,900	41,000	100,000	750	NS	19,000	310	20,000	NS	5,100	5,100	NS	67	7,200	100,000	NS	NS	NS	NS	NS	NS	NS
EPA - Ecological Receptors (m=mammal, b=bird, i = invertebrate, p=plant)						NS	21 m	NS	NS	37 p	NS	NS	29 p	NS	5 p	32 b	61 i	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	120 i	NS	NS	NS	NS	NS	NS	NS
ORNL - Ecological Receptors[5]						NS	5	NS	NS	9.9	283	10	4	NS	0.4	20	60	NS	40.5	NS	NS	0.00051	30	NS	0.21	2	NS	1	2	8.5	NS	NS	NS	NS	NS	NS	NS

NOTES:
Analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, CO using EPA Method 6000 Series & Method 7471.
mg/kg = milligrams per kilogram
t CaCO3/Kt = tons of calcium carbonate needed to neutralize 1000 tons of waste/soil. Negative number indicates lack of $CaCO_3$ positive value indicates excess (no need).
su = standard units
< value = analyte not detected above indicated Mewthod Detection Limit (MDL
B = analyte detected between MDL and practical quantification limit (PQL
NA = not analyzed
NC = Not calculated
Mean values calculated using one half the MDL if results were below the MDI

STANDARD NOTES:
1 = Wasington Department of Ecology MTCA (WAC 173-340) Industial criteria, Table 745-1 (Ecology, 2001).
2 = Wasington Department of Ecology MTCA (WAC 173-340) Industial criteria, Table 749-2 (Ecology, 2001).
3 - EPA Region 9 Industrial Preliminary Remediation Goals - (EPA, 2002)
4 - EPA Ecological Soil Screening Levels - Lowest Criteria Listed (EPA, 2000
5 - ORNL = Oak Ridge National Laboratory Preliminary Remediation Goals for Ecological Endpoints August 19
NS = No standard

Table 5. Synthetic Precipitation Leaching Procedure and Toxicity Characteristics Leach Procedure Results for Waste Rock Samples
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample ID	Sample Date	Sample Depth (feet)	Waste Rock (WR) or Ore	SPLP Arsenic	TCLP Arsenic	SPLP Barium	TCLP Barium	SPLP Cadmium	TCLP Cadium	SPLP Chromium	TCLP Chromium	SPLP Lead	TCLP Lead	SPLP Mercury	TCLP Mercury	SPLP Selenium	TCLP Selenium	SPLP Silver	TCLP Silver
				mg/L															
OM-OP1-1	7/27/2004	2-4	Ore	< 0.04	< 0.04	0.045	0.003 B	0.454	**3.22**	< 0.001	< 0.01	0.31	**39.2**	< 0.0002	< 0.0002	< 0.04	< 0.04	< 0.005	< 0.005
OM-WR1-2	7/27/2004	9.0	WR	< 0.04	NA	0.011	NA	< 0.005	NA	< 0.001	NA	0.06 B	NA	< 0.0002	NA	< 0.04	NA	< 0.005	NA
OM-WR1-3	7/27/2004	1.0	WR	< 0.04	< 0.04	0.006 B	0.12	< 0.005	0.253	< 0.001	< 0.001	0.06 B	**13.2**	< 0.0002	< 0.0002	< 0.04	< 0.04	< 0.005	< 0.005
OM-WR2-1	7/27/2004	0-1	WR	< 0.04	< 0.04	0.013	0.565	< 0.005	0.109	< 0.001	< 0.001	< 0.04	1.13	< 0.0002	< 0.0002	< 0.04	< 0.04	< 0.005	< 0.005
OM-WR2-2	7/27/2004	4-10	WR	< 0.04	NA	0.015	NA	< 0.005	NA	< 0.001	NA	< 0.04	NA	< 0.0002	NA	< 0.04	NA	< 0.005	NA
OM-WR3-1	7/28/2004	1.0	WR	< 0.04	NA	0.011	NA	< 0.005	NA	< 0.001	NA	0.1 B	NA	< 0.0002	NA	< 0.04	NA	< 0.005	NA
OM-WR4-1	7/28/2004	0.5	WR	< 0.04	NA	< 0.003	NA	< 0.005	NA	< 0.001	NA	< 0.04	NA	< 0.0002	NA	< 0.04	NA	< 0.005	NA
OM-WR5-1	7/28/2004	0.5	WR	< 0.04	NA	< 0.003	NA	< 0.005	NA	< 0.001	NA	< 0.04	NA	< 0.0002	NA	< 0.04	NA	< 0.005	NA
Applicable Standards																			
RCRA TCLP Disposal Limits				5	5	100	100	1	1	5	5	5	5	0.2	0.2	1	1	5	5

Notes: Analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, CO (EPA Method 1312 for SPLP and Method 1311 for TCLP)
mg/L = milligrams per liter
< value = analyte not detected above method detection limit (MDL)
B = analyte detected between method detection limit (MDL) and practical quantification limit (PQL)
Bolded values indicate that the value exceeds one or more standard

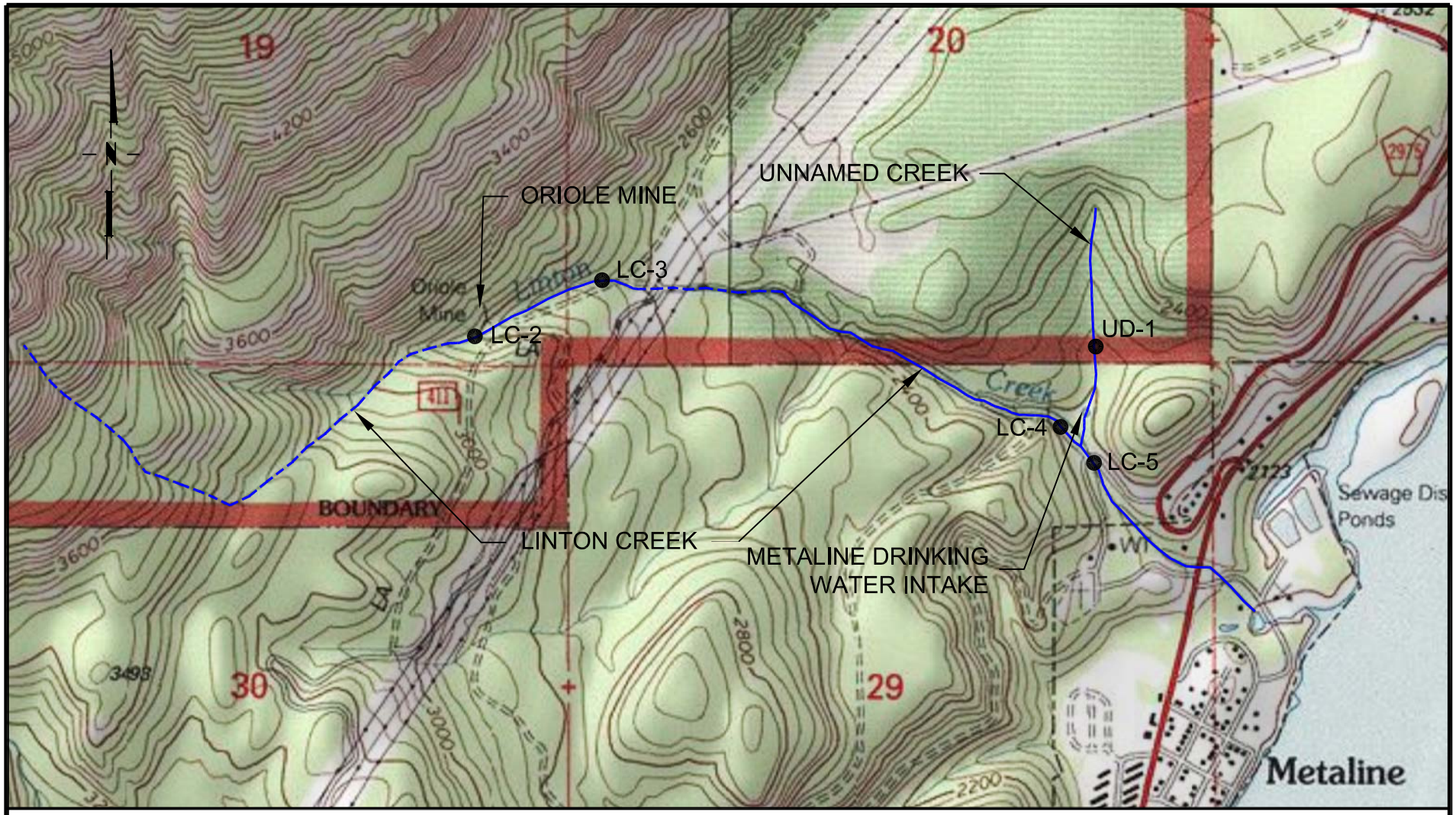
Table 6. Vegetation Analytical Results
Oriole Mine Site Inspection, Colville National Forest, Washington

Sample ID	Sample Date	Onsite (O) or Background (B)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
			mg/kg																						
OM-V1	07/28/04	O	40	< 0.1	< 0.3	34.8	< 0.2	0.13 B	23,500	1 B	< 1	4 B	86	0.7	9,640	44.6	< 0.05	< 1	14,400	< 0.5	0.03 B	< 30	0.07 B	< 0.5	24
OM-V2	07/28/04	B	57	0.2 B	< 0.3	27.4	< 0.2	0.25 B	19,900	1 B	< 1	4 B	96	4.55	7,810	74.0	< 0.05	< 1	12,700	< 0.5	0.06 B	< 30	< 0.03	< 0.5	28
OM-V3	07/28/04	O	47	0.2 B	< 0.3	56.0	< 0.2	0.3 B	18,100	1 B	< 1	6	83	3.98	7,130	56.0	< 0.05	< 1	16,800	< 0.5	0.08 B	< 30	0.06 B	< 0.5	35
OM-V4	07/28/04	B	43	0.2 B	< 0.3	6.7	< 0.2	0.59	16,000	< 1	< 1	9	135	3.4	8,190	132	< 0.05	< 1	18,300	< 0.5	0.05 B	< 30	< 0.03	< 0.5	45
OM-V5	07/28/04	B	68	< 0.1	< 0.3	40.6	< 0.2	0.05 B	19,100	< 1	< 1	8	137	0.85	7,370	66.5	< 0.05	< 1	17,800	< 0.5	< 0.03	< 30	< 0.03	< 0.5	16

NOTES:
Analysis was conducted by ACZ Laboratories, Inc. in Steamboat Springs, CO, per EPA Method 6010/7000 series.
Digestion by EPA Method 3050B
mg/kg = milligrams per kilogram
< value = analyte not detected above Method Detection Limit (MDL, shown)
B = analyte detected between MDL and Practical Quantification Limit (PQL, shown)
NA = not analyzed
PQL and MDL are consistent among samples

FIGURES

Figure 1. **Aquatic Sampling Stations**
Figure 2. **Oriole Mine Layout and Sampling Locations**



EXPLANATION

SHC-01 ● Aquatic Sampling Stations

Perennial Streamflow

Ephemeral Streamflow

0 1200 FEET

SCALE
(LOCATIONS ARE APPROXIMATE)

(SOURCE: 7.5 MIN USGS TOPOGRAPHIC MAP PRINTED NATIONAL GEOGRAPHIC HOLDINGS)

Figure 1. Aquatic Sampling Stations

PROJECT NUMBER: 2323024	ORIOLE MINE SITE INSPECTION
DATE: 12/20/04	
DWG BY 6DGW / DWG NO: 2323024F1.dwg	USDA FOREST SERVICE COLVILLE NATIONAL FOREST METALINE, WASHINGTON
PROJECT MANAGER: 6DGW	
REVISED:	CASCADE EARTH SCIENCES A Valmont Industries Company

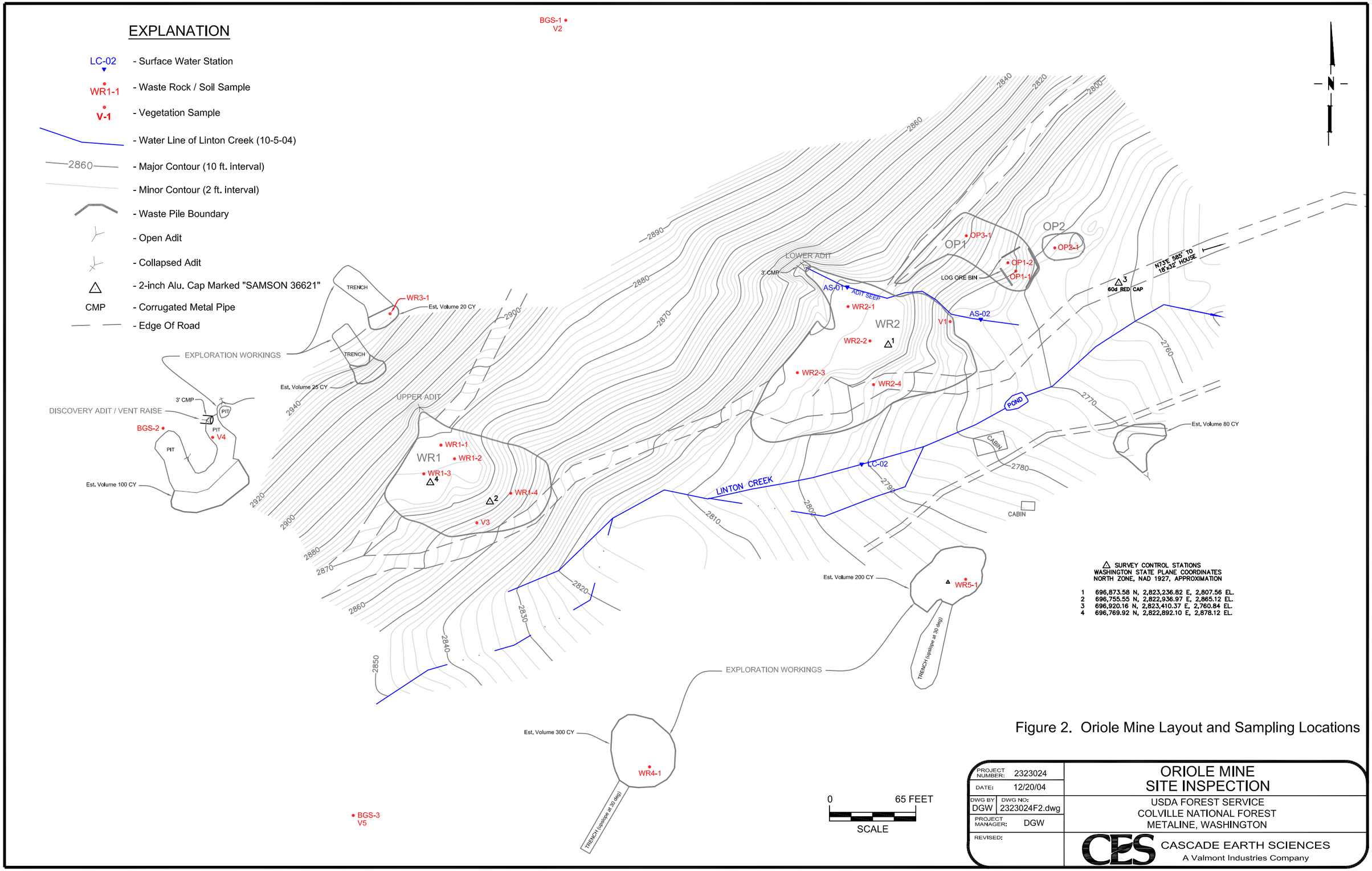
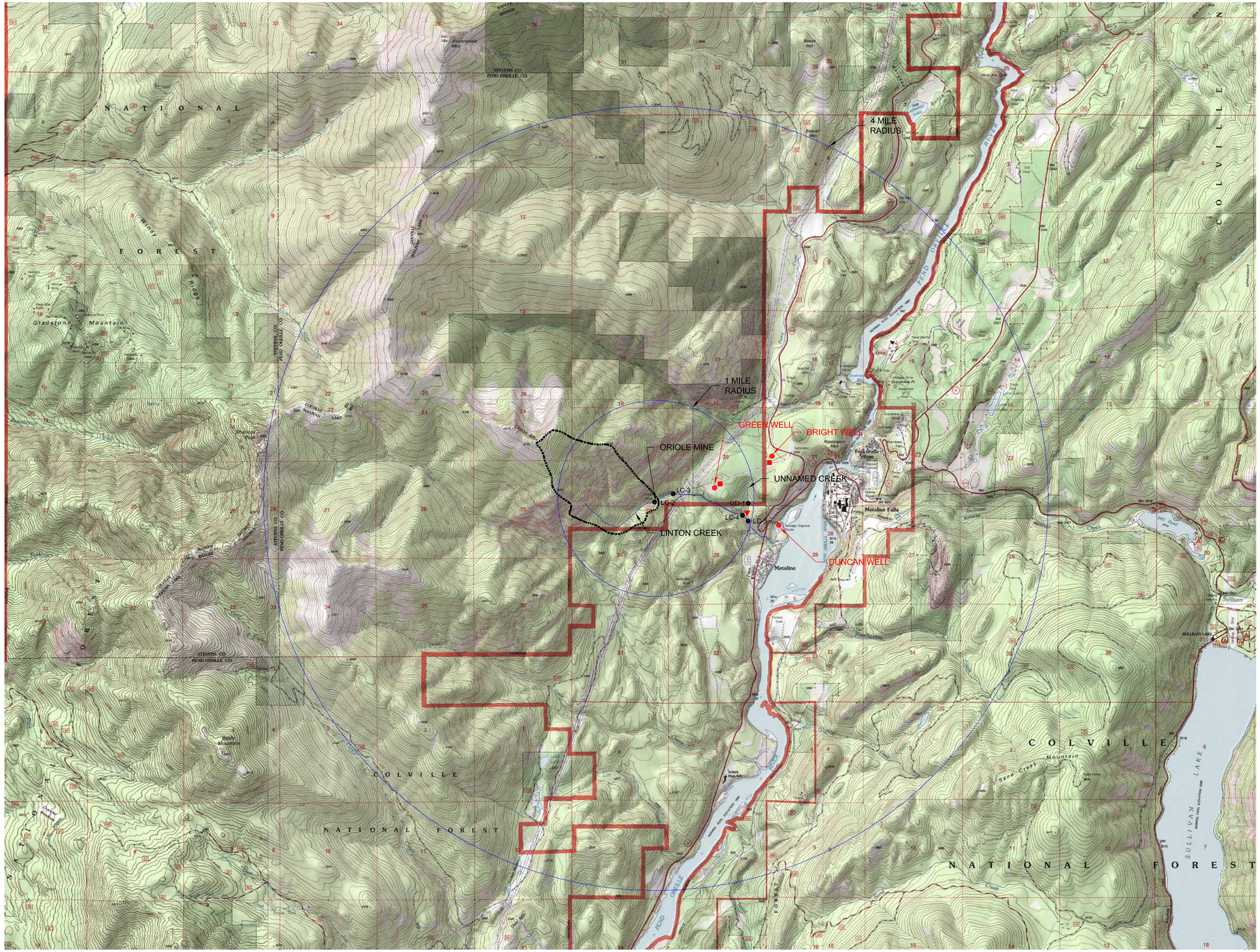


Figure 2. Oriole Mine Layout and Sampling Locations

PLATES

Plate 1. Oriole Mine Watershed Boundaries with 1 and 4 mile radius



(SOURCE: NATIONAL GEOGRAPHIC TOPO MAPS OF WASHINGTON ON CD-ROM, 2000)

EXPLANATION

- Watershed Boundary
- Radius Surrounding Mines
- Surface Water Rights - Approximate Location
- Water Well - Approximate Location
- AS-2 Surface Water Station
- Occupied Residence - Approximate Location

N

SCALE 1 INCH = 2,500 FEET

1 1/2 0 1 MILE

CONTOUR INTERVAL = 40 FT.

Plate 1. Oriole Mine Watershed Boundary with 1 and 4 mile Radius

PROJECT NUMBER: 2323024	ORIOLE MINE SITE INSPECTION
DATE: 12/20/04	
DWG BY: DGW DWG NO: 2323024P1.dwg	COLVILLE NATIONAL FOREST
PROJECT MANAGER: DGW	
REVISED:	CASCADE EARTH SCIENCES A Valmont Industries Company

APPENDICES

Appendix A. **Photographs**
Appendix B. **Ecological Survey Tables and Figures**

Appendix A.

Photographs

Photograph 1: View upstream of LC-02 (Ryan Tobias, CES July 28, 2004)

Photograph 2: View upstream at Station LC-03 (Ryan Tobias, CES, July 28, 2004)

Photograph 3: View downstream at Station LC-04 (Ryan Tobias, CES, July 28, 2004)

Photograph 4: View upstream at Station LC-05 (Ryan Tobias, CES, July 27, 2004)

Photograph 5: View downstream at Station UD-01 (Rone Brewer, CES, July 27, 2004)

Photograph 6: Looking northeast at access road to WR1 (Dustin Wasley, CES, July 28, 2004)

Photograph 7: Looking at WR2-1 test pit, notice native soil beneath waste rock (Dustin Wasley, CES, July 28, 2004)

Photograph 8: Looking north at the Upper Adit (Dustin Wasley, CES, July 28, 2004)

Photograph 9: Looking south from Upper Adit to WR1 (Dustin Wasley, CES, July 28, 2004)

Photograph 10: Looking north and upslope from access road at WR1 (Dustin Wasley, CES, July 28, 2004)

Photograph 11: Looking west at WR2 from access road (Dustin Wasley, CES, July 28, 2004)

Photograph 12: Looking north at Lower Adit seep from WR2 (Dustin Wasley, CES, July 28, 2004)

Photograph 13: Looking at adit seep from Lower Adit (Dustin Wasley, CES, July 28, 2004)

Photograph 14: Looking north at area between WR2 and OP1 (Dustin Wasley, CES, July 28, 2004)

Photograph 15: Looking north at Ore Bin and OP1 (Robert Lambeth, CES, July 29, 2004)

Photograph 16: Looking northeast at Debris Pile and OP2 (Robert Lambeth, CES, July 28, 2004)

Photograph 17: Looking east at Mine Office (Robert Lambeth, CES, July 28, 2004)

Photograph 18: Looking at vent raise west of Upper Adit (Rone Brewer, CES, July 29, 2004)

Photograph 19: Looking at exploration workings, west of Upper Adit (Robert Lambeth, CES, July 28, 2004)

Photograph 20: Looking at exploration workings, west of Upper Adit (Robert Lambeth, CES, July 28, 2004)

Appendix B.

Ecological Survey Tables and Figures

1.0 AQUATIC ECOLOGICAL SURVEY

Aquatic surveys were conducted within Linton Creek to assess the potential impacts of the Site on the instream habitat, benthic macroinvertebrate community, and presence of fish species due to the potential for site-related physical impacts or chemical contamination. Refer to Appendix B for supplemental figures and tables. Five stream reaches, each approximately 100 feet long, were established with one (LC-02) reach adjacent to the Site, three downstream of the Site on Linton Creek (LC-03, 04, and 05), and one reference sampling reach on the unnamed creek (UD-01). An attempt was made to conduct sampling in both riffle and pool habitats in each of the five selected stream reaches. However, no pools were present in or near the established sampling reaches at LC-03, LC-05, or UD-01. Numeric habitat ratings were developed for each reach using USEPA Rapid Bioassessment Protocol - Habitat Assessment Field Data Sheets for High Gradient Streams (Barbour 1999). Using this method, ten instream and riparian habitat parameters are each scored separately and then these individual habitat scores are summed to provide a habitat total score. The individual habitat parameter scores may also be used to differentiate habitat quality in multiple stream reaches. Additional instream characterization was conducting with the Physical Characterization Field Data Sheet (Barbour 1999). The following habitat conditions were noted:

> Habitat total scores were 181, 168, 168, 182, and 168 (out of 200) at UD-01, LC-02, LC-03, LC-04, and LC-05, respectively. This indicates the overall instream physical habitat conditions were optimal for all reaches.
> At UD-01, the velocity/depth regime was rated as poor because only the fast/shallow regime was present.
> At LC-02, substrate, embeddedness, frequency of riffles, and riparian zone width were all suboptimal. The velocity/depth regime was rated marginal.
> At LC-03, channel flow status (i.e., amount of water in channel) and bank stability were rated as suboptimal, and velocity/depth regime was rated as marginal.
> At LC-04, the velocity/depth regime was rated as marginal.
> At LC-04, the available substrate and vegetative protection were rated as suboptimal and the velocity/depth regime was rated as marginal.

Near LC-02, adjacent to the Site, Linton Creek was less than 3 feet wide with moist bank soil and dense herbaceous and shrubby riparian vegetation that completely covered the stream in many areas. These conditions were different from those at the other four stations. The creek channel widened and became more defined approaching LC-03, which had a similar amount of water, drier bank soils, and a sparse riparian area, compared to LC-02. Approximately 150 feet downstream from LC-03 the creek channel became dry and then widened into several braided channels that extended several hundred feet downstream, where the they reformed into a single channel. The channel remained dry downstream to the confluence of a small, apparently, perennial tributary of Linton Creek flowing from the southwest. Stream habitat quality increased at this confluence. The riparian corridor surrounding LC-04 and UD-01 were most similar to LC-02, but were predominantly an herbaceous/mossy ground cover that did not cover the 3 to 6 foot wide stream channel. Vegetation along the unnamed creek at UD-01 was predominantly moss with a dense coniferous canopy and many fallen trees along and over the channel. The Linton Creek gradient increases noticeably between LC-04 and LC-05. LC-05 is downstream from a culvert underlying a gravel road and upstream of a culvert underlying a paved road. The riparian area surrounding LC-05 was limited by the nearby gravel roads and cleared private properties.

Sampling of benthic macroinvertebrates was conducted from each of the five stream reaches included using a standard D-ring kick net with 500 micrometer mesh. Samples were collected from pool and riffle habitats when both were present (LC-02 and LC-04), or just riffle habitats if no pools were present. Both of the sampled pools were within the main stream channel. Three kick-net samples (i.e., jabs) from each pool and riffle sampling location were composited into one larger sample. Samples were preserved with 90% ethanol and shipped to the laboratory. Laboratory enumeration was completed to the species level, when possible, for at least 300 individuals in each sample. Identified invertebrates are listed in Table B-1 (Appendix B). Abundance, diversity, and several biological indices were examined for the invertebrates present in each pool and riffle

sample, and qualitatively compared between stations. Pool data were only compared to other pool data and riffle data were only compared to other riffle data.

The abundance and diversity data provide understanding of the number of individual invertebrates and the number of species, respectively, at each station. The metals tolerance index was developed in Montana (Montana Department of Environmental Quality, 1995) and is based upon a correlation of invertebrate species present in known metals contaminated streams versus those present in unimpacted streams. A higher metals tolerance index value indicates that a higher percentage of the invertebrate species present are known to be tolerant of the presence of metals contamination. The Shannon-Weaver index is a measure of the number of species (i.e., diversity) and the number of individuals within each species (i.e., evenness). A higher Shannon-Weaver index indicates more diversity and a lower likelihood of impacted invertebrate populations. The fine sediment biotic index is a measure of the number of species present that are tolerant of increased sediment in the stream substrate. A higher fine sediment biotic index indicates there are more sediment tolerant species present in the sample. The intolerant species index is a measure of how many metals sensitive species are present in each sample. A lower number in intolerant species suggests the invertebrate population may be impacted.

The results of the benthic invertebrate investigation in pool habitats show that:

> The number of all invertebrates was 347 at LC-02P and 521 at LC-04P.
> Diptera (primarily Chironomidae) and Ephemeropteran, Plechopteran, and Trichorpteran (i.e., EPT) species were equally abundant at LC-02P. Diptera were the most abundant group at LC-04P (Figure B-1). A few Oligochaetes were present at LC-04P.
> While the overall composition of species remained similar across both stations (Figure B-2), the total number of species (i.e., diversity) decreased from 33 at LC-02P to 30 at LC-04P. The number of EPT species also decreased from 11 to 4, while the number of Chironomid species increased from 14 to 16.
> The composition of functional feeding groups changed from predominantly gatherers and shredders at LC-02P to predominantly gatherers at LC-04P (Figure B-3).
> The metals tolerance index and Shannon-Weaver species diversity index (log e), and fine sediment index were all low and relatively consistent across the two stations. The number of intolerant species and the fine sediment biotic index were both lower at LC-04P (Figure B-4).

The increased invertebrate abundance noted at LC-04P is likely a result of better instream habitat compared to LC-02P. An abundance of Dipteran species (especially chironomids), and a relatively low number of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera) (i.e., EPT species) is common in stream pools. This pattern is realized at LC-04P, but not at LC-02P. The relatively high percentage of EPT species (primarily one species of Plecoptera: *Zapada columbiana*) at LC-02P seems somewhat unusual but may be related to the small size of the pool at LC-02P within a limited, but predominantly riffle/run habitat area. In addition, the substrate at LC-02P contained more organic material preferred by *Z. columbiana* than the predominantly sand bottom at LC-04P.

The number and types of species present at each of the two pool stations are quite similar (Figure B-2). The increase in the number of chironomid species and the slight decrease in the number of EPT species are most likely indicative of changing habitat conditions between the two stations. The increased percentage of gatherers at LC-04P compared to LC-02P (Figure B-3) is directly related to the increased percentage of Diptera species shown in Figure B-1. As discussed earlier, this is likely related to different habitat conditions in the two pools.

The low metals tolerance indices and consistent Shannon-Weaver indices shown in Figure B-4 suggest there is no mine-related impact at the two stations. The decreasing fine sediment biotic index reflects the decrease in fine sediment and organic matter between LC-02P and LC-04P. The decreasing intolerant taxa index is directly related to the decrease in the number of EPT species as discussed above. Generally, pool habitats are representative of instream sediment quality. The benthic invertebrate survey results for pool habitats provide no clear evidence that the Site is impacting Linton Creek.

Results of the benthic invertebrate investigation in riffle habitats suggest that:

> The numbers of invertebrates were 280, 852, 315, 881, and 549 at UD-01R, LC-02R, LC-03R, LC-04R, and LC-05R, respectively.
> EPT species were the most abundant at UD-01R, LC-02R, LC-04R, and LC-05R, but decreased consecutively across the first three stations, then increased consecutively at the last two stations (Figure B-5). Chironomid species increased between UD-01R and LC-03R, becoming the most abundant group at LC-03R. The mayfly groups Baetidae and Ephemerellidae were absent from LC-02R and Baetidae species comprised only 1 percent of the total number of invertebrates at LC-03R.
> UD-01R had a lower overall number of species (i.e. lower diversity) than the other four stations (Figure B-6). The species groups remained similar across the stations with the exception of LC-03R where there were fewer EPT species than chironomid species.
> The composition of functional feeding groups was relatively similar at UD-01R, LC-04R, and LC-05R (Figure B-7). Compared to other stations, the percentage of scrapers was noticeably decreased at LC-02R and LC-03R, and the percentage of gatherers was higher at LC-03R.
> The metals tolerance index was low and consistent, and the Shannon-Weaver species diversity index (log e) was consistent, across all five stations (Figure B-8). The number of intolerant taxa varied between UD-01R, LC-02R, and LC-03R, and then increased steadily from LC-03R to LC-05R.

Differences in invertebrate abundance and functional feeding groups suggest there are different conditions at LC-02R and LC-03R, compared to the other three stations. However, the consistency of species diversity, Shannon-Weaver index, and metals tolerance index do not suggest Site impacts. Thus, it seems likely that habitat conditions are different at LC-02R and LC-03R compared to the other stations, and that these different habitat conditions are resulting in differences in invertebrate abundance and functional feeding groups.

Generally, riffle habitats are representative of instream water quality. Although conditions at LC-02R and LC-03R show some differences from the remaining stations, it is likely that these differences are related to habitat conditions and are not the result of Site related impacts. A previously undiscovered invertebrate species was identified at LC-02 and LC-05. This species is of the genus Euryhapsis. Additional sampling is planned for the spring of 2005 to obtain and then hatch examples of this species in captivity, for species description and documentation.

The potential presence of fish was documented by visual observation during the ecological survey. No fish were noted in Linton Creek. The culverts above and below LC-05R are likely barriers to upstream fish migration. Through communications with regional biologists, the Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species Program (PHSP), and the Washington Natural Heritage Program (WNHP; see Appendix B) it was documented that rainbow trout (*Oncorhynchus mykiss*), a state priority species, are present in the downstream portions of Linton Creek. In addition, westslope cutthroat trout (O*ncorhynchus clarki lewisi*), a federal species of concern, are present in nearby Flume Creek and may also be present in Linton Creek, downstream of LC-05. These and other rare, threatened, or endangered (RTE) species known or expected to inhabit the area surrounding the Site are listed in Table B-2.

2.0 TERRESTRIAL ECOLOGICAL SURVEY

Terrestrial habitats and animals that are present or likely at, and surrounding, the Site were documented during the ecological survey and via communication with regional biologists. Four 30-minute bird surveys were also conducted. A majority of plants were identified across each identified major vegetative community. Qualitative surveys were conducted at and surrounding the Site for mammal and invertebrate presence and use. Lists of RTE plants and animals likely or known to be present in the vicinity of the Site were obtained from the USFS, the WDFW PHSP, and/or the WNHP (See Appendix B). The terrestrial RTE species potentially present within the area of the Site are listed in Table B-2. None of the listed RTE plants were observed during the field activities. However, if a removal action is necessary, field surveys for particular species may be needed prior to any ground disturbance activity.

The Site is within the Northern Rocky Mountain ecoregion (Bailey 1995). This ecoregion is characterized by warm dry summers and wet cold winters, with 30 to 40 inches of precipitation per year. The majority of the precipitation occurs in the fall, winter, and spring with abundant snowfall. The dominant plant communities in this ecoregion vary from Englemann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) forests at higher elevations, to western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*), and Douglas fir (*Pseudotsuga menziesii*) forests at middle and lower elevations.

The Site is encompassed by lowland forest and at a break in slope with steep foothills present upgradient and a more moderately sloped hillside downgradient. The major plant communities surrounding and at the Site included a Douglas fir/trembling aspen (*Populus tremuloides*) forest community, wetland/riparian community, and disturbed mine community. The forest community canopy layer was dominated by Douglas fir, trembling aspen, and grand fir (*Abies grandis*). The shrub layer included sticky currant (*Ribes visisimum*), ocean spray (*Holodiscus discolor*), and bracken fern (*Pteridium aquilinum*). The herbaceous layer included Bluegrass (*Poa* sp.), needlegrass (*Stipa* sp.), thimbleberry (*Rubus parviflorus*). These and other species observed in the forest community are listed in Table B-2.

The wetland/riparian community had a dense canopy layer, primarily consisting of paper birch (*Betula papyrifera*) and western red cedar (*Thuja plicata*). The shrub layer was moderately dense, dominated by Douglas maple (*Acer glabrum*) and devil's club (*Oplopanax horridus*). The dense ground cover (herbaceous layer) was dominated by thimbleberry (*Rubus parviflorus*), false Solomon's seal (*Smilacina racemosa*), queen's cup (*Clintonia uniflora*), one-leaved foamflower (*Tiarella unifoliata*), clasping twisted stalk (*Streptopus amplexifoliu*), pathfinder (*Adenocaulon bicolor*), and northern bog violet (*Viola nephrophylla*). These and other species observed in the wetland/riparian community are listed in Table B-3.

The disturbed mine areas were primarily waste rock or excavated gravelly soil. Numerous colonizing and weedy species were present, with no canopy layer, and a patchy shrub and herbaceous layer. White clover (*Trifolium repens*), red-osier dogwood (*Cornus stolinifera*), and thimbleberry (*Rubus parvifolius*) were the dominant species. Other common species included oxeye daisy (*Leucanthemum vulgare*), St. John's wort (*Hypericum perforatum*), trembling aspen (*Populus tremuloides*), sitka alder (*Alnus sinuata*), and Soopalallie (*Shepherdia canadensis*). These and other species observed in the disturbed mine community are listed in Table B-3.

The Site is primarily within the forested community and immediately adjacent to the wetland/riparian community. The vegetation within close proximity to the Site is clearly different from both of these two vegetation communities. There was some evidence that the wetland/riparian community was also disturbed by past activities near the Site. However, the presence of moisture and organic rich soils has allowed the development of a dense but likely successional community of plants. None of the identified plants are RTE species.

Invertebrates noted on and near the Site included black carpenter ants (*Camponotus pennsylvanicus*), butterflies, moths, many small black flies, many small bees, yellow jackets (*Vespula* sp.), and a small flying wasp. None of

these or any other invertebrates in the vicinity of the Site are known RTE species. The invertebrate species observed, expected, or possible in the vicinity of the mine are listed in Table B-4.

Game trails were not clearly present, but deer tracks and elk pellets were noted, suggesting that whitetail deer (*Odocoileus verginianus*) or mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) are present near the Site. Moose (*Alces alces*) may also inhabit the region surrounding the Site. Other mammals observed included, Douglas' tree squirrel (*Tamiasciurus douglasii*), snowshoe hares (*Lepus americanus*), and an unidentified mouse or vole. Townsend's big-eared bats (*Plecotus townsendi*), a state candidate species and federal species of concern, have been documented in the mine workings. The other RTE mammal species listed in Table B-2 may inhabit the region, but are unlikely or uncommon at the Site. The mammal species observed, expected, or possible in the vicinity of the mine are listed in Table B-5.

Birds seen or heard during the bird survey or during other field work at the Site are listed in Table B-6. A majority of these birds were identified by their song or call and were outside of the 100 feet survey circle. They represent an assemblage common among mixed coniferous and deciduous forests. As noted in Table B-2, pileated woodpeckers are a state candidate for listing as a threatened or endangered species. The other RTE bird species listed in Table B-2 may inhabit the forest surrounding the Site, but are unlikely to forage in the disturbed mine area.

No reptiles or amphibians were found during the survey. Those likely to be present include northern alligator lizards (*Elgaria coerulea*), western skink (*Eumeces skiltonianus*), rubber boa (*Charina bottae*), gopher snake (*Pituophis catenifer*), common garter snakes (Thamnophis sirtalis), long-toed salamander (*Ambystoma macrodactylum*), western toad (*Bufo boreas*), and pacific treefrog (*Pseudacris regilla*). Red-legged frogs and western toads are RTE species (Table B-2) that may be found in the vicinity of the Site, but are unlikely within the disturbed mine habitat. The reptile and amphibian species observed, expected, or possible in the vicinity of the mine are listed in Table B-7.

Overall, relatively few species were identified during this limited ecological survey. This is likely the result of there being only one dominant vegetation community: mature forest. The wetland/riparian community is very small and thus does not support numerous other species that might be expected in a similar, but larger habitat. Of the invertebrates and wildlife documented or likely to inhabit the Site, ground-dwelling invertebrates such as ants are the species most likely to be exposed to Site related contamination. Invertivorous species that forage frequently on invertebrates within or near the waste rock piles may also be relatively highly exposed to Site related contamination.

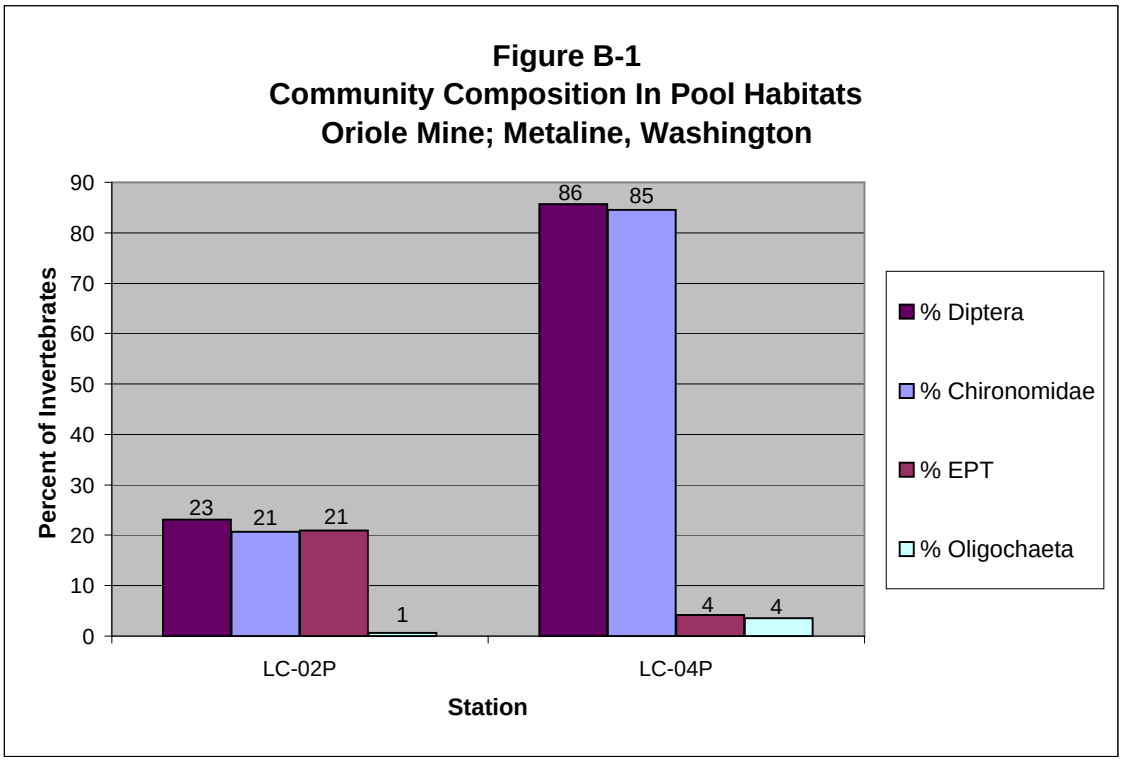


Figure B-1
Community Composition In Pool Habitats
Oriole Mine; Metaline, Washington
Percent of Invertebrates
90
80
70
60
50
40
30
20
10
0
23
21
21
1
86
85
4
4
LC-02P
LC-04P
Station
% Diptera
% Chironomidae
% EPT
% Oligochaeta

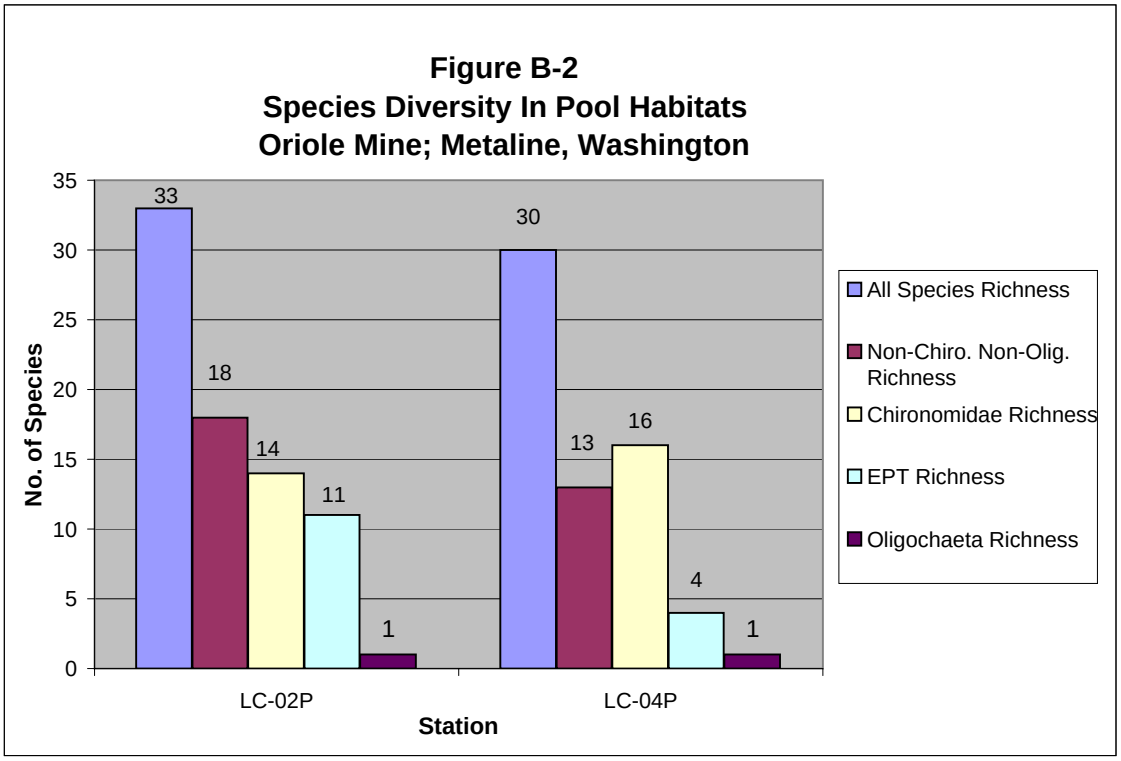


Figure B-2
Species Diversity In Pool Habitats
Oriole Mine; Metaline, Washington
No. of Species
35
30
25
20
15
10
5
0
33
18
14
11
1
30
13
16
4
1
LC-02P
LC-04P
Station
All Species Richness
Non-Chiro. Non-Olig. Richness
Chironomidae Richness
EPT Richness
Oligochaeta Richness

Figure B-3
Functional Group Composition In Pool Habitats
Oriole Mine; Metaline, Washington

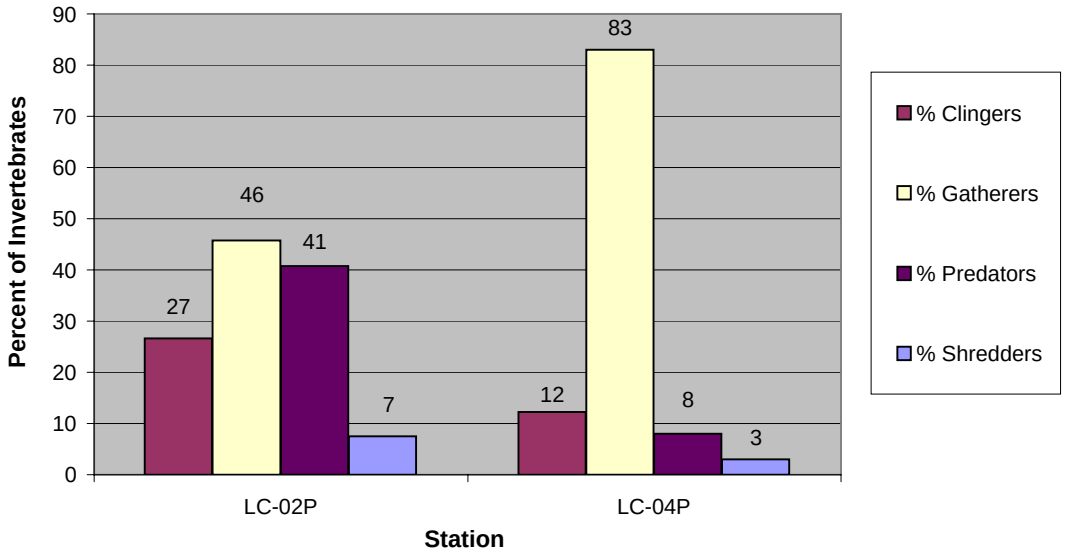
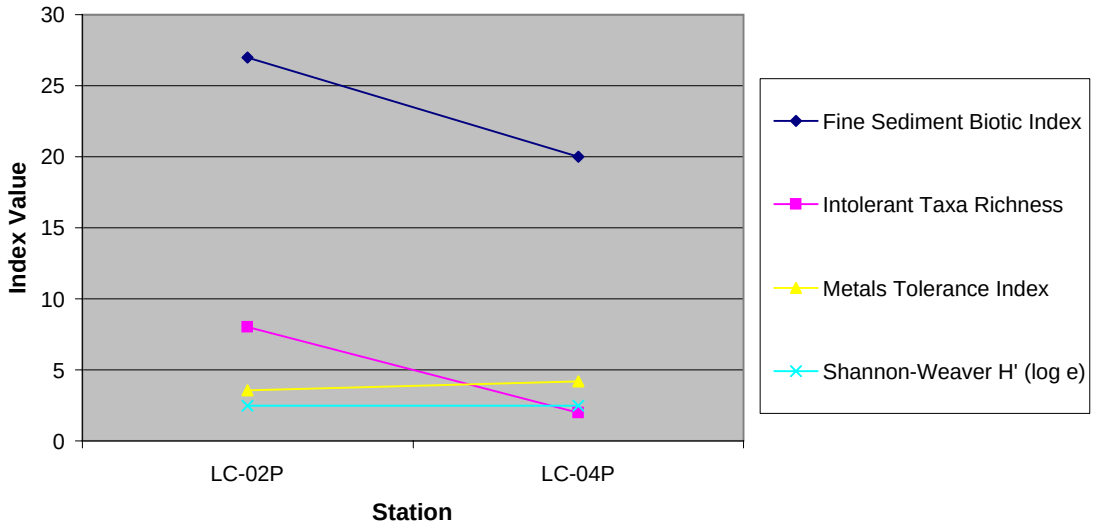


Figure B-4
Biological Indices for Pool Habitats Oriole Mine; Metaline, Washington



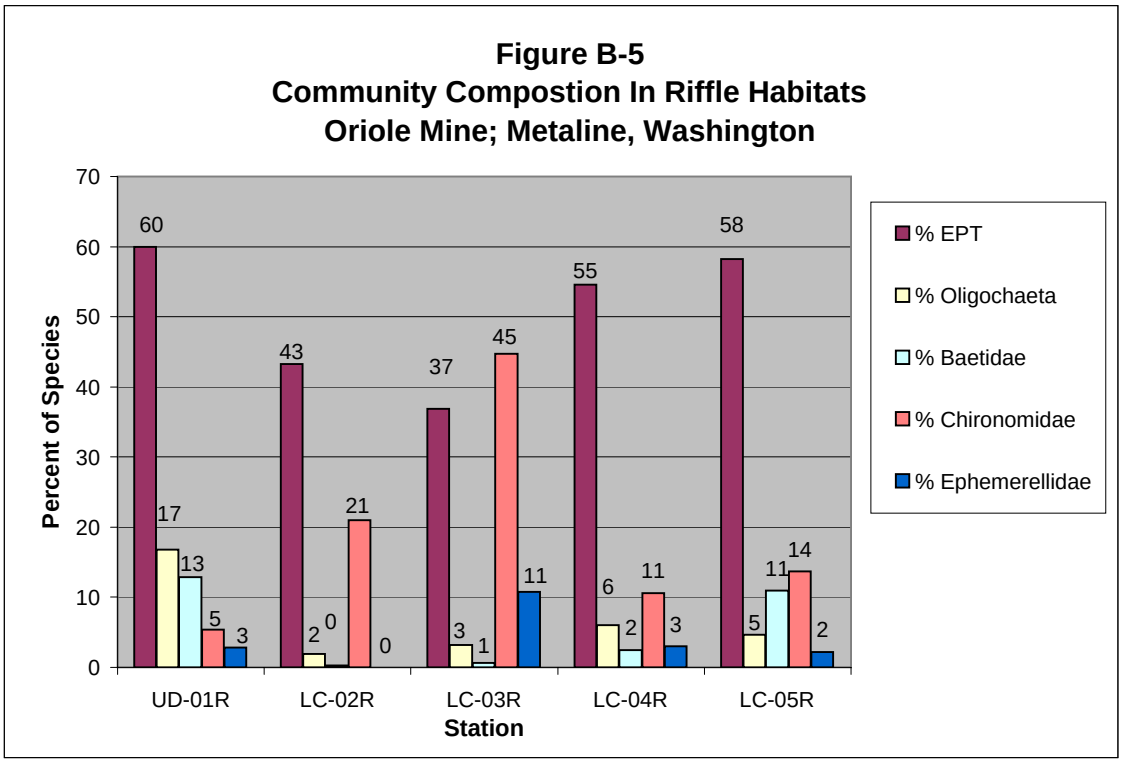


Figure B-5
Community Compostion In Riffle Habitats
Oriole Mine; Metaline, Washington
Percent of Species
70
60
50
40
30
20
10
0
60
17
13
5
3
43
2
0
21
0
37
3
1
45
11
55
6
2
11
3
58
5
11
14
2
UD-01R
LC-02R
LC-03R
LC-04R
LC-05R
Station
% EPT
% Oligochaeta
% Baetidae
% Chironomidae
% Ephemerellidae

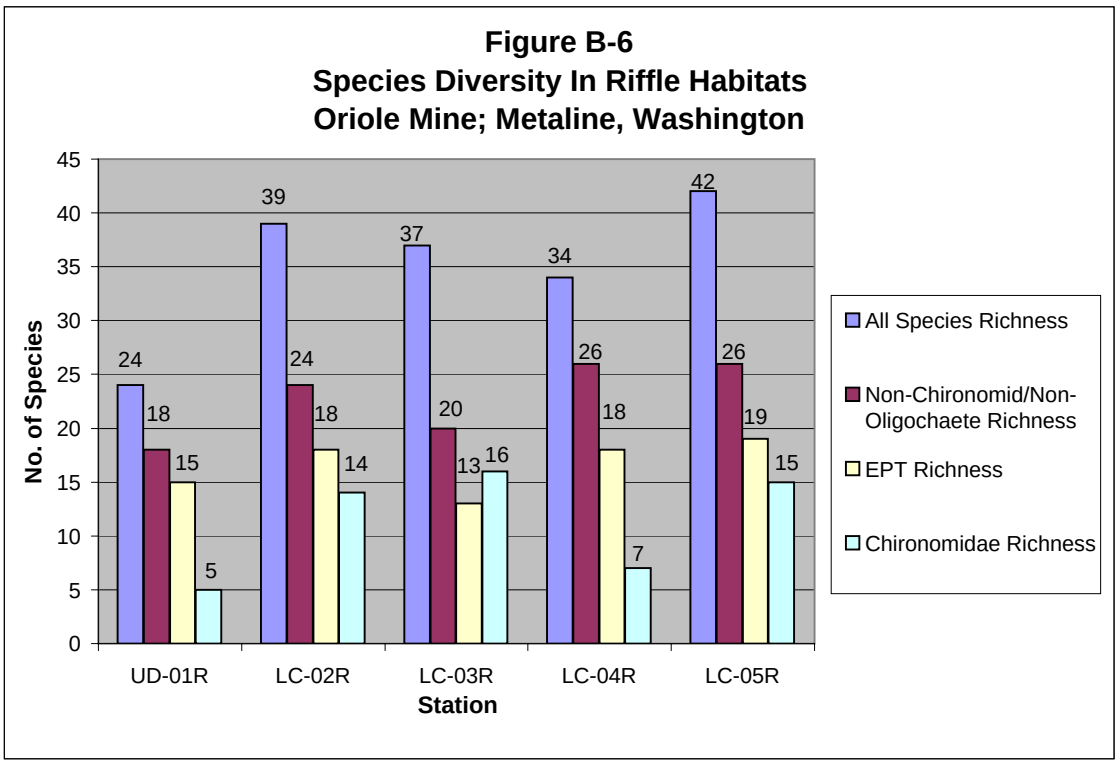


Figure B-6
Species Diversity In Riffle Habitats
Oriole Mine; Metaline, Washington
No. of Species
45
40
35
30
25
20
15
10
5
0
24
18
15
5
39
24
18
14
37
20
13
16
34
26
18
7
42
26
19
15
UD-01R
LC-02R
LC-03R
LC-04R
LC-05R
Station
All Species Richness
Non-Chironomid/Non-Oligochaete Richness
EPT Richness
Chironomidae Richness

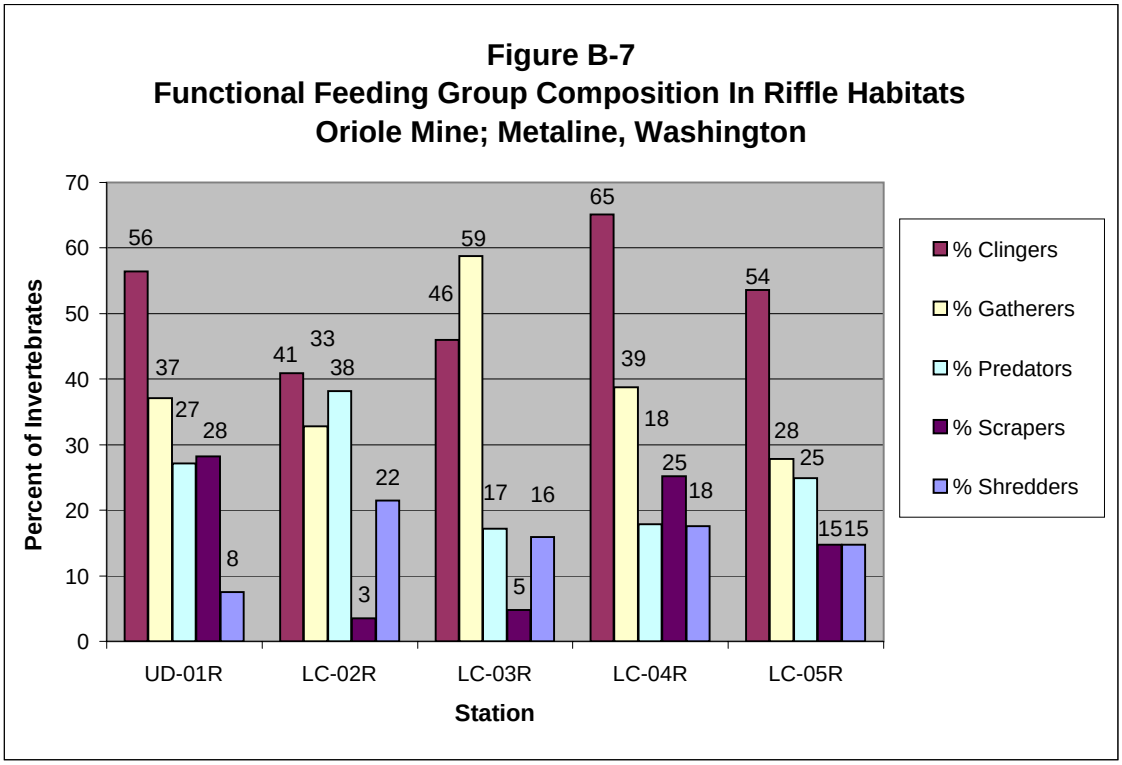


Figure B-7
Functional Feeding Group Composition In Riffle Habitats
Oriole Mine; Metaline, Washington
Percent of Invertebrates
70
60
50
40
30
20
10
0
56
37
27
28
8
41
33
38
3
22
46
59
17
5
16
65
39
18
25
18
54
28
25
15
15
UD-01R
LC-02R
LC-03R
LC-04R
LC-05R
Station
% Clingers
% Gatherers
% Predators
% Scrapers
% Shredders

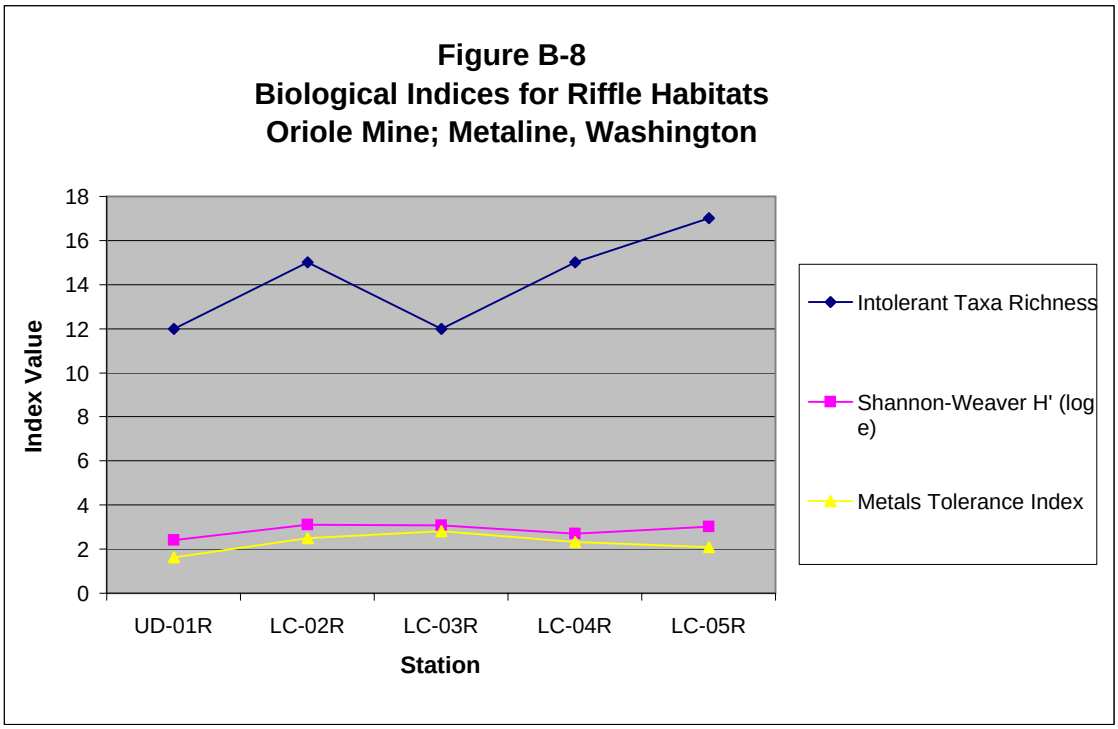


Figure B-8
Biological Indices for Riffle Habitats
Oriole Mine; Metaline, Washington
Index Value
18
16
14
12
10
8
6
4
2
0
UD-01R
LC-02R
LC-03R
LC-04R
LC-05R
Station
Intolerant Taxa Richness
Shannon-Weaver H' (log e)
Metals Tolerance Index

TABLE B-1
DOCUMENTED AQUATIC INVERTEBRATE SPECIES
ORIOLE MINE
METALINE, WASHINGTON

Taxonomic Group	Scientific Name	Taxonomic Group	Scientific Name
Ephemeroptera	Ameletus sp.	Diptera-Chironomidae (continued)	Parametriocnemus sp.
	Baetis bicaudatus		Paratendipes sp.
	Baetis sp.		Polypedilum sp.
	Baetis tricaudatus		Prodiamesa sp.
	Cinygma sp.		Protanypus sp.
	Cinygmula sp.		Pseudodiamesa sp.
	Drunella coloradensis/flavilinea		Psilometriocnemus sp.
	Epeorus deceptivus		Reomyia sp.
	Epeorus grandis		Rheocricotopus sp.
	Ephemerellidae		Stempellinella sp.
	Ironodes sp.		Stilocladius sp.
	Leptophlebiidae		Synorthocladius sp.
	Rhithrogena sp.		Thienemanniella sp.
Plecoptera	Leuctridae		Tvetenia bavarica gr.
	Megarcys sp.	Diptera	Bezzia/Palpomyia sp.
	Peltoperlidae		Ceratopogoninae
	Perlodidae		Chelifera/Metachela sp.
	Plecoptera		Dicranota sp.
	Sweltsa sp.		Dixa sp.
	Zapada columbiana		Empididae
	Zapada sp.		Glutops sp.
Coleoptera	Ametor sp.		Meringodixa sp.
	Heterlimnius sp.		Pedicia sp.
Diptera-Chironomidae	Brillia sp.		Rhabdomastix fascigera gr.
	Brundiniella sp.		Tipulidae
	Corynoneura sp.	Trichoptera	Chyrandra centralis
	Cricotopus sp.		Cryptochia sp.
	Eukiefferiella brehmi gr.		Dolophilodes sp.
	Eukiefferiella claripennis gr.		Glossosoma sp.
	Eukiefferiella devonica gr.		Lepidostoma sp.
	Eukiefferiella gracei gr.		Limnephilidae
	Eukiefferiella tirolensis		Micrasema sp.
	Euryhapsis sp.		Neothremma sp.
	Heterotrissocladius marcidus gr.		Parapsyche elsis
	Hydrobaenus sp.		Philopotamidae
	Krenosmittia sp.		Rhyacophila betteni gr.
	Larsia sp.		Rhyacophila narvae
	Limnophyes sp.		Rhyacophila pellisa/valuma
	Macropelopia sp.		Rhyacophila sp.
	Micropsectra sp.		Rhyacophila vofixa gr.
	Monodiamesa sp.	Bivalvia	Sphaeriidae
	Odontomesa sp.	Annelida	Oligochaeta
	Orthocladiinae	Acari	Acari
	Orthocladius (Symp.) lignicola	Crustacea	Ostracoda
	Orthocladius Complex	Other Organisms	Nematoda
	Pagastia sp.		Polycelis sp.
	Parakiefferiella sp.		Turbellaria

TABLE B-2
SUMMARY OF RARE, THREATENED, OR ENDANGERED SPECIES IN THE VICINITY
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Species Name	State Status	Federal Status	U.S. Forest Service Status	Observed/ Expected/ Possible
AQUATIC INVERTEBRATES					
None					
FISH					
Westslope cutthroat	***Oncorhynchus clarki lewisi***		**Concern**		**Expected**
Rainbow trout	***Oncorhynchus Mykiss***	**Priority**			**Expected**
PLANTS					
Crested shield-fern	**Dryopteris cristata**	**Sensitive**			**Expected**
Blue-eyed grass	Sisyrinchium septentrionale	Sensitive			Possible
Bronze sedge	Carex foenea	Threatened			Possible
Creeping snowberry	Gaultheria hispidula	Sensitive			Possible
Kidney-leaved violet	Viola renifolia	Sensitive			Possible
Yellow sedge	Carex flava	Sensitive			Possible
TERRESTRIAL INVERTEBRATES					
None Identified					
REPTILES AND AMPHIBIANS (HERPETILES)					
Spotted frog	***Rana pretiosa***	**Endangered**	**Candidate**	**Sensitive**	**Expected**
Northern leopard frog	*Rana pipiens*	Endangered	Concern		Possible
BIRDS					
Pileated woodpecker	***Dryocopus pileatus***	**Candidate**			**Observed**
Black-backed woodpecker	***Picoides arcticus***	**Candidate**			**Expected**
Great gray owl	***Strix nebulosa***			**Sensitive**	**Expected**
Northern goshawk	***Accipiter gentilis***	**Candidate**	**Concern**	**Sensitive**	**Expected**
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Threatened		Possible
Harlequin duck	*Histrionicus histrionicus*	Priority			Possible
Flammulated owl	*Otus flammeolus*	Candidate			Possible
Golden eagle	*Aquila chrysaetos*	Candidate			Possible
Lewis' woodpecker	*Melanerpes lewis*	Candidate			Possible
Olive-sided flycatcher	*Contopus borealis*		Concern		Possible
Vaux's swift	*Chaetura vauxi*	Candidate			Possible
White-headed woodpecker	*Picoides albolarvatus*	Candidate			Possible
Willow flycatcher	*Empidonax traillii*		Concern		Possible
MAMMALS					
Townsend's big-eared bat	***Coryhorhinus townsendii***	**Candidate**	**Concern**		**Expected**
Canada lynx	*Lynx canadensis*	Threatened	Threatened	Sensitive	Possible
Yuma myotis	*Myotis yumanensis*	none	Concern		Possible
Gray wolf	*Canis Lupus*	Endangered	Threatened	Sensitive	Possible
Wolverine	*Gulo gulo*	Candidate	Concern		Possible

Notes:

Blank status indicates the species is not rare, threatened, or endangered under that jurisdiction.

Bold indicates species observed or expected at or near the Oriole Mine.

TABLE B-3
OBSERVED PLANT SPECIES
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Habitat Type	Percent Cover	Federal Status	State Status	U.S. Forest Service Status
TREES						
western red cedar	*Thuja plicata*	Disturbed	5			
Sitka alder	*Alnus sinuata*	Disturbed	7			
trembling aspen	*Populus tremulloides*	Disturbed	7			
Douglas fir	*Pseudotsuga menziesii*	Disturbed	<5			
Engelmann's spruce	*Picea engelmannii*	Disturbed	<5			
lodgepole pine	*Pinus contorta*	Disturbed	<5			
paper birch	*Betula papyrifera*	Disturbed	<5			
ponderosa pine	*Pinus ponderosa*	Disturbed	<5			
white pine	*Pinus monticola*	Disturbed	<5			
Douglas fir	*Pseudotsuga mensiezii*	Forest	30			
trembling aspen	*Populus tremulloides*	Forest	30			
grand fir	*Abies grandis*	Forest	15			
ponderosa pine	*Pinus ponderosa*	Forest	5			
paper birch	*Betula papyrifera*	Wetland/Riparian	60			
western red cedar	*Thuja plicata*	Wetland/Riparian	25			
grand fir	*Abies grandis*	Wetland/Riparian	10			
SHRUBS						
red osier dogwood	*Cornus stolinifera*	Disturbed	10			
thimbleberry	*Rubus parviflorus*	Disturbed	10			
black gooseberry	*Ribes lacustre*	Disturbed	<5			
mock orange	*Philadelphus lewisi*	Disturbed	<5			
prickly rose	*Rosa acicularis*	Disturbed	<5			
red elderberry	*Sambucus racemosa*	Disturbed	<5			
Snowberry	*Symphoricarpos albus*	Disturbed	<5			
trailing blackberry	*Rubus usiinus*	Disturbed	<5			
sticky currant	*Ribes viscosissum*	Forest	30			
ocean spray	*Holodiscus discolor*	Forest	20			
thimbleberry	*Rubus parviflorus*	Forest	10			
Douglas maple	*Acer glabrum*	Forest	5			
Oregon grape	*Mahonia aquifolium*	Forest	<5			
Douglas maple	*Acer glabrum*	Wetland/Riparian	30			
thimbleberry	*Rubus parviflorus*	Wetland/Riparian	20			
Devil's club	*Oplopanax horridus*	Wetland/Riparian	10			
Pacific yew	*Taxus brevifolia*	Wetland/Riparian	5			
red osier dogwood	*Cornus stolinifera*	Wetland/Riparian	5			
black gooseberry	*Ribes lacustre*	Wetland/Riparian	<5			
ocean spray	*Holodiscus discolor*	Wetland/Riparian	<5			
red elderberry	*Sambucus racemosa*	Wetland/Riparian	<5			
GROUNDCOVER						
white clover	*Trifolium repens*	Disturbed	15			
oxeye daisy	*Leucanthemum vulgare*	Disturbed	8			
St. John's wort	*Hypericum perforatum*	Disturbed	8			
soopalallie	*Shepherdia canadensis*	Disturbed	7			
common horsetail	*Equisetum arvense*	Disturbed	5			
Dewey's sedge	*Carex deweyana*	Disturbed	5			
hair bentgrass	*Agrostis scabra*	Disturbed	5			
prince’s pine	*Chimaphila umbellate*	Disturbed	5			
white sweet clover	*Melilotus alba*	Disturbed	5			
bracken fern	*Pteridium aquilinum*	Disturbed	<5			
Canada goldenrod	*Solidago canadensis*	Disturbed	<5			
Canada thistle	*Cirsium arvense*	Disturbed	<5			
Crawford's sedge	*Carex crawfordii*	Disturbed	<5			
false Solomon’s seal	*Smilacina racemosa*	Disturbed	<5			

TABLE B-3
OBSERVED PLANT SPECIES
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Habitat Type	Percent Cover	Federal Status	State Status	U.S. Forest Service Status
fireweed	*Epilbium angustifolium*	Disturbed	<5			
nodding wood-reed	*Cinna latifolia*	Disturbed	<5			
pearly everlasting	*Anaphalis margaritacea*	Disturbed	<5			
redtop	*Agrostis gigantean*	Disturbed	<5			
self heal	*Prunella vulgaris*	Disturbed	<5			
skullcap	*Scutellaria* sp.	Disturbed	<5			
smooth alumroot	*Heuchera glabra*	Disturbed	<5			
spotted knapweed	*Centaurea maculosa*	Disturbed	<5			
twinflower	*Linnaea borealis*	Disturbed	<5			
wall lettuce	*Lactuca muralis*	Disturbed	<5			
western salsify	*Tragopogon dubius*	Disturbed	<5			
white hawkweed	*Hieracium albiflorum*	Disturbed	<5			
false Solomon's seal	*Smilacina racemosa*	Forest	25			
bluegrass	*Poa* sp.	Forest	20			
queen's cup	*Clintonia uniflora*	Forest	15			
needlegrass	*Stipa* sp.	Forest	10			
bracken fern	*Pteridium aquilinum*	Forest	8			
pathfinder	*Adenocaulon bicolor*	Forest	5			
prince's pine	*Chimaphila umbellate*	Forest	5			
soopalallie	*Shepherdia canadensis*	Forest	5			
wild ginger	*Asarum caudatum*	Forest	5			
Arctic lupine	*Lupinus arcticus*	Forest	<5			
bitter cherry	*Prunus emarginata*	Forest	<5			
false box	*Pachistama myrsinites*	Forest	<5			
saskatoon	*Amelanchier anifolia*	Forest	<5			
clasping twisted stalk	*Streptopus amplexifolius*	Wetland/Riparian	10			
false Solomon's seal	*Smilacina racemosa*	Wetland/Riparian	10			
northern bog violet	*Viola nephrophylla*	Wetland/Riparian	10			
one-leaved foamflower	*Tiarella unifoliata*	Wetland/Riparian	10			
pathfinder	*Adenocaulon bicolor*	Wetland/Riparian	10			
queen's cup	*Clintonia uniflora*	Wetland/Riparian	10			
oak fern	*Gymnocarpium dryopteris*	Wetland/Riparian	5			
sweet-scented bedstraw	*Galium triflorum*	Wetland/Riparian	5			
twinflower	*Linnaea borealis*	Wetland/Riparian	5			
lesser wintergreen	*Pyrola minor*	Wetland/Riparian	<5			
mountain sweet cicely	*Osmorhiza chilensis*	Wetland/Riparian	<5			
MOSSES						
None Identified						
LICHENS						
dog pelt	*Peltigera canina*	Forest	5			

Notes:

Blank status indicates the species is not rare, threatened, or endangered.

TABLE B-4
DOCUMENTED OR EXPECTED TERRESTRIAL INVERTEBRATES
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Federal Status	State Status	U.S. Forest Service Status	Observed/ Expected/ Possible
bees	Order *Hymenoptera*				Observed
black carpenter ants	*Camponotus pennsylvanicus*				Observed
black flies	*Simulium* sp.				Observed
butterflies and moths	Order *Lepidoptera*				Observed
wasps	Order *Hymenoptera*				Observed
yellow jackets	*Vespula* sp.				Observed
alderflies	*Sialis* sp.				Expected
centipedes	Order *Chilopoda*				Expected
common black ground beetle	*Pterostichus* sp.				Expected
grasshoppers and crickets	Order *Orthoptera*				Expected
mayflies	Order *Ephemeroptera*				Expected
mites and ticks	Order *Acarina*				Expected
spiders	Order *Araneae*				Expected
daddy-long-legs	Order Opiliones				Possible

Notes:

Bold indicates regulated or managed species observed, expected, or possible at the site.

Blank status indicates no listing was available for the species.

TABLE B-5
DOCUMENTED OR EXPECTED MAMMALS
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	State Status	Federal Status	U.S. Forest Service Status	Observed/ Expected/ Possible
mule deer	*Odocoileus hemionus hemionus*				Observed
red squirrel	*Tamiasciurus hudsonicus*				Observed
snowshoe hare	*Lepus americanus*				Observed
Townsend big-eared bat	***Plecotus townsendii townsendii***	**Candidate**	**Concern**	**Sensitive**	**Observed**
whitetail deer	*Odocoileus verginianus*				Observed
big brown bat	***Eptisicus fuscus***			**Sensitive**	**Expected**
black bear	*Ursus americanus*				Expected
boreal redback vole	*Clethrionomys gapperi*				Expected
Canada lynx	***Lynx canadensis***	**Threatened**	**Threatened**	**Sensitive**	**Expected**
coyote	*Canis latrans*				Expected
dusky shrew	*Sorex obscurus*				Expected
fisher	***Martes pennanti***	**Endangered**	**Concern**	**Sensitive**	**Expected**
hoary bat	*Felis concolor*				Expected
longtail weasel	*Mustela frenata*				Expected
masked shrew	*Sorex cinereus*				Expected
mountain lion (cougar)	*Felis concolor*				Expected
porcupine	*Erethizon dorsatum*				Expected
raccoon	*Procyon lotor*				Expected
shorttail weasel (ermine)	*Mustela erminea*				Expected
silver-haired bat	***Lasionycteris noctivagans***			**Sensitive**	**Expected**
small-footed myotis	***Myotis leibii***		**Concern**		**Expected**
beaver	*Castor canadensis*				Possible
bobcat	*Lynx rufus*				Possible
bushytail woodrat	*Neotoma cinerea*				Possible
California myotis	*Myotis californicus*				Possible
elk	*Cervus canadensis*				Possible
golden-mantled ground squirrel	*Spermophilus lateralis*				Possible
gray wolf	***Canis lupus***		**Threatened**		**Possible**
grizzly bear	***Ursus arctos***		**Threatened**		**Possible**
little brown myotis	***Myotis lucifugus***			**Sensitive**	**Possible**
long-eared myotis	***Myotis evotis***		**Concern**	**Sensitive**	**Possible**
longtail vole	*Microtus longicaudus*				Possible
marten	***Martes americana***			**Sensitive**	**Possible**
moose	*Alces alces*				Possible
mountain phenacomys (heather vole)	*Phenacomys intermedius*				Possible
northern bog lemmiing	*Synaptomys borealis*				Possible
northern water shrew	*Sorex palustris*				Possible
red fox	*Vulpes fulva*				Possible
striped skunk	*Mephitis mephitis*				Possible
vagrant shrew	*Sorex vagrans*				Possible
water vole (Richardson vole)	*Microtus richardsoni*				Possible
western jumping mouse	*Zapus princeps*				Possible
woodchuck	*Marmota monax*				Possible

Notes:

Bold indicates regulated or managed species observed, expected, or possible at the site

Blank status indicates no listing was available for the species.

TABLE B-6
DOCUMENTED OR EXPECTED BIRDS
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Oregon State Status	Federal Status	U.S. Forest Service Status	Observed/ Expected/ Possible
American robin	*Turdus migratorius*				Observed
black-capped chickadee	*Parus atricapillus*				Observed
downy woodpecker	*Picoides pubescens (Dendrocopos pubescens)*				Observed
pileated woodpecker	***Dryocopus pileatus***	**Candidate**			**Observed**
pine siskin	*Carduelis pinus (Spinus pinus)*				Observed
pygmy nuthatch	*Sitta pygmaea*				Observed
red-breasted nuthatch	*Sitta canadensis*				Observed
ruffed grouse	*Bonasa umbellus*				Observed
Swainson's thrush	*Catharus ustulata (Hylocichla ustulata)*				Observed
winter wren	*Troglodytes troglodytes*				Observed
American crow	*Corvus brachyrhynchos*				Expected
American dipper	*Cinclus mexicanus*				Expected
barred owl	*Strix varia*				Expected
brown creeper	*Certhia familiaris*				Expected
cedar waxwing	*Bombycilla cedrorum*				Expected
common raven	*Corvus corax*				Expected
dark-eyed junco (slate-colored)	*Junco hyemalis*				Expected
fox sparrow	*Passerella iliaca*				Expected
golden-crowned kinglet	*Regulus satrapa*				Expected
great gray owl	*Strix nebulosa*				Expected
great horned owl	*Bubo virginianus*				Expected
hairy woodpecker	*Picoides villosus (Dendrocopos villosus)*				Expected
Hammond's flycatcher	*Empidonax hammondii*				Expected
northern flicker	*Colaptes auratus (Colaptes cafer)*				Expected
olive-sided flycatcher	***Contopus borealis***		**Concern**		**Expected**
pygmy owl	*Glaucidium gnoma*				Expected
red crossbill	*Loxia curvirostra*				Expected
red-tailed hawk	*Buteo jamaicensis*				Expected
ruby-crowned kinglet	*Regulus calendula*				Expected
rufous-sided towhee	*Pipilo erythrophthalmus*				Expected
saw-whet owl	*Aegolius acadicus*				Expected
sharp-shinned hawk	*Accipiter striatus*				Expected
Steller's jay	*Cyanocitta stelleri*				Expected
three-toed woodpecker	*Picoides tridactylus*				Expected
Townsend's solitaire	*Myadestes townsendi*				Expected
turkey vulture	*Cathartes aura*				Expected
varied thrush	*Ixoreus naevius*				Expected
western tanager	*Piranga ludoviciana*				Expected
yellow-bellied sapsucker	*Sphyrapicus varius*				Expected
American redstart	*Wetophaga ruticilla*				Possible
bald eagle	***Haliaeetus leucocephalus***	**Threatened**	**Threatened**		**Possible**
black-backed woodpecker	***Picoides arcticus***	**Critical**			**Possible**
black-chinned hummingbird	*Archilochus alexandri*				Possible
blue grouse	*Dendragapus obscurus*				Possible
Calliope hummingbird	*Stellula calliope*				Possible
chestnut-backed chickadee	*Parus rufescens*				Possible
common nighthawk	*Chordeiles minor*				Possible
Cooper's hawk	*Accipiter cooperii*				Possible
dusky flycatcher (Wright's flycatcher)	*Empidonax oberholseri*				Possible
flammulated owl	***Otus Flammeolus***	**Candidate**			**Possible**
golden eagle	*Aquila chrysaetos*				Possible
gray jay	*Perisoreus canadensis*				Possible
hermit thrush	*Catharus guttatus (Hylochichla guttata)*				Possible
long-eared owl	*Asio otus*				Possible
MacGillivray's warbler	*Oporornis tolmiei*				Possible
mountain bluebird	*Sialia currucoides*				Possible
mountain chickadee	*Parus gambeli*				Possible
northern goshawk	***Accipiter gentilis***	**Candidate**			**Possible**
orange-crowned warbler	*Vermivora celata*				Possible
osprey	*Pandion haliaetus*				Possible
purple finch	*Carpodacus purpureus*				Possible
red-breasted sapsucker	*Sphyrapicus ruber*				Possible
rufous hummingbird	*Selasphorus rufus*				Possible

TABLE B-6
DOCUMENTED OR EXPECTED BIRDS
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Oregon State Status	Federal Status	U.S. Forest Service Status	Observed/ Expected/ Possible
Townsend's warbler	*Dendroica townsendi*				Possible
turkey	*Meleagris gallopavo*				Possible
veery	*Catharus fuscescens (Hylocichla fuscescens)*				Possible
western bluebird	*Sialia mexicana*				Possible
western flycatcher	*Empidonax difficilis*				Possible
western wood pewee	*Contopus sordidulus*				Possible
white-winged crossbill	*Loxia leucoptera*				Possible
Williamson's sapsucker	*Sphyrapicus thyroideus*				Possible
yellow-rumped warbler	*Dendroica coronata*				Possible

Notes:

Bold indicates regulated or managed species observed, expected, or possible at the site.

Blank status indicates no listing was available for the species.

TABLE B-7
DOCUMENTED OR EXPECTED AMPHIBIANS, REPTILES, AND INVERTEBRATES
ORIOLE MINE
METALINE, WASHINGTON

Common Name	Scientific Name	Federal Status	State Status	U.S. Forest Service Status	Observed/ Expected/ Possible
AMPHIBIANS					
long-toed salamander	*Ambystoma macrodactylum*				Expected
Pacific treefrog	*Hyla regilla*				Expected
red-legged frog	***Rana aurora***			**Sensitive**	**Possible**
western toad	***Bufo boreas***	**Concern**	**Candidate**		**Possible**
REPTILES					
common garter snake	*Thamnophis sirtalis*				Expected
northern alligator lizard	*Gerrhonotus coeruleus*				Possible
rubber boa	*Charina bottae*				Possible
Western skink	*Eumeces skiltonianus*				Possible

Notes:

Bold indicates regulated or managed species observed, expected, or possible at the site.

Blank status indicates no listing was available for the species.