Engineering Evaluation / Cost Analysis

Almeda Mine

Josephine County, Oregon

September 25, 2014

Prepared for:

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EXECUTIVE SUMMARY

Millennium Science and Engineering (MSE), a subsidiary of E W Wells Group, LLC (Wells) was contracted by the U.S. Department of Interior, Bureau of Land Management (BLM) to prepare an Engineering Evaluation/Cost Analysis (EE/CA) for the Almeda Mine site in Josephine County, Oregon. This EE/CA is being performed by the BLM under its authority as lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The purpose of this EE/CA is to fulfill requirements of CERCLA (42 USC 9601 et seq., 1980), under the Superfund Accelerated Cleanup Model (SACM) and the National Contingency Plan (NCP, 40 CFR 300.415). The EE/CA is intended to: (1) satisfy environmental review requirements for removal actions, (2) satisfy administrative record requirements for documentation of removal action selection, and (3) provide a framework for evaluating and selecting alternative technologies. The primary objectives of this EE/CA are to:

- Interpret and evaluate the results of previous studies at the Site applicable to the 520 Adit, waste rock and smelter slag piles.
- Identify and address potential data gaps necessary to satisfy environmental review requirements, review applicable or relevant and appropriate requirements (ARAR), and document the need for removal actions to address on-site contamination.
- Identify the removal action objectives (RAO's).
- Identify and evaluate applicable removal action technologies.
- Develop appropriate removal action alternatives.
- Develop estimated costs for implementing each removal action alternative.
- Analyze and evaluate the removal action alternatives.
- Recommend a removal action alternative(s) for the mine site.
- Satisfy administrative record requirements for documenting the selected removal action.

Specific Site features are described below:

- The Almeda Mine is located along the north bank of the Rogue River in Josephine County, approximately 3 miles north of the town of Galice, and 30 miles by road northwest of Grants Pass.
- The Site is located in the Recreational section of the National Wild and Scenic Rogue River just upstream of the Wild Section. Activities that may affect the potential historic and scenic Site features may be limited under the Wild and Scenic River Act.
- Site access is via boat across the Rogue River, or via 4-wheel drive along Hog Creek Road approximately 10 miles from the intersection with the Merlin-Galice Road.
- Features at the Site consist of three open and five collapsed adits, at least one collapsed shaft, waste rock piles, smelter slag, mine structure remnants and miscellaneous debris.
- The 520 Adit (also known as the river level adit) has a discharge from about 6 to 15 gallons per minute and flows across an exposed bedrock floodplain before entering the Rogue River. The discharge is highly acidic (pH ~2.5) and contains high concentrations of metals, particularly aluminum, arsenic, iron and zinc.
- According to flood studies conducted by the BLM, the 520 Adit portal is located within the 2- to 5-year floodplain.

The official outstandingly remarkable values established by the Resource Management Plan (RMP) for the Recreational section of the Rogue River include fish, recreation and scenery. Land uses in the area surrounding the Site include recreational activities such as rafting, kayaking, sightseeing, and fishing. The Site is a sightseeing and picnic location for rafters; however, significant public use is limited because of the difficult access by land.

Based on information provided in the Site Inspection (SI) report, the primary contaminants of interest (COI) at the Site include: aluminum, arsenic, cadmium, copper, lead, manganese, and zinc. The major contaminant sources at the Site include: (1) approximately 5,600 cubic yards (cy) of waste rock and 250 cy of smelter slag; and (2) acid mine drainage (AMD) discharging from the 520 Adit.

A Human Health Risk Assessment (HHRA) was completed for the Almeda Site by PBS in 2012. A streamlined Ecological Risk Assessment (ERA) was also completed by the U.S. Fish and Wildlife Service in 2013. Results of the risk assessments indicate there are low but actionable levels (*e.g.* excess cancer risk greater than 1E-06) of risk at the Site.

Potential general removal technologies and processes were identified from a review of technical literature and previous experience at similar sites. The general removal action categories include:

- **No Action** that involves leaving the site as is. The No Action alternative is used as a baseline to compare with the various alternatives.
- **Treatment** that involves the physical destruction or immobilization of contaminants.
- **Engineering Controls** that minimize uncontrolled migration and exposure to the environment.
- **Institutional Controls** that minimize or prevent public exposure by limiting access or providing public awareness.

During the initial screening step, the removal actions and potential technologies were evaluated based on effectiveness, implementability and cost. In addition to the No Action alternative, three potential removal action alternatives to manage mine wastes were developed from the general removal technologies retained from the preliminary screening process. These alternatives are described as follows:

Alternative 1 - No Action.

This alternative consists of no further action and leaving the Site as is:

- Water discharging from the 520 Adit would continue to flow untreated into the Rogue River.
- Mine waste would continue in an uncontained state.
- The public would be unaware of potential site risks.

Alternative 2 – Adit Plug with Water Treatment and Geotube Filtration.

This alternative will consist of the following elements:

- Containment will be accomplished by installation of a 3-ft. thick adit plug that would preclude floodwater entry at location “0+75 feet”.
- A treatment system consisting of a caustic/polymer injection system will be installed and activated.
- Discharge will be treated with a caustic/polymer injection system.
- Treated effluent will be discharged to nearby containerized 4’x25’ GeoTube filters in a lined and covered excavation wherein sludge will be collected.
- Containers will be removed in the same manner as standard garbage receptacles (dumpsters) for disposal and returned to the Site.
- Effluent water from the GeoTubes will be collected in a floor drain and discharged to a drainfield protected by filters.

Alternative 3 – Mine Waste Stabilization

This alternative will consist of the following elements:

- This alternative focuses on stabilizing the toe of the existing waste rock dump to reduce erosion and sediment load to the river during periods of high flows.
- The stabilization alternative consists of constructing an embankment at the bottom of the waste rock pile and reclaiming the surface of the waste rock pile above the embankment. The benched embankment would armor the toe of the slope, contain eroded sediment, and divert runoff upslope from the current drainage carrying adit discharge.
- Waste rock present below the 5-year flood plain will be consolidated and used to construct the bench at the toe of the slope.
- The embankment would collect eroded waste rock and divert runoff from the waste rock pile approximately 400 feet upstream from the existing adit drainage.
- The waste rock pile will also be stabilized by re-establishing biological conditions at the surface and re-vegetating the steep slope to the degree attainable. Imported biological soil amendments include solid humic shale (leonardite) at a rate of 500 pounds per acre, compost at a rate of 8 tons per acre, liquid humic acid at a rate of 10 gallons per acre, tackifier, and 1,000 pounds per acre of protein source such as spent grain.
- The waste rock pile above and below the embankment will be re-vegetated with native seed.
- Additional re-vegetation activities will include planting of willows below the constructed embankment and selected tree plantings along the slope of the waste rock pile.

Alternative 4 - Institutional Controls

This alternative will consist of the following elements:

- Signs will be posted around the mine waste (waste rock and smelter slag) and adit discharge areas to notify the public of risks of dermal contact and ingestion.
- The locked gate on the site access road will be maintained to control site access.
- Informational kiosks will be installed at selected areas frequented by river recreationists (*e.g.* Almeda County Park and BLM Smullin Visitors Center) to inform the public of site risks. Informational posters will also be distributed to area rafting and guiding businesses.

Wells/MSE recommends adoption of both Alternatives 3 and 4 for the following reasons:

1. Alternative 1 does not comply with ARARs.

2. Alternative 2 provides short-term effective treatment of the 520 Adit discharge. However, it was not recommended due to the long-term O&M obligations at a remote location with difficult site access, long-term system reliability concerns, and high cost.

3. Alternative 3 reduces metals exposure to human and ecological receptors by removing and consolidating waste rock present below the 5 year flood plain (area most accessible to the public and wildlife) and using it to construct an embankment at the toe of the waste rock dump. The embankment will reduce erosion of mine waste during high flood events and collect eroded material from the upper slopes of the mine waste pile. The surface will also be re-vegetated (to the degree attainable) to help reduce erosion and transport of metals. The mine waste in the smelter slag pile is vitrified and metals are generally not mobile; therefore, no additional waste containment actions were recommended for this material.

4. Alternative 4 will help prevent the public from contact with or drinking the 520 Adit discharge. Signs will also be placed around the mine waste rock dump and smelter slag pile informing the public on potential health concerns.

The total estimated removal action construction cost for both Alternative 3 and 4 is $185,700.

1.0 INTRODUCTION

In 2010, Millennium Science and Engineering (MSE), a subsidiary of E W Wells Group, LLC (Wells) was contracted by the U.S. Department of Interior, Bureau of Land Management (BLM) to prepare a focused Engineering Evaluation/Cost Analysis (EE/CA) for the Almeda Mine site in Josephine County, Oregon. The "focused" EE/CA was limited to evaluating alternatives to reduce or treat the acid mine drainage (AMD) associated with discharge from the 520 Adit at the Almeda Mine (Site). The AMD discharges directly into the adjacent Rogue River across a bedrock flood plain approximately 200 feet wide. MSE submitted a draft EE/CA in April 2011. The draft was based on previous qualitative risk assessment data that identified human health and ecological receptors at high risk from metals concentrations in the AMD from a screening level perspective; however, they were recognized as low risk from a practical perspective due to the remoteness of the site, limited habitat and dilution of the receiving stream. As directed by the BLM, the EE/CA focused on evaluating five active treatment options (plus the "no action" alternative). An adit plug with caustic/flocculent addition prior to discharge to a GeoTube System was recommended by MSE as the preferred treatment alternative. Information presented in the draft 2011 EE/CA is included in this current document.

The BLM subsequently updated the human health and ecological risk assessments with site specific risk exposure data (PBS 2012; USFW 2013) which indicates a low but still actionable level of risk from adit discharge and mine waste deposited at the site (*e.g.* excess cancer risk greater than 1E-06). Based on this new information, the BLM has requested that Wells/MSE revise our previous draft to incorporate this data into our analysis. In addition, the BLM has requested that on-site mine waste (waste rock and smelter slag piles) be incorporated into the EE/CA analysis to provide a document that is comprehensive of the entire site.

This EE/CA is being performed by the BLM under its authority as lead agency under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The purpose of this EE/CA is to fulfill requirements of CERCLA (42 USC 9601 et seq., 1980), under the Superfund Accelerated Cleanup Model (SACM) and the National Contingency Plan (NCP, 40 CFR 300.415). The EE/CA is intended to: (1) satisfy environmental review requirements for removal actions, (2) satisfy administrative record requirements for documentation of removal action selection, and (3) provide a framework for evaluating and selecting alternative technologies. Primary objectives of this EE/CA were to:

- Interpret and evaluate the results of previous studies at the Site applicable to the 520 Adit, waste rock and slag piles.
- Identify and address potential data gaps necessary to satisfy environmental review requirements, review applicable or relevant and appropriate requirements (ARAR), and document the need for removal actions to address on-site contamination.
- Identify the removal action objectives (RAO).
- Identify and evaluate applicable removal action technologies.
- Develop appropriate removal action alternatives.
- Develop estimated costs for implementing each removal action alternative.
- Analyze and evaluate the removal action alternatives.
- Recommend a removal action alternative(s) for the mine site.
- Satisfy administrative record requirements for documenting the selected removal action.

This EE/CA was prepared in general conformance with the following:

- CERCLA.
- NCP 40CFR 300.415.

- Superfund Amendments and Reauthorization Act (SARA).
- CERCLA Response Actions Handbook (BLM Handbook H-1703-1).
- Department of Labor regulations governing hazardous waste operations and emergency response (29CFR 1910.120).
- EPA's *"Guidance on Conducting Non-time Critical Removal Actions Under CERCLA"* (EPA/540-R-93-057).

The primary sources of data used in preparation of this EE/CA were provided by the BLM and include:

- Human Health Risk Assessment Report, Almeda Mine Josephine County, Oregon (PBS 2012).
- Streamlined Ecological Risk Evaluation for the Almeda Mine Josephine County, Oregon (USFW 2013).
- Removal Site Inspection (SI) Report Almeda Mine (BLM 2003).
- Report of Underground Mine Reconnaissance and Recommendations for Almeda Mine (Saguaro GeoServices, Inc. [SGSI] 2002).
- Report of Subsurface Exploration and Rock Characterization Field Activities 2003-2005 (SGSI 2007).
- Bulkhead Feasibility Assessment, 520 Level, Almeda Mine (SGSI 2010).
- Almeda Mine AMD Reclamation Report Review (Abel 2008).
- Quarterly Water Quality Monitoring at the Almeda Mine, 2009-2014, (Katalyst, Inc. [Katalyst] 2014).
- Action Memorandum (BLM 2003).
- Action Memorandum (BLM 2009).
- Treatability Report and Feasibility Assessment for a Caustic Drip System at the Almeda Mine (Ionic Water Technologies, Inc. [Ionic] 2010).

2.0 SITE CHARACTERIZATION

A detailed Site characterization is presented in the Almeda Mine Removal Site Inspection (SI) Report (BLM 2003), and more recently in the Abandoned Mine Lands Inventory Survey of Almeda Mine on 7/21/10 Summary Report (BLM 2010) and the Human Health Risk Assessment Report (PBS 2012). Wells/MSE conducted a limited reconnaissance of the Site with BLM staff on October 5, 2010 and April 8, 2014. Selected Site photographs are presented in Appendix 1. In general, the observed Site features were consistent with descriptions presented in the SI report and other project documents. One notable difference from the SI was the condition of the 520 Adit portal, which was re-opened by the BLM in 2009. Figures 1 through 4 show general features of the area and various key Site features. Specific Site features are described below:

- The Almeda Mine is located along the north bank of the Rogue River in Josephine County, Oregon, approximately 3 miles north of the town of Galice, and 30 miles by road northwest of Grants Pass.
- The Site is located in the Recreational section of the National Wild and Scenic Rogue River just upstream of the Wild Section.
  - The Rogue River is an important salmon and steelhead fishery.
  - There are two developed recreation sites within 1 mile upstream of the Site: (1) Almeda County Park, and (2) BLM Smullin Visitor Center at Rand.
  - The Site is an occasional sightseeing and picnicking destination for rafters.
  - Flood estimates for the Rogue River at the Site range from 75,000 cubic feet per second (cfs) (elevation ~ 680 feet above mean seal level [amsl]) for the 2-year flood to 304,000 cfs (elevation ~ 707 feet amsl) for the 100-year flood (BLM 2003).
  - The lower portion of the Site is in the Rogue River flood plain.
- Site access is via boat across the Rogue River, or via 4-wheel drive along Hog Creek Road approximately 10 miles from the intersection with the Merlin-Galice Road. The access road crosses a short section of private land near the Site and has been gated to minimize public access. Access through private land is maintained by a perpetual nonexclusive easement. Portions of the 4-wheel drive road within one to two miles of the Site are located along steep valley sidewalls, with sharp turns and narrow roadbed, limiting vehicle/equipment access.
- Site coordinates are N 42º36’15.3” and W 123º36’12.6”, Township 34 South, Range 8 West (T34S, R08W), Section 13 of the Willamette Meridian.
- The Site ranges in elevation from about 680 feet amsl at the 520 Adit (also known as the River Level Adit) to about 794 feet amsl at the 794 Adit.
- Average annual precipitation at the Site is 33.5 inches, and the average temperature is 54º Fahrenheit (Soil Conservation Service 1984).
- The Site has been determined to be of cultural and archaeological significance, and the State Historical Preservation Office (SHPO) has concurred with BLM’s recommendation of eligibility for the National Register of Historic Places.
- The mine consists of a complex series of adits and stopes connected by crosscuts, raises, and vertical shafts. There are approximately 10,000 feet of underground workings extending from 300 feet above to over 400 feet below the river elevation (BLM 2003; BLM 2010).
- Features at the Site consist of three open and five collapsed adits, at least one collapsed shaft, waste rock piles, smelter slag, mine structure remnants and miscellaneous debris.
  - The 520 Adit is located at the toe of the hillside along the north bank of the Rogue River.
    - The BLM reopened the adit in 2009 and installed a locked steel-cage door in the adit portal.
    - MSE and BLM personnel completed a Site reconnaissance during Fall 2010 and Spring 2014.

    - The tunnel opens into a fairly large stope about 120 feet inside the portal.
    - Discharge from the adit ranges from about 6 to 15 gallons per minute (gpm) and flows across exposed bedrock over an area of about 1 to 2 acres before entering the Rogue River. During the Site reconnaissance by MSE, the flow was estimated to be about 10 gpm. The discharge is highly acidic (pH ~2.5) and contains high concentrations of metals, particularly aluminum, arsenic, iron and zinc.
  - The 0 Adit is located on the hillside above the 520 Adit, approximately half way between the 520 Adit and the 620 Adit.
    - The adit portal is collapsed and covered with waste rock; the exact location is unknown.
    - The 0 level is reported to be about 35 feet in elevation above the 520 level (SGSI 2010).
    - 0 level elevation = 715 feet amsl.
  - The 620 Adit is located up the hill from the 520 Adit in the access road cut.
    - There is a locked steel bat gate installed in the adit portal.
    - The 620 level is reported to be about 95 feet in elevation above the 520 level (Abel 2008).
    - 620 level elevation = 775 feet amsl.
  - The 794 Adit is located up the hill from the 620 Adit.
    - There is a locked steel bat gate installed in the adit portal.
    - 794 level elevation is assumed to be about 794 feet amsl.
  - The waste rock pile is located up the hill and directly to the east from the 520 Adit.
    - Approximately 5,600 cubic yards of mine waste is present.
    - The waste rock pile is located on a steep slope (greater than 2:1) with eroded waste rock material deposited below the pile within the 5-year floodplain of the Rogue River.
  - The smelter slag pile is located adjacent to the access road approximately 250 feet west of the 520 Adit.
    - Approximately 250 cubic yards of material is present.
    - The smelter slag is located within the 5-year floodplain for the Rogue River.
- A repository that contains approximately 150 cubic yards of mine waste material from re-opening the 520 Adit is located approximately 75 feet east of the 620 Adit. The repository was constructed in 2009 and consists of an unlined excavation filled with the material from the adit opening. It is capped with geotextile fabric, a single layer of 50-mil high density polyethylene (HDPE), and covered with two feet of soil (PBS 2012).
- According to flood studies conducted by the BLM during the SI (2003), the 520 Adit portal is located within the 2- to 5-year floodplain.
  - The area outside the portal consists of exposed bedrock that gently slopes to the river.
  - The adit discharge meanders over the exposed bedrock forming several small pools then passing through limestone-filled channels before entering the Rogue River. The neutralization capacity of the limestone is greatly hindered by precipitate/reactive armoring, and interstitial pore space appears now largely filled with precipitate, thus inhibiting flow and contact.
  - Ferricrete deposits are pervasive as is a white crystalline material which may be gypsum and other sulfate-based salts.
- The area along the north bank of the Rogue River downstream of the 520 Adit consists of a long, broad bench sloping toward the Rogue River within the 2- to 5-year flood plain.
  - The bench is covered with approximately one foot of soil overlying Rogue River Quaternary Alluvium.
  - There are a series of alluvial terraces approximately 20 to 30 feet above the bench in the area immediately west of the switchback in the access road leading down to the 520 Adit. These terraces appear to be in the 20- to 50-year flood plain.
  - According to soil samples collected from this area during the SI, the soils in these areas consists of Brockman Variant very gravelly loam.

- Portions of this area have cultural and/or archaeological significance.

2.1 Surrounding Land Use and Populations

The official outstandingly remarkable values established by the Resource Management Plan (RMP) for the Recreational section of the Rogue River include fish, recreation and scenery (BLM 1994). Land uses in the area surrounding the Site include recreational activities such as rafting, kayaking, sightseeing, and fishing. The Site is a sightseeing and picnic location for rafters; however, extensive public use is limited because of the difficult access by land. Developed recreational areas within 1 mile of the Site include the Almeda County Park and the BLM Smullin Visitor Center at Rand, located upstream and on the opposite side of the river from the Site (Figure 2). The unincorporated communities of Galice and Merlin are located about 3 and 12 miles upstream of the Site, respectively; and have a combined population of about 2,163 residents (U.S. Census Bureau 2010).

2.2 Data Gaps

Several data gaps were identified during the initial Site reconnaissance and preliminary review of project documents. These include:

1. Agronomic properties of the waste rock material are unknown. Prior to re-vegetation design, samples should be collected and analyzed for standard suite of agronomic properties to aid in amendment selection.
2. Selected alternatives may require some access road improvements and also incur maintenance. An assessment should be completed to determine improvement and maintenance costs.
3. Thickness of waste rock at the toe of the slope.

Broad assumptions regarding material quantities and Site conditions were used to address the data gaps in the development of conceptual designs presented in this EE/CA. These data can affect the overall removal action cost and will be needed for preparing the final design.

2.3 Source, Nature and Extent of Contamination

Based on information provided in the SI report, the primary contaminants of interest (COI) at the Site include: aluminum, arsenic, cadmium, copper, lead, manganese, and zinc. The major contaminant sources at the Site include: (1) approximately 5,600 cubic yards (cy) of waste rock and 250 cy of smelter slag, and (2) AMD discharging from the 520 Adit.

<u>Mine Waste Material</u>

During the SI, the BLM performed a series of field measurements of the waste rock and smelter slag areas using a Niton 702 X-ray Fluorescence spectrometer (XRF). Additional laboratory analytical samples of waste rock and smelter slag were also collected by PBS during preparation of the HHRA in 2012. Analytical results of soil samples are summarized in Table 1 and described below. Refer to the SI (BLM 2003) and HHRA (PBS 2012) for more detailed information.

- The BLM measured the waste rock dump as covering an area of approximately 50,000 square feet with a thickness ranging from several inches to three feet. The volume was estimated at 5,600 cubic yards.
- The BLM measured the smelter slag area at approximately 2,000 square feet with an estimated volume of 250 cubic yards.

- The BLM sampled the waste rock dump using an XRF at 12 locations during the SI in 2001 and 2002:
  - Average XRF results for iron, lead, arsenic and zinc were 127,396; 537; 410; and 462 parts per million (PPM), respectively.
  - Results of a Synthetic Potential Leaching Procedure (SPLP) composite sample from the waste rock dump indicate leachable concentrations of cadmium, copper and zinc in excess of Rogue River water quality standards are potentially produced. However, waste rock leachate concentrations are about an order of magnitude less than the 520 Adit drainage. The BLM indicated that this suggest that the waste rock dumps are not an important source of metals loading to the adit mine drainage from the 520 Adit.
  - The smelter slag is glassified and essentially inert.
- PBS sampled the waste rock dump, smelter slag pile, and background soil during performance of a HHRA in 2012:
  - 24 samples were collected from the waste rock dump. The majority of samples contained detectable levels of aluminum, chromium, iron, manganese, zinc and nickel below mean background concentrations, and levels of arsenic, cadmium, selenium, lead and silver above mean background concentrations.
  - The samples from the smelter slag area did not contain detectable levels of chromium, nickel, selenium and cadmium; however, silver was present in most samples. Concentrations of lead and manganese were below background levels; however, concentrations of aluminum, arsenic, copper, iron and zinc were above background concentrations.
  - Background samples indicated few detectable concentrations of nickel, selenium, silver, chromium and cadmium; however, concentrations of manganese and nickel were higher than samples from the waste rock dump. Background levels of iron, lead and arsenic appeared to be elevated when compared to generic risk based concentrations.

Surface Water and Mine Water

The BLM collected surface water samples from the Rogue River and 520 Adit discharge during the SI in 2001 and 2002. Additional surface water and mine water samples were collected by Katalyst in 2009 through 2014 following re-opening of the 520 Adit portal. Analytical results of the surface water samples are summarized in Table 2 and described below. Refer to the SI (BLM 2003), HHRA (PBS, 2012) and quarterly water monitoring reports (Katalyst 2014) for more detailed information.

- The BLM sampled surface water at the Site during the SI in 2001 and 2002:
  - Two surface water samples were collected from the Rogue River: one upstream and one downstream of the Site (RR-UP and RR-DN).
  - Quarterly surface water samples were collected from the 520 Adit discharge at the collapsed portal (Seep 1).
- Katalyst, Inc. sampled surface water at the Site following re-opening of the adit portal in 2009:
  - Quarterly surface water samples were collected from the 520 Adit discharge (November 2009, then Quarterly through spring 2014.
  - Two surface water samples were also collected from the Rogue River in summer during 2010 through 2013: one upstream and one downstream of the Site (RRRA and RRAR).
- The samples collected from the Rogue River upstream of the Site are assumed to represent background surface water quality conditions for the Site.
  - Aluminum exceeded Oregon's historic recommended chronic ambient water quality criteria for protection of aquatic life (87 μg/L). This criterion is in flux and is listed as No Standard with the understanding that the former criterion is potentially applicable.

- Mercury was reported as non-detect; however, the reporting limits (RL's) were above one or more screening criteria. This indicates that mercury could be present at concentrations above the screening criteria.
- Lead and arsenic were detected at concentrations from below the detection limit up to 0.00029 micrograms per liter (ug/L) and 0.00093 ug/L, respectively.
- Copper, manganese and zinc were detected at concentrations from below the detection limit up to 0.003 ug/L, 0.017 ug/L, and 0.029 ug/L, respectively.
- No COIs exceeded human health or ecological screening criteria.
- The pH values ranged from 6.98 to 8.12.
- Hardness in the June 2002 sample was 38.5 milligrams per liter (mg/L) calcium carbonate ($CaCO_3$).
- The mean annual flow in the Rogue River has ranged from 3,351 cubic feet per second (cfs) upstream of the Site at the Grants Pass USGS stream gage to 5,762 cfs downstream of the Site at the Agness USGS stream gage (1961 to 2009; USGS 2010).

- The samples from the 520 Adit portal discharge contained concentrations of several COIs above Oregon state and federal screening criteria.
  - Arsenic, cadmium, copper, iron, lead, selenium, and zinc all exceeded various Oregon state or EPA human health screening criteria and drinking water standards.
  - Iron and selenium exceeded Oregon state and EPA ecological screening criteria for protection of aquatic life. Other Oregon criteria may have been exceeded, but standards have not yet been accepted by EPA.
  - Mercury was reported as non-detect in all but one sample; however, the RL was above the Oregon ecological screening criteria. This indicates that mercury could be present at concentrations above the screening criteria.
  - The pH values ranged from 2.5 to 3.34.
  - Hardness values ranged from 374 to 597 mg/L $CaCO_3$.
  - The adit discharge flow rate ranged from 5 to 28.3 gpm.
- Results of the downstream surface water samples from the Rogue River were very similar to the upstream sample results.
  - There was no statistically significant change in COI concentrations in samples from the Rogue River upstream and downstream of the Site. While concentrations of some metals increased downstream, others decreased.
  - The pH values ranged from 7.01 to 8.37.
  - Hardness in the June 2002 sample was 31.3 mg/L $CaCO_3$.

2.4 Risk Summary

A Human Health Risk Assessment (HHRA) was completed of the Almeda Site by PBS in 2012. A streamlined Ecological Risk Assessment (ERA) was also completed by the U.S. Fish and Wildlife Service (FWS) in 2013. Results of the risk assessments are discussed below.

2.4.1 Potential Human Health Risks

PBS performed a HHRA of the Site for the BLM. The HHRA focused on mine water discharge from the 520 Adit, and the smelter slag pile and waste rock piles. Potential human health risks from exposure to the 520 Adit discharge and mine waste were evaluated using Oregon DEQ and U.S. EPA protocol. PBS collected additional samples of the slag, waste rock and background soil to supplement previous site data.

The COI evaluated in the HHRA included aluminum, arsenic, cadmium, copper, iron, lead, manganese, mercury and zinc. The Conceptual Site Model (CSM) developed for the site included exposure routes of dermal contact and ingestion for adit surface water discharge; and dermal contact, ingestion and

inhalation for the smelter slag and waste rock piles. Exposure scenarios for the site were modified from default values based on reduced site-specific exposure conditions. The primary current and future receptors were identified as recreationalists accessing the Site while floating down the Rogue River, and construction/excavation workers doing remediation work on-site. The river recreationalist would tend to be adults/adolescents unlikely to stay for more than a couple of hours. Therefore, the daily exposure duration was adjusted down from a default value of 24-hours to a four-hour period. Site access via the 4-wheel drive road was identified as unlikely given the locked gate and distance (ten miles via jeep and 4-wheel drive road). Since it is unlikely that a recreational user would visit the site on a regular basis the exposure scenario was reduced to six times per year for one-half day (four hours). Similar reductions were also included for construction/excavation workers that may visit the site for future maintenance/remediation activities. Due to the current and likely future uses of the site, residential and occupational use scenarios were not evaluated (PBS 2012).

Results of the HHRA include:

- Non-carcinogenic effects do not exceed site-specific acceptable levels for either construction workers or recreational users. All metals have a Hazard Index (HI) less than one and have a cumulative HI (considering exposure to both the 520 Adit discharge and mine waste piles) of less than one.
- Carcinogenic risks were evaluated for both arsenic and cadmium in the 520 Adit discharge and for arsenic in the mine waste piles. The acceptable risk level for excess lifetime cancer risk (ECR) is 1.0E-06 (one in a million) for individual compounds, and 1.0E-5 (one in one hundred thousand) for multiple carcinogens.
    - For Almeda, ECR for a single compound was below the threshold for construction/excavation workers (9.1E-09 for Adit 520 discharge and 4.2E-07 for mine waste); however, it was slightly exceeded under the recreational user scenario for both the Adit 520 discharge and mine waste piles. ECR for recreational users was 7.0E-06 for the Adit 520 discharge and 1.5E-06 for the mine waste.
    - ECR for multiple compounds was not exceeded for either recreational users or construction/excavation workers. ECR was 8.5E-6 for recreational users and 4.3E-07 for construction/excavation workers.
    - The HHRA indicated that the majority of the ECR is attributed to the concentration of arsenic in the 520 Adit discharge and the ECR from the mine waste piles is secondary (only about 20% of the cumulative ECR at the Site).
- Cleanup goals established by the HHRA for surface water are 13 ug/L for arsenic (site concentrations have ranged from 19 to 1,480 ug/L with an average of 71 ug/L.
- The cleanup goals established for arsenic in mine waste is 184 mg/kg (slag concentrations ranged from 50 to 301 mg/kg, with an average of 129 mg/kg; waste rock concentrations ranged from 5.3 to 628 mg/kg, with an average of 263 mg/kg).

2.4.2 Ecological Risk Assessment

A streamlined ERA was conducted by the FWS for the Almeda Mine site. The ERA followed EPA and Oregon guidance and utilized existing analytical data for surface water and surface soil/mine waste. Results of the ERA include:

- In general, concentrations of copper and zinc are elevated in both the 520 Adit discharge and mine waste piles.

- The 520 Adit discharge has a low pH and concentrations of cadmium, copper, lead, and zinc above both chronic and acute water quality standards. However, the adit discharge is considered a waste stream and not aquatic habitat.
- The Rogue River is in the normal range for pH and has no exceedances for metals. Metals concentration data from upstream/downstream samples is inconclusive with no statistically significant increase downstream of the Almeda Site.
- Copper and zinc are at concentrations in soil indicating plants may be at risk in the waste rock and smelter slag areas.
- Metals concentrations indicate that terrestrial invertebrates may be at risk from elevated concentrations of copper and zinc in the smelter slag pile; and arsenic, selenium and mercury in the waste rock pile.
- Birds and mammals may be at risk for arsenic, cadmium, copper, lead, selenium and zinc in the mine waste piles.
- The FWS noted that the mine waste areas are denuded of most vegetation and do not contain habitat, therefore, animals are not likely to live in the actual waste areas. Surrounding area habitat is likely to support a diversity of birds and mammals, with exposure limited to periodic migration and movement across the waste piles. In addition, herbivorous animals would have limited use of the mine waste areas.

2.5 Sensitive Environments

Sensitive environments at or in close proximity to the Site include the Rogue River, which provides essential fish habitat to Coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*Oncorhynchus tshawytscha*), and Steelhead (*Oncorhynchus mykiss*). Other sensitive animal species that may inhabit the Site include numerous federal and state rare, threatened, or endangered (T&E) mammals, birds, and reptiles that have potential habitat in the vicinity of the Site. Townsend's big-eared bats (*Coryhorhinus townsendii*), which are a state candidate species and a federal species of concern, may inhabit the open adits. A bat habitat assessment may be considered to determine whether those species may inhabit the open adits. If warranted, a BLM Biologist can be consulted to determine whether protective measures need to be taken if these sensitive species are present onsite. A complete survey is not necessary to determine bat presence.

No sensitive or T&E plant and animal species were observed during the Site reconnaissance by MSE/Wells. However, Coho salmon are listed as Threatened in the Rogue River drainage.

3.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs are "applicable" or "relevant and appropriate" federal and state environmental requirements used to:

1. Evaluate the extent of site cleanup needed.
2. Scope and develop removal action alternatives.
3. Guide the implementation and operation of the preferred alternative.

Applicable requirements include cleanup standards and other substantive requirements, criteria, or limitations promulgated under federal or state laws that apply to hazardous substances and removal actions at the Site. Relevant and appropriate requirements are not applicable to the Site but may be suitable for use because they address issues or problems sufficiently similar to those present at the Site. In addition to ARARs, federal and state environmental and public health guidance and proposed standards that are not legally binding but may prove useful are "to be considered" standards. The ARARs for the Site are discussed below and summarized in Appendix 2.

The National Contingency Plan (NCP) (40CFR 300.415(j)) establishes that a removal action shall "to the extent practical, considering the exigencies of the situation, attain ARARs under federal environmental or state environmental facility siting laws." To determine whether compliance with ARARs is practicable, two factors are specified in 40 CFR 415(j):

- Urgency.
- Scope of the removal action.
  - The scope of the removal action is often directed at minimizing and mitigating a potential hazard rather than totally eliminating the hazard; even though a particular standard may be an ARAR for a particular medium, it may be outside the scope of the immediate problem the removal action is addressing.

The ARARs were used to determine the design specifications and performance standards for the project. They are grouped as federal or State of Oregon ARARs, and are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR, and whether the ARAR is applicable, or relevant and appropriate (see Appendix 2).

- Administrative requirements are not ARARs and thus do not apply to actions conducted entirely onsite. Administrative requirements are those that involve consultation, issuance of permits, documentation, reporting, record keeping, and enforcement.
- The CERCLA program has its own set of administrative procedures, which assure proper implementation of CERCLA. The preamble to the final NCP states that the application of additional or conflicting administrative requirements could result in delay or confusion.
- Provisions of statutes or regulations that contain general goals that merely express legislative intent about desired outcomes or conditions, but are non-binding, are not ARARs. In accordance with Section 121(e) of CERCLA, no permits are required for removal actions conducted onsite.

3.1 Water Quality Standards

The potential surface water ARARs are based on Oregon state and federal standards for the protection of aquatic life and human health, and are summarized in Appendix 2. The numeric criteria derived from these ARARs are provided at the bottom of Table 2. The values for hardness dependent metals were adjusted based on an apparent background value of 38.5 mg/L as $CaCO_3$ in the upstream sample collected

from the receiving stream (i.e. Rogue River) during the SI (BLM 2003). Based on analytical results of surface water samples collected during the SI (2001-2002) and quarterly monitoring events (2009-2014), several COIs exceed surface water quality ARARs:

- Results for mercury in upstream and downstream Rogue River samples were reported as not detected; however, the laboratory RLs were above the empirically- or calculation-derived ARAR criteria. These constituents could be present at concentrations above the ARARs, but cannot be verified without additional sampling and analysis.
- No samples collected from the Rogue River upstream and downstream of the Site during quarterly monitoring in July 2010 – 2013 contained metals above criteria or ARARs. However, this is partly due to EPA's rejection of some Oregon criteria, leaving no standard except for specific applications or defaulting to prior criteria.
    - There does not appear to be a statistically significant impact to surface water quality in the Rogue River from the 520 Adit discharge.
- Samples from the 520 Adit discharge contained several COIs above both human health and ecological ARARs:
    - Concentrations of pH, arsenic, cadmium, copper, iron, lead, selenium, and zinc all exceeded human health ARARs.
    - Concentrations of pH, iron and selenium exceeded ecological ARARs.

3.2 Soil Standards

The potential soil ARARs are based on Oregon state and federal standards for the protection of human health and are summarized in Appendix 2. Based on analytical results of surface soil/mine waste samples collected during the HHRA (PBS 2012), several COIs exceed soil quality ARARs:

- Results for arsenic, copper, iron and silver exceed Oregon Risk Based Screening Levels (RBSLs) and EPA Preliminary Remediation Goals (PRG's) in the smelter slag pile.
- Results for arsenic, iron and lead exceed Oregon and EPA RBSLs in the waste rock pile.
- It should be noted that arsenic, iron, lead and manganese also exceed Oregon and EPA RBSLs in background soil samples.

4.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The general goal of a removal action is to protect human health and the environment by preventing or minimizing the potential release of a hazardous substance and reducing the potential for direct contact and transport of contaminants to the environment. Based on the human health and ecological risks identified at the Almeda Mine, the following non-time critical removal action objectives (RAO) were developed for the Site:

- Reduce or eliminate the potential risks to both human health and ecological receptors from exposure to metals in the mine waste, and human health receptors from the 520 Adit discharge.
- Reduce or eliminate potential contaminant (*i.e.*, metals) loading to the Rogue River from erosion of mine waste and the 520 Adit discharge.

The following sections discuss the justification for a removal action at the Site, scope of the removal action, and the proposed removal action schedule.

4.1 Removal Action Justification

Federal regulation 40 CFR 300.415(b), lists several factors to be considered in determining whether a removal action is appropriate. The factors relevant at this Site, and the conditions establishing the presence of those factors, are summarized below:

- **Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants:**
  - The risk screening indicated potential risk to human receptors from exposure to metals in the 520 Adit discharge.
    - The maximum detected concentration (MDC) of arsenic (1,480 μg/L) exceeds Oregon's ambient water quality criteria for protection of human health (2.1 μg/L).
    - The MDC of copper (5,030 μg/L) exceeds EPA's recommended chronic ambient water quality criteria for protection of aquatic life (2.34 μg/L); however, the adit discharge prior to mixing with the Rogue River was determined by FWS to be a waste stream and not aquatic habitat.
  - The risk screening indicated potential risk to human and ecological receptors from exposure to metals in mine waste (ECR under the recreational user scenario was 7.0E-06 for the Adit 520 discharge and 1.5E-06 for mine waste, slightly exceeding the acceptable risk level of 1.0E-06).
  - Land uses in areas surrounding the Site include recreational activities such as rafting, fishing and sightseeing.
    - While vehicular access to the Site is restricted, physical access is still possible and the Site is an occasional sightseeing and picnicking location for rafters who can cross over the Rogue River on boats.
- **Actual or potential contamination of drinking water supplies or sensitive ecosystems:**
  - Contaminated effluent from the 520 Adit discharges to the Rogue River.
  - Erosion of mine waste into the Rogue River occurs during periods of high stream flow and surface erosion/runoff.
  - There are no public water supplies at the Site and no drinking water wells along the discharge flowpath within a 4-mile radius; Although, recreationists may occasionally use water from the Rogue River for cooking and as a drinking source.
    - The maximum detected concentration of arsenic (1,480 μg/L) in discharge from the 520 Adit exceeds Oregon and EPA human health screening criteria, as does pH.

  - It should be noted that the discharge from the 520 Adit was determined by FWS to not be aquatic habitat and is therefore not a sensitive ecosystem.
  - The Rogue River is habitat to the Rainbow trout (*Oncorhynchus mykiss*), which is a state priority species.
- **Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release:**
  - There are no known hazardous substances in containers at the Site.
- **High levels of hazardous substances, pollutants, or contaminants in soils, at or near the surface that may migrate:**
    - Metals are present in mine waste rock and smelter slag at the surface. However, the smelter slag is vitrified and the metals are generally not mobile.
- **Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released:**
  - The 520 Adit is located within the 2- to 5-year flood plain.
  - The waste rock dump consists of loosely consolidated material on a steep, un-vegetated slope that is susceptible to surface erosion and transport during high precipitation and high stream flows (toe of the slope is within the 2- to 5-year flood plain).
  - Smelter slag is vitrified and the metals are generally not mobile; however, the material is susceptible to physical erosion and transport downstream during flooding.
- **Threat of fire or explosion:**
  - There is no known threat of fire or explosion at the Site.
- **Other situations or factors that may pose threats to public health or the environment:**
  - Open adits are gated/secured and not accessible to the public. The site does include steep slopes.

4.2 Scope of Removal Action

The scope of removal actions evaluated in this EE/CA focus on:

(1) Reducing or eliminating potential risks to both human health and ecological receptors from exposure to metals in mine waste, and human health receptors from the 520 Adit discharge.
(2) Reducing or eliminating potential contaminant (i.e. metals) loading to the Rogue River from mine waste and the 520 Adit discharge.

The EE/CA does not consider sediment that has already migrated to the Rogue River for the following reasons: (1) sediment does not pose a significant human health risk; (2) there is no apparent impact to aquatic organisms downstream of the Site; and (3) because of excessive collateral damage to aquatic habitat/organisms that would be caused by an in-stream removal action. Groundwater is not used for drinking water at the Site and future use as a drinking source is not anticipated; therefore, treatment of groundwater is also beyond the scope of this EE/CA.

Post-removal action monitoring will be required to evaluate the removal action effectiveness and compliance with the ARARs. The monitoring should include surface water sampling and post-removal monitoring of the aquatic habitat in the Rogue River immediately downstream of the Site.

4.3 Removal Action Schedule

If selected, a removal action is tentatively proposed for 2015; however, the date is dependent on funding and may be subject to change by the BLM.

5.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section describes the selection of a removal action using a two–step process:

1. Identify potential removal action options and alternatives applicable to the Site and screen to eliminate ineffective or unfeasible alternatives.
2. Analyze selected removal action alternatives based on effectiveness, implementability, and cost.

Removal action technologies applicable to the Site were identified based on a review of technical literature and previous experience at similar mine sites. For evaluation of adit mine drainage treatment technologies, BLM has also conducted demonstrations of applicability of caustic addition and lime addition mechanisms at the Site (see Appendix 3). The technologies were screened to eliminate inappropriate, ineffective, infeasible or cost prohibitive methods. In addition, technologies with unproven or uncertain performance were eliminated if they had relatively high implementation costs and/or would likely require implementation with other costly mitigation components. Technologies with uncertain or unproven performance were retained if they represented potentially cost effective mitigation and the performance can be investigated through pilot or bench scale testing. All components not screened out were retained as potential technologies that could be implemented at the Site.

The technologies for both adit mine drainage and mine waste material were assessed relative to others in the same sub-category based on effectiveness, implementability, and cost. This allowed each technology to be assigned a relative ranking of high, medium, or low for each evaluation criterion. Table 3 summarizes the results of the removal action technology screening process. Table 4 summarizes the technologies retained for incorporation into removal action alternatives.

5.1 Identification and Screening of Removal Action Options and Alternatives

Potential general removal technologies and processes were identified from a review of technical literature and previous experience at similar sites. The general removal action categories include:

- **No Action** that involves leaving the site as is. The No Action alternative is used as a baseline to compare with the various alternatives.
- **Treatment** that involves the physical destruction or immobilization of contaminants.
- **Engineering Controls** that minimize uncontrolled migration and exposure to the environment.
- **Institutional Controls** that minimize or prevent public exposure by limiting access or providing public awareness.

Within each of these categories, there are several potential removal technologies to be considered. During this initial screening step, the removal actions and potential technologies were evaluated based on the following criteria:

- Effectiveness;
- Implementability; and
- Cost.

Available Site information regarding contaminant types and concentrations, and on-site physical characteristics, was used in the screening process. Two factors that commonly influence technology screening are: (1) the presence or concentration and types of contaminants that limit the applicability of many types of treatment processes; and (2) site conditions that limit the ability to install or deploy certain

technologies. Major limitations at Almeda include restricted site access, frequent high intensity floods, limited low-slope area, steep topography, remoteness, and absence of electrical power.

Although many treatment technologies and process options are available and applicable for mine waste, most are not considered feasible for remote abandoned mine sites because of high costs or unproven technologies. Many of these technologies involve a variety of techniques related to physical/chemical processes that would require extensive treatability studies to determine potential success based on site-specific conditions. Therefore, many of these technologies are cost prohibitive and were screened out on the basis of cost. The general removal technologies and process options are discussed in the following sections and are also summarized in Table 3.

5.1.1. No Action

No action consists of leaving the Site, or portions of the Site as is. This removal technology is ***retained***, as required for consideration by the NCP, and serves as a baseline for comparison with other removal actions.

5.1.2. Treatment

Treatment involves chemical, physical, and thermal processes employed to reduce the toxicity and/or volume of contaminants in the waste material. For the Site, treatment is only considered for the adit discharge stream. Treatment for mine waste material (smelter slag and waste rock) was not considered due to limited site access, unproven technology and high costs.

Contaminant discharge from the 520 Adit mine drainage to the Rogue River can be stopped by either plugging the adit completely (*e.g.* engineering control) or treating the effluent.

For evaluating treatment alternatives, the depressed pH (2.5 su to 3.23 su) indicates that neutralization by base addition will probably be necessary. Further, because there is no power on-site and none will be brought to the Site, the treatment system must be as passive and as low energy consumptive as feasible. To this end BLM scientists tested the applicability of two neutralization systems.

1. Aquafix – A system that adds solid lime to the discharge using a small Pelton Wheel driven by the discharge flow.
2. A caustic addition system developed by Ionic Water Technologies 2010.

Both systems worked and have respective advantages and disadvantages. A lime addition system such as Aquafix will produce a more dense sludge, but is chemically inefficient unless the treated effluent is thoroughly agitated to consume all lime. This is power intensive in a location that will probably mandate solar panel power. Small hydropower plants are also an option, but are likely limited by the Wild and Scenic river designation, require careful sighting and maintenance, and are vulnerable to vandalism. Caustic is more expensive, and is also more corrosive. Also, concentrated caustic freezes at 45-55 degrees F. Dilute solutions freeze at lower temperatures, but require more storage capacity. Neutralization is a well proven technology; however, the more complex concern is how to manage the generated sludge. For any treatment system, addition of a flocculent will greatly enhance settlement, and flocculent additives can further be used to sorb and remove trace dissolved metals remaining in the treated effluent discharge.

The conceptual removal alternative designs developed by Wells/MSE all follow a consistent theme: Containment followed by neutralization and flocculent addition, then sludge settling. System design must consider pipe length and chemical injection points relative to settlement location to minimize precipitant

clogging of the system. Although not fully illustrated, cleanouts are planned to maintain all piping through all proposed alternatives.

As a viable option for reducing metals treatment in the 520 Adit discharge, treatment (*i.e.* neutralization and flocculent addition, then sludge settling) is ***retained.***

Natural systems treatment (*e.g.* wetlands) were are also considered for reducing toxicity/contaminant concentrations in the adit discharge; however, they have several limitations, including:

1. All potential locations for wetlands construction appear to be within the 50-year flood plain and, therefore, subject to washout.
2. Effluent pH would have to be adjusted upward to prevent wetland destruction. Increased pH tends to cause precipitation. Therefore, the wetlands then become little more than an expensive settling basin.
3. The low flow of the adit discharge may not sustain an adequately large wetland.

For these reasons, wetland treatment was ***not retained***.

5.1.3. Engineering Controls

Engineering controls are engineered measures designed to minimize the potential for human exposure to contamination by either limiting direct contact with contaminated areas or controlling migration of contaminants through environmental media. Engineering controls typically consist of adit plug, containment, surface controls, and on-site or off-site disposal.

<u>Plug</u>
The feasibility of terminating 520 Adit discharge flow with a portal plug was evaluated by Saguaro GeoSciences, Inc. (2010). Wells/MSE engineers have reviewed the report including hydraulic conductivity estimates, which indicate that some leakage would occur. In addition, the plug is best located approximately 75 feet from the portal, which means the lithostatic load would be exceeded at approximately 50 feet water head, accounting for sidehill slope above the plug. Drill hole packer tests indicated that permeability increases rapidly prior to this depth. The latter illustrates probable significant leakage unless the head was maintained below approximately 25 feet. At this depth effluent would discharge through the “0” Level Adit, requiring the installation of another plug or discharge treatment at the “0” Level Adit. However, this would be more expensive and visible than treatment at the 520 Level with no added benefit. Non-point source leakage through the rock is also a distinct possibility as hydraulic head is increased. A complete portal-sealing plug is probably not an option for flow termination because of leakage potential and the fact that there are interconnected workings at the 620 and higher levels which contribute to acid production. In the absence of existing site constraints, the discharge issue is best approached by some combination of containment and treatment. As a potential control for adit discharge an adit plug is ***retained*** for further consideration.

<u>On-Site Disposal</u>
On-site disposal consists of excavating, consolidating and placing the untreated or treated waste materials in an engineered on-site repository or existing waste area. This applies to Bevill-exempt solid wastes from the beneficiation of ores and minerals. The disposal area design is dependent on available space for construction, toxicity, mobility, and type of waste. The design could range from simply consolidating the materials in an existing waste area to a fully-encapsulated repository with a leachate collection system.

The extensive Rogue River floodplain and presence of steep sidewalls in the valley significantly limit the available locations for an on-site repository of the size necessary to contain the mine waste. The only

suitable location that is relatively level and above the 100 year flood plain is in an area approximately 750 feet west of the 520 Adit at the access road switchback. However, this location has archeological significance from both historic mine settlement and potential Native American use. Due to the lack of a suitable area, on-site disposal is ***not retained*** for further consideration.

Containment

Containment controls are intended to eliminate direct contact and fugitive emissions from contaminated materials by placing a cover over the material. Covering mine waste material in-place can be a viable alternative when excavation and treatment or disposal costs are prohibitive. However, covering waste in place can be unfeasible on steep slopes (*e.g.* Almeda waste rock dump). In addition, the location of mine waste (smelter slag) within the 5-year flood plain limits the feasibility of a cover as it would be subject to frequent erosion. Based on the steep slopes of the mine waste rock and location of the smelter slag within the 5-year flood plain, in-place covers were ***not retained***.

Cover systems may also be employed to cap waste that has been placed in an on-site repository. However, since on-site disposal is not feasible, on-site covers were ***not retained***.

Surface Controls

Surface controls are used to minimize contaminant migration resulting from surface water and wind erosion. Typical controls include consolidation, grading, surface water containment or diversion, erosion protection, and re-vegetation. These controls alone will not eliminate direct contact with the contaminated material so they are usually used to augment other technologies such as containment or institutional controls.

Consolidation involves grouping contaminated materials of a similar type in a common area for more effective management or treatment. This can be particularly applicable at sites consisting of several small waste piles or with piles in sensitive areas such as wetlands or floodplains.

Grading consists of reshaping and compacting areas to stabilize slopes, promote run-off, and reduce infiltration. Grading usually includes the waste areas as well as peripheral areas for run-on/run-off control, site access, etc.

Surface water controls are used to divert surface water run-on and run-off around the waste materials and typically consist of diversion channels and sediment control ponds. Erosion protection, such as riprap, is usually incorporated in the surface water controls to prevent erosion of the waste materials. Erosion resistant materials, such as mulch and natural or synthetic fabric mats, may also be used in other areas to minimize water and wind impacts.

Re-vegetation generally involves the selection of appropriate plant species, preparation of the seeding area, seeding and/or planting, mulching and/or chemical stabilization, and fertilization. Re-vegetation may also involve adding a growth medium and/or soil amendments to provide nutrients and organic materials to establish vegetation. Neutralizing agents and/or additives to improve pH conditions and/or the water storage capacity of the waste may also be appropriate. Neutralizing agents such as lime, kiln dust, or limestone can be mixed to varying depths, or throughout the entire volume of waste materials. Re-vegetation is essential to controlling water and wind erosion processes and minimizing infiltration of water through plant evapotranspiration processes. Periodic maintenance may be required during the establishment of vegetation to address erosion issues, adjust soil amendments or seed mixtures, and help establish a self-sustaining plant community. Site controls may also be necessary to limit disturbance of the area until adequate vegetation can be established.

Surface controls alone may not provide adequate protection (*e.g.* may not eliminate direct contact); however, they are ***retained*** for further analysis in combination with other technologies.

Off-Site Disposal

Off-site disposal involves excavating the waste materials and transporting to an off-site disposal facility permitted to accept such materials. Off-site disposal options include an existing nearby mine waste repository, solid-waste landfill, RCRA-permitted facility, or an engineered repository. Non-Bevill exempt hazardous materials, such as mine process reagents, would require disposal in a RCRA hazardous waste facility. Less toxic materials could be disposed of in a permitted solid waste or sanitary landfill. However, it is generally not acceptable to dispose of mining waste in a sanitary landfill.

Off-site disposal of mine waste is ***not retained*** for further analysis due to the limited transport capacity of the access road, quantity of materials and distance to suitable disposal facilities, which make this alternative non-competitive on the basis of feasible equipment access and cost.

5.1.4. Institutional Controls

Institutional controls are administrative and/or legal controls that help minimize risk and/or protect the integrity of a remedy by educating the public on site risk, limiting future land use or preventing access to the site. Examples include placement of informational kiosks to inform river recreational users, locked gates on site access road to restrict site access, fencing and/or warning signs to discourage access to the site. While such controls may not effectively achieve cleanup goals, they are often used to augment other removal alternatives. Therefore, institutional controls are ***retained*** for combination with other technologies.

5.2 Components of the Removal Action Scope

Specific removal actions are required for both the adit discharge and mine waste material to achieve the following RAOs:

- Reduce or eliminate the potential risks to both human health and ecological receptors from exposure to metals in the mine waste, and human health receptors from the 520 Adit discharge.
- Reduce or eliminate potential contaminant (*i.e.* metals) loading to the Rogue River from erosion of mine waste and the 520 Adit discharge.

Technologies described and retained above (Section 5.1; Table 3) include various components of no action; treatment; engineering controls; and institutional controls. These technologies have been assembled into specific alternatives for comparative analysis and estimation of construction costs.

In addition to the No Action alternative, three potential removal action alternatives to manage mine wastes were developed from the general removal technologies retained from the preliminary screening process. These alternatives are summarized in Table 4 and described as follows:

Alternative 1 - No Action.

This alternative consists of no further action and leaving the Site as is:

- Water discharging from the 520 Adit would continue to flow untreated into the Rogue River.
- Mine waste would continue in an uncontained state.
- The public would be unaware of potential site risks.

Alternative 2 – Adit Plug with Water Treatment and Geotube Filtration with Optional Full-Seal Testing.

A conceptual mine water treatment flowsheet is presented as Figure 5. This alternative will consist of the following elements:

- Containment will be accomplished by installation of a 3-ft. thick adit plug that would preclude floodwater entry at location "0+75 feet".
- Seepage would be contained by a small portal dam for recycle to the treatment system.
- Steel doors will be installed at the portal to provide protection for the treatment system from flooding.
- Head will be controlled by selection of a standpipe in the stope behind the plug allowing greater flexibility of treatment system designs.
- Three standpipe heights will be installed (current heights are estimates only).
- The appropriate height that minimizes fracture leakage while providing adequate treatment head will be determined by field trial.
- Prior to installation of a treatment system, discharge valves will be closed to test viability of a complete sealing plug. If no leakage occurs and no discharges are induced at other locations, installation of a treatment system will be postponed, and a proposal to evaluate long-term viability of complete sealing will be developed.
- If a full seal test is not successful (*i.e.* leakage and distal discharge occur), a treatment system consisting of a caustic/polymer injection system will be installed and activated.
- Discharge will be treated with a caustic/polymer injection system.
- Treated effluent will be discharged via pipeline to nearby containerized 4'x25' GeoTube filters in a lined and covered excavation (located approximately 250 feet west of the 520 Adit) wherein sludge will densify and dewater (See Figure 5 for conceptual flowsheet).
    - The recommended excavation depth is 6 feet below ground surface to provide added treatment head and minimize visibility.
    - Total height with a roof will be approximately 12 ft. (Six ft. above grade).
    - As the GeoTubes dewater, effluent will drain from the dumpsters to the floor.
    - Seven GeoTubes will provide approximately three months of sludge storage (sludge generation rates are estimates).
- Containers will be removed in the same manner as standard garbage receptacles (dumpsters) for disposal and returned to the Site.
- The system will generate high density sludge at 15+% solids with rapid removal (according to the manufacturer).
- Because the sludge is containerized and moderately dense, it should be disposable in a Subtitle D landfill such as those near Whiterock, Oregon. This, however, must be verified.
- Secure fencing or gating will be required for human health and ecological protection.
- Effluent water from the filters will be collected in a floor drain and discharged to a drainfield protected by filters.
- A small maintenance basin will be constructed for application during filter shutdown.
- Because the dumpsters are heavy, it is unlikely they will be impacted by flooding other than requiring general cleanup.
- Sludge is unlikely to be dispersed by flooding, because it is contained within the fabric GeoTubes.
- The drainfield will act as a final treatment system and assumes the drainfield can be safely installed in lower floodplains (*i.e.* shallow bedrock is not present).
- A monitor well will be installed downgradient from the drainfield.

- Road reconstruction and maintenance will be required for the life of the plug.

Alternative 3 – Mine Waste Stabilization

The stabilization alternative consists of constructing an embankment at the bottom of the waste rock pile and reclaiming the surface of the waste rock pile above the embankment. The benched embankment would armor the toe of the slope and contain eroded sediment and divert runoff upslope from the current drainage carrying adit discharge. Figures 6 and 7 present a conceptual design of this alternative, which will consist of the following elements:

- The embankment would be sloped upstream and constructed at the toe of the waste rock dump. The embankment would be constructed with approximately 10 feet of crest reverse sloped towards the waste rock to divert runoff to the east (upstream).
- The outslope of the bench would be approximately 2:1 (H:V).
- Waste rock present below the 5 year flood plain will be consolidated and used to construct the embankment at the toe of the slope.
- Approximately one-half acre of area would be cleared of waste rock below the embankment, reclaimed with soil amendment, and re-vegetated.
- The embankment would collect eroded waste rock and divert runoff from the waste rock pile approximately 400 feet upstream from the existing adit drainage.
- The waste rock pile will also be stabilized by re-establishing biological conditions at the surface and re-vegetating the steep slope to the degree attainable. Imported biological soil amendments include solid humic shale (leonardite) at a rate of 500 pounds per acre, compost at a rate of 8 tons per acre, liquid humic acid at a rate of 10 gallons per acre, tackifier, and 1,000 pounds per acre of protein source such as spent grain.
- The access road at the top of the waste pile will be used to distribute solid biological amendments. Liquid amendment and seed will be applied via hydroseed. The waste rock pile above and below the embankment will be re-vegetated with native seed.
- Additional re-vegetation activities will include planting of willows below the constructed embankment and selected tree plantings along the slope of the waste rock pile (note: construction in the flood plain, and historic and scenic designations will need to be considered under this alternative).

Alternative 4 - Institutional Controls

This alternative will consist of the following elements:

- Signs will be posted around the mine waste (waste rock and smelter slag) and adit discharge areas to notify the public of risks of dermal contact and ingestion.
- The locked gate on the site access road will be maintained to control site access.
- Informational kiosks will be installed at selected areas frequented by river recreationists (*e.g.* Almeda County Park and BLM Smullin Visitors Center) to inform the public of site risks. Informational posters will also be distributed to area rafting and guiding businesses.

With the exception of the no action alternative, the alternatives consist of a combination of one or more general removal technologies retained during screening. The removal action alternatives are further described in Section 6.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Each of the removal action alternatives identified in Section 5 were evaluated based on the following criteria:

- Effectiveness;
- Implementability; and
- Cost.

Effectiveness is defined as the ability of an alternative (relative to other options in the same technology sub-category) to:

- Protect public health and the community, protect workers during implementation, and protect the environment – addresses whether or not the remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.
- Comply with ARARs – addresses whether or not a remedy will meet all ARARs or other federal and state environmental statutes and/or provide grounds for invoking a waiver.

Implementability encompasses the technical and administrative feasibility of implementing a removal action and the availability of resources needed to implement the removal action. It also takes into account legal considerations. Factors of particular consideration include removal action and operational feasibility; availability of equipment, personnel, and treatment capacity; community acceptance; and the ability to obtain necessary permits for off-Site actions.

- Technical feasibility – refers to construction and operational considerations, the demonstrated performance and useful life, adaptability to site-specific environmental conditions, whether it contributes to remedial performance.
- Administrative feasibility – refers to the permits required, easements or right-of-ways required, impacts on adjoining properties, the ability to implement institutional controls, and the likelihood of obtaining an exemption from statutory limits, if needed.
- Availability – includes the availability of equipment, personnel and services, outside laboratory testing services (if needed), off-Site treatment and disposal capacity (if needed).

The relative cost of each alternative was evaluated based on professional experience, engineering judgment, and standard cost estimating tools. Primary cost considerations include:

- Capital costs;
- Engineering and design costs; and
- Operation and maintenance (O&M) costs.

The comparative analysis of removal action alternatives is described in Table 5 and summarized below by criteria. State and community acceptance is considered acceptable for the purposes of this evaluation; however, will be determined during the public comment period.

<u>Effectiveness</u>

- **Alternative 1** – No Action is the least effective.
  - Effluent would continue to discharge to the Rogue River.

- Mine waste rock will continue to contribute metals load to the Rogue River.
- The discharge would also continue to pose a threat to humans and continue contributing metals loading to the Rogue River.
- Not protective of human health and the environment, and would not comply with ARARs.

- **Alternative 2** – Plug with treatment and GeoTubes plus drainfield for final effluent is highly protective of human health and environment by:
  - Precluding inundation in the adit.
  - Treating effluent and removing sludge, plus infiltrating final effluent.
  - Collecting and treating effluent and attaining most ARARs to the extent practical.
  - Removal criteria are protective of human health and the environment.
  - Most key chemical-specific ARARs would be attained:
    - Surface water discharge to the Rogue River is eliminated, complying with ARARs.
    - Sludge is containerized, limiting potential contact.
  - Compliance with Solids Disposal ARARs – Key action-specific ARARs would be attained by removing sludge from the Site.
  - Limited long-term effectiveness and permanence, because of potential inundation and system O&M requirements.
  - There is additional risk to human health and the environment during off-site transportation of mine waste from potential accidents, spills or releases at transfer points and in route.
  - High reduction in toxicity or volume through treatment.
  - Elimination of surface drainage by drainfield use.
  - No settlement basin in floodplain with attendant flooding concerns.
    - Alternative 2a – Test of complete plug to terminate discharge:
      - Precludes inundation in the adit, if successful.
      - Removal criteria are protective of human health and the environment, if successful.
      - Most key chemical-specific ARARs would be attained, if successful:
        - Surface water discharge to the Rogue River is terminated which complies with ARARs.
        - Sludge basin not required.
      - No Solids Disposal, if successful.
      - High short-term and moderate long-term effectiveness and permanence, if successful.
      - No additional risk to human health and the environment from off-site transportation of mine waste from potential accidents, spills or releases at transfer points and in route.
      - High reduction in toxicity and discharge volume, if successful.
      - No settlement basin in floodplain.
      - No sludge.

      Note: This is not an Alternative, but rather a test to determine viability of complete sealing. We view this as unlikely, but no additional cost is incurred in testing. Cost impacts are not known, because additional evaluations would be necessary to determine if a seal can actually be created, including exposing the upper adits and installing plugs and evaluating the potential for slope failure and attendant catastrophic release of large volumes of sludge and AMD.

- **Alternative 3** – Mine Waste Stabilization is moderately protective of human health and environment by:
  - Reducing surface erosion of metals in mine waste to Rogue River.
  - Reducing windblown transport of metals in mine waste.
  - Reducing contaminant transport to groundwater from surface water infiltration through use of a vegetative cover.

- Compliance with ARARs would be partially achieved.
- Surface water quality in the Rogue River would be protected because of decreased contaminant migration.
- Air quality would be improved by reducing fugitive dust emissions through re-vegetation.
- Action specific ARARs for stormwater run-off and dust suppression should be complied with through the implementation of BMPs during construction.
- Long-term effectiveness will depend on vegetative success. Selecting plant species that are shallow rooted, metal tolerant and adapted to local environment.
- The toxicity or volume of waste will not be reduced.
- Short-term effectiveness may be limited until re-vegetation is established.
- There may be short-term impacts from constructing the embankment. However, those impacts should be minimized through implementation of BMPs during removal activities.

- **Alternative 4** – Institutional Controls is moderately protective of human health and environment by:
  - Continue limiting site access from vehicle traffic along 4-wheel drive access road.
  - Reducing human exposure from mine waste and adit drainage by placement of signage to inform the public.
  - Educating the public to avoid site risk through community outreach and installation of informational kiosks at key locations utilized by river recreationalists.

Implementability

- **Alternative 1** – No Action is most technically feasible and easiest to implement.

- **Alternative 2** – Plug, treatment, GeoTubes, complex basin is difficult to implement.
  - Site access is remote and limited to only small construction equipment.
  - The services and materials required for this alternative require underground construction capabilities that are not easily obtained and readily available.
  - Construction of a reinforced plug requires special skill and equipment.
  - Ground support requires special underground experience.
  - Avoiding damage from periodic floods will be challenging.
  - Treatment system construction is a specialty.
  - GeoTube in dumpsters must be purchased from an external source.
  - Excavated and roofed facility for the GeoTube dumpsters can be readily obtained locally.
  - A filter-protected drainfield is moderately implementable.
    - Alternative 2a – Test of complete plug to terminate discharge easily implemented; however, the success is unlikely given current site constraints (This is not a true alternative, but if successful would lead to additional evaluation toward a new Alternative).
  - Fails ARARs related to construction in a flood plain.
  - Concerns regarding site vandalism and long-term maintenance of the access road.

- **Alternative 3** – Mine Waste Stabilization is moderately implementable.
  - Site access is limited to small construction equipment.
  - The services and materials for this alternative use conventional construction techniques and equipment and are readily available.
  - Construction personnel are readily available.
  - Re-vegetation and soil amendments will require special coordination and selection.

- Success of re-vegetation efforts may be difficult to implement due to steep slopes, lack of soil, south-facing aspect and low pH/metals in waste rock.

- **Alternative 4** – Institutional Controls are easily implementable.
  - A locked gate restricting vehicle access is already in-place.
  - Placement of signage is easily achieved, but will require periodic maintenance.
  - Design and placement of information kiosks will require coordination with local agencies and river recreationalists.
  - May be subject to vandalism.

Cost

The following summarizes costs for each of the alternatives. A detailed cost summary for each of the alternatives is included in Appendix 4. For comparison purposes, costs assume a five year period of operation and maintenance. An annual sinking fund is included to budget for future maintenance expenses.

- Alternative 1 – No Action is the least expensive alternative at **$0**.

- Alternative 2 – Plug, treatment, with GeoTubes is the most expensive alternative.
  - This alternative only addresses water treatment of the 520 Adit discharge.
  - Costs assume quarterly sludge removal and local disposal.
  - Costs assume a phased approach with the plug installed and tested first. If a full seal is achieved installation of the treatment system will be postponed and viability of complete sealing will be evaluated.
  - O&M will be required for the life of the project.

Item	Phase I - Plug	Phase II Treatment	Total Cost
Planning and Permitting	30,000	0$	$30,000
Construction	$586,600	$1,338,870	$1,925,470
Annual O&M	$8,640	$146,598	$155,238
Annual Sinking Fund	$8,640	$20,598	$29,238
FIVE YEAR TOTAL	**$703,000**	**$2,174,850**	**$2,877,850**

- Alternative 3 – Mine Waste Stabilization
  - This alternative only addresses the waste rock pile.

Item	Cost
Planning and Permitting	$21,000
Construction	$98,400
Annual O&M	$0
Annual Sinking Fund	$1,360
FIVE YEAR TOTAL	**$126,200**

- Alternative 4 – Institutional Controls
  - This alternative is the least expensive action alternative.

- Institutional controls would be proposed for the 520 Adit discharge, smelter slag pile and waste rock pile.

Item	Cost
Planning and Permitting	$2,000
Construction	$53,750
Annual O&M	$0
Annual Sinking Fund	$750
FIVE YEAR TOTAL	**$59,500**

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Wells/MSE recommends adoption of both Alternatives 3 and 4 for the following reasons:

1. Alternative 1 does not comply with ARARs.

2. Alternative 2 provides effective treatment of the 520 Adit discharge. However, it was not recommended due to the long term O&M at a remote location with difficult site access, long-term system reliability concerns, and high cost.

3. Alternative 3 reduces metals exposure to human and ecological receptors by removing and consolidating waste rock present below the 5 year flood plain (area most accessible to the public and wildlife) and using it to construct an embankment at the toe of the waste rock dump. The embankment will divert runoff and capture eroded sediment from the waste rock pile. The surface of the waste rock dump will be re-vegetated to help reduce erosion and wind transport of waste material. The mine waste material in the smelter slag pile is vitrified and metals are generally not mobile; therefore, no additional waste containment actions were recommended.

4. Alternative 4 will help prevent the public from contact with or drinking the 520 Adit discharge. There is no public water supply and, although water discharging from the adit exceeds ARAR-based drinking water criteria, there is no statistically significant impact to the Rogue River. In addition, the 520 Adit discharge is not considered aquatic habitat. Signs will be posted on site, informational kiosks will be installed at upstream launch sites frequented by river recreationalists, and a community outreach program will be initiated to educate the public on site drinking water risks. Signs will also be placed around the mine waste rock dump and smelter slag pile informing the public on potential health concerns.

The recommended Alternatives 3 and 4 will satisfy many of the eight factors in 40 CFR 300.415(b) as described below.

Factor	Site Condition	Satisfied?
(1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants.	Although water discharging from the 520 Adit exceeds ARAR-based criteria, there is no statistically significant impact to the Rogue River and the adit discharge is not considered aquatic habitat. Alternative 3 will reduce erosion and transport of metals from waste rock into the floodplain and Rogue River. Alternative 4 will help prevent public exposure to metals through institutional controls and community outreach. Signs will be posted on-site, informational kiosks will be installed at upstream launch sites frequented by river recreationalists, and a community outreach program will be initiated to educate the public on site risks.	Yes
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems.	There is no public water supply and, although water discharging from the 520 Adit exceeds ARAR-based drinking water criteria, there is no statistically significant impact to the Rogue River. The 520 Adit water quality is not considered aquatic habitat. Alternative 4 will help prevent the public from	Yes

	contact with or drinking the adit discharge. Signs will be posted on-site, informational kiosks will be installed at upstream launch sites frequented by river recreationalists, and a community outreach program will be initiated to educate the public on site drinking water risks.	
(3) Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release.	No hazardous substances or pollutants will be stored on-site.	Not Applicable
(4) High levels of hazardous substances, pollutants, or contaminants in soils largely at, or near, the surface that may migrate.	Metals slightly above risk based levels are present in mine waste rock and smelter slag. Waste rock will be consolidated and removed from the 5 year floodplain. The surface of the waste rock dump will be re-vegetated to reduce erosion and transport of metals. The steep slopes and installation of signs will restrict public access to the waste rock area. The smelter slag is vitrified and metals are generally not mobile. Signage will inform the public of the potential risk of dermal contact and ingestion of soil.	Yes
(5) Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released.	The slopes of the waste rock dump will be re-vegetated to reduce erosion and transport during precipitation events. An earthen embankment will be constructed at the toe of the dump to help divert runoff and capture eroded sediment. Waste rock below the 5 year flood elevation will be consolidated and used to construct the earthen embankment. The smelter slag is vitrified and metals are generally not mobile.	Yes
(6) Threat of fire or explosion.	There is no threat of fire or explosion.	Not Applicable
(7) The availability of other appropriate federal or state response mechanisms to respond to the release.	The Site is on BLM land and is being addressed by the BLM.	Yes
(8) Other situations or factors that may pose threats to public health or the environment.	No other hazards are present.	Not Applicable

The total estimated removal action construction cost for Alternative 3 and 4 is $185,700.

The proposed removal action designs presented in this EE/CA are conceptual only and not intended for construction. All material quantities are estimates only and should be verified during final design.

8.0 RECOMMENDED DATA GAP INVESTIGATION

There are several data gaps that should be investigated prior to making a final decision on Alternatives 3 and 4; these are briefly discussed as follows:

1. Agronomic properties of the waste rock material are unknown. Prior to re-vegetation design, samples should be collected and analyzed for standard suite of agronomic properties to aid in amendment selection. Estimated minimum cost is **$5,000**.
2. Alternative 3 may require some access road improvements and also incur road maintenance. An assessment should be completed to determine improvement and maintenance costs. Estimated minimum cost is **$5,000**.
3. Thickness of waste rock at the toe of the slope. Estimated minimum cost is **$5,000.**

The proposed data gap investigation costs presented in this EE/CA are conceptual only.

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REFERENCES

Abel, J.F. 2008. Letter Report To Eric Hoffman, BLM re: Almeda Mine AMD Reclamation Report Review, Independent Consultant, Golden, Colorado

BLM 1994. "Medford District Resource Management Plan" http://www.blm.gov/or/plans/wopr/rod/files/wopr_medford_RMP.pdf

BLM 2003. "Removal Site Inspection Report, Almeda Mine," Medford District Office and National Science And Technology Center, Denver, Colorado

BLM 2003. "Action Memorandum: Request For A Time Critical Removal Action At The Almeda Mine Site, Near Galice, OR (Grants Pass Resource Area), Medford District Office

BLM 2009. "Removal Action Plan Memorandum Addendum: Request For A Time Critical Removal action At The Almeda Mine Site, Near Galice, OR (Grants Pass Resource Area), Medford District Office

BLM 2010. "Summary Report: Abandoned Mine Lands Inventory Survey Of Almeda Mine On 07/21/10,"T. Christian, D. Fair, G, Aull, and W. Miller, Medford District Office, Oregon (Cultural Resources Document – not subject to FOIA)

EPA 1991. "Risk Assessment Guidance for Superfund (RAGS), Volume 1: Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals)." Interim. EPA Publication 9285.7-01B. EPA Office of Emergency and Remedial Response. Washington, DC.

EPA 1993. "Guidance on Conducting Non-Time Critical Removal Actions Under CERCLA." EPA/540/F-94-009. Washington, DC.

EPA 2000. "Mine Waste Technology Program Annual Report 2000." EPA Office of Research and Development, Cincinnati, Ohio.

EPA.2006. "National Recommended Water Quality Criteria." EPA Office of Water. Online address: http://www.epa.gov/waterscience/criteria/wqcriteria.html.

Ford 2004. "Risk Management Criteria for Metals at BLM Mining Sites, BLM Publication.

Ionic Water Technologies 2010. "Treatability Report And Feasibility Assessment For A Caustic Drip System At The Almeda Mine, Almeda Mine, Josephine County, Oregon," Reno, Nevada.

Katalyst 2010. "2010 Summer Annual Water Quality Monitoring At The Almeda Mine," Katalyst, Inc. Medford, Oregon.

Katalyst 2014. "2014 Spring Water Quality Monitoring, Year 5, at the Almeda Mine: Renewed BLM Contract: PO L12PX01875" Katalyst, Inc. Medford, Oregon.

Means, R.S., 2005. *Environmental Remediation Cost Data – Unit Price.* Reed Construction Data, Kingston, Mass. 11th Annual Edition.

NRCS 2010. Climate Data.

ODEQ 2010. Oregon Water Quality Criteria, Tables 20, 33A, 33B.

PBS 2012. "Human Health Risk Assessment Report Almeda Mine Josephine County, Oregon" PBS Engineering + Environmental, Bend, Oregon, 19p.

Saguaro GeoServices, Inc. 2002. "Report of Underground Mine Reconnaissance and Recommendations for Almeda Mine."

Saguaro GeoServices, Inc. 2007. "Report of Subsurface Exploration and Rock Characterization Field Activities 2003 – 2005."

Saguaro GeoServices Inc., 2010. "Bulkhead Feasibility Assessment, 520 Level, Almeda Mine, Josephine County, Oregon," Saguaro GeoServices, Inc., Arizona.

Soil Conservation Service 1984. Oregon Climatological Data.

U.S. Census Bureau 2010. http://quickfacts.census.gov/grd/states/41/41033.html.

U.S. Fish and Wildlife 2013. "Streamlined Ecological Risk Evaluation for the Almeda Mine Josephine County, Oregon May 2013" USFS Service – Region 6 Lakewood, CO, 46p.

Tables

TABLE 1

Soil Sample Laboratory Analytical Results - Total Metals

Bureau Of Land Management - Almeda Mine

Josephine County, Oregon

Sample Number	Aluminum	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Mercury	Nickel	Selenium	Silver	Zinc
	mg/kg												
BG-1	11,700	105 J	< 15.70	< 31.5	93.3 J	49,900	180	1,750		< 31.5	< 15.7	< 15.7	157
BG-2	3,770	174 J	< 29.2	< 58.4	107 J	96,600	374	357		< 58.4	< 29.2	< 29.2	292
BG-3	4,530	305 J	< 57.9	< 116	116 J	138,000	719	736	0.202	< 116	< 57.9	< 57.9	< 579
BG-4	28,400	211 J	< 32.5	< 65.1	236 J	85,300	519	563		< 65.1	< 32.5	7.25	325
BG-5	30,500	183 J	< 57.2	< 114	365 J	87,900	493	847		< 114	< 57.2	< 57.2	< 572
BG-6	30,700	< 33.0 J	< 33.0	< 66.1	108 J	49,800	50.9	2,590		< 66.1	< 33.0	< 33.0	< 330
BG-7	22,300	15.7 J	< 14.2	33.7	55.9 J	38,800	29.9	1,910		35.9	< 14.2	< 14.2	182
BG-8	19,500	< 12.6 J	< 12.6	< 25.2	33.5 J	31,900	< 12.6	921	< 0.111	< 25.2	< 12.6	< 12.6	< 126
BG-9	24,200	47.5 J	< 0.631	36.2	96.2 J	59,400	27.3	960		33.3	2.93	< 0.631	120
BG-10	24,100	12.7 J	< 0.583	43.7	69.6 J	45,600	17.7	1,100		36.2	< 0.583	< 0.583	115
SL-1	25,100	< 55.9	< 55.9	< 112	4,620	188,000	71.0	159		< 112	< 55.9	27.9	4,590
SL-2	14,300	276	< 65.0	< 130	3,620	171,000	227	< 130		< 130	< 65.0	419	< 650
SL-3	5,420	301	< 69.2	< 138	463	98,000	< 69.2	< 138		< 138	< 69.2	44.5	711
SL-4	27,100	50.3	< 31.2	< 62.4	4,440	52,100	78.3	279	0.272	< 62.4	< 31.2	50.0	401
SL-5	17,600	140	< 58.2	< 116	2,500	129,000	254	119		< 116	< 58.2	131	3,150
SL-6	27,800	< 55.7	< 55.7	< 111	2,500	156,000	78.0	136		< 111	< 55.7	37.3	4,800
SL-7	11,300	235	< 36.7	< 73.4	287	67,000	< 36.7	184		< 73.4	< 36.7	36.7	< 367
SL-8	51,700	70.7	< 54.8	< 110	3,690	152,000	68.5	198	< 0.0984	< 110	< 54.8	14.6	4,680
SL-9	52,000	< 53.5	< 53.5	< 107	3,050	168,000	< 53.5	179		< 107	< 53.5	14.7	2,750
SL-10	33,900	< 54.7	< 54.7	< 109	3,050	173,000	63.4	148		< 109	< 54.7	28.3	4,540
FR-1	8,180	138	< 3.42	31.9	258	37,400	430	152		26.6	7.56	42.9	167
FR-2	7,160	251	3.41	37.3	575	92,800	861	234	1.29	28.3	13.4	16.6	388
RD-1	3,220	536	< 0.609	3.30	106	45,300	653	61.7		1.92	23.5	14.4	64.9
RD-2	1,120	178	< 0.586	1.29	46.6	23,700	355	10.1		< 1.17	11.4	4.82	25.6
RD-3	4,150	266	< 0.574	2.55	63.8	31,600	380	92.1	1.36	1.86	9.55	12.2	63.9
RD-4	2,960	465	0.572	3.75	205	85,300	807	39.7		1.69	23.4	24.6	108
RD-5	8,330	308	1.79	11.5	182	63,500	834	166		8.48	26.1	45.6	535
RD-6	5,280	270	0.706	3.36	117	61,000	475	148		1.89	36.6	18.9	136
RD-7	5,620	277	0.634	4.78	176	72,000	528	110	2.56	2.32	25.4	13.5	129
RD-8	6,230	479	0.702	8.12	242	103,000	694	163		3.37	34.6	32.1	155
RD-9	15,100	108	< 0.590	23.5	183	76,300	486	368	2.46	25.1	8.71	19.9	170
RD-10	3,390	180	< 0.605	4.06	112	33,500	553	179		2.92	20.1	16.9	106
RD-11	1,930	112	< 0.636	2.66	94.2	27,200	691	26.6		2.43	22.0	25.2	101
RD-12	2,290	170	1.96	4.56	181	41,400	2,960	33.1		1.79	56.1	96.8	322
RD-13	6,790	628	1.08	3.82	328	88,900	1,050	140		3.25	40.8	35.9	185
RD-14	6,630	566	0.772	3.97	267	86,400	1,090	119		2.82	41.1	93.0	204
RD-15	10,800	494	1.18	4.72	244	73,800	740	253		3.78	19.2	47.6	243
RD-16	7,370	531	0.738	4.51	241	71,600	1,360	129	6.14	2.95	36.4	174	228
RD-17	801	20.9	< 0.584	< 1.17	9.1	7,550	164	3.32		< 1.17	3.86	3.79	13.0
RD-18	952	15.4	< 0.573	< 1.15	6.6	10,900	170	1.32		< 1.15	6.14	4.11	< 5.73
RD-19	675	5.3	< 2.95	< 5.90	< 5.90	2,900	17.6	< 5.90		< 5.90	8.88	3.60	< 29.5
RD-20	1,190	71.1	< 2.81	< 5.62	39.1	21,100	464	< 5.62		< 5.62	7.81	15.0	< 28.1
RD-21	928	284	< 2.72	< 5.45	85.0	33,500	1,050	< 5.45		< 5.45	6.73	36.7	< 27.2
RD-22	1,290	40.0	< 2.93	< 5.97	94.4	18,900	1,090	< 5.87	4.18	< 5.87	3.84	29.5	51.4
RD-23	1,010	180	< 3.17	< 6.33	78.4	50,200	776	< 6.33		< 6.33	7.50	38.5	< 31.7
RD-24	1,940	130	< 2.98	< 5.96	39.5	21,400	395	10.8		< 5.96	5.84	14.4	< 29.8

Notes:

Samples collected by PBS on 1/18/2012

BG = Background samples (BG-1 thru BG-5 Rouge Fm.; BG-6 thru BG-10 Gallice Fm.)

FR = Furnace Area

J = Estimated value based on laboratory QA/QC

RD = Rock Dump

SL =Slag Pile

TABLE 2
Surface Water Sample Laboratory Analytical Results
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Sample Number	Sample Date	Description	Flow[a] (gpm)	pH (s.u.)	SC (µS/cm)	T (°C)	Sample Matrix	Hardness	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Lithium	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorous	Potassium	Selenium	Silica	Silicon	Silver	Sodium	Thallium	Tungsten	Vanadium	Zinc
								mg/L																														
Portal Seep - BLM SI (2003)																																						
Seep 1	10-May-01	Discharge at 520 Adit Portal	ND	2.85	ND	ND	Total Rec.	374	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	ND	14.2	< 0.050	< 0.050	0.06	< 0.001	0.07	0.0340	110	< 0.005	0.435	1.990	50.9	0.290	< 0.1	24.2	1.25	< 0.00030	< 0.05	0.05	< 0.1	1.66	0.02600	41.4	19.3	0.001	10.6	ND	< 0.05	< 0.05	6.50
Seep 1	2-Nov-01	Discharge at 520 Adit Portal	5	2.94	ND	ND	Total Rec.	486	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	ND	13.4	< 0.050	< 0.050	< 0.05	< 0.001	0.135	0.0370	155	< 0.005	0.35	1.800	109	0.280	< 0.1	23.6	1.24	< 0.00030	< 0.05	0.08	< 0.1	1.78	0.03600	40.1	18.9	< 0.001	11.8	ND	0.23	< 0.05	7.54
Seep 1	6-Feb-02	Discharge at 520 Adit Portal	ND	2.6	ND	ND	Total Rec.	597	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	ND	24.5	< 0.050	< 0.050	0.007	< 0.001	0.114	0.0510	188	< 0.005	0.435	4.890	95.7	0.400	< 0.1	30.8	1.73	< 0.00030	< 0.05	0.11	< 0.1	1.87	0.04800	52.1	24.3	0.002	12.7	ND	0.37	0.12	9.64
Seep 1	18-Jun-02	Discharge at 520 Adit Portal	8	2.5	ND	ND	Total Rec.	539	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	ND	24.5	< 0.027	< 0.060	< 0.01	< 0.0006	0.115	< 0.0540	163	< 0.001	0.57	3.580	140	0.420	0.037	30.1	1.41	< 0.00030	< 0.005	1.25	< 0.009	2.03	< 0.01000	48.2	22.5	--	12.8	ND	< 0.311	< 0.001	11.2
Portal Seep - Katalyst																																						
A520	17-Nov-09	Discharge at 520 Adit Portal	8.7	3.23	1337	13.5	Total Rec.	ND	17.900	ND	1.49	ND	ND	ND	0.0530	ND	ND	ND	2.670	196	0.650	ND	ND	1.6	0.00150	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.70
							Dissolved	ND	15.2	ND	0.006	ND	ND	ND	0.0500	ND	ND	ND	2.380	65.1	0.020	ND	ND	1.55	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.64
A520	28-Jan-10	Discharge at 520 Adit Portal	11.2	3.19	1400	13.8	Total Rec.	ND	18.200	ND	0.04	ND	ND	ND	0.0494	ND	ND	ND	4.160	54.6	0.040	ND	ND	1.6	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.83
							Dissolved	ND	17.9	ND	0.023	ND	ND	ND	0.0500	ND	ND	ND	4.100	51.8	0.040	ND	ND	1.57	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.85
A520	26-Apr-10	Discharge at 520 Adit Portal	15	2.93	1655	14	Total Rec.	ND	23.000	ND	0.108	ND	ND	ND	0.0600	ND	ND	ND	5.040	100	0.120	ND	ND	1.79	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.80
							Dissolved	ND	22.8	ND	0.013	ND	ND	ND	0.0600	ND	ND	ND	5.030	78.3	0.120	ND	ND	1.81	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.40
A520	22-Jul-10	Discharge at 520 Adit Portal	12.4	3	1436	14.9	Total Rec.	ND	20.800	ND	0.06	ND	ND	ND	0.0520	ND	ND	ND	3.070	99.1	0.070	ND	ND		< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	110.7
							Dissolved	ND	20.6	ND	0.014	ND	ND	ND	0.0500	ND	ND	ND	3.250	79.7	0.070	ND	ND		< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.20
A520	12-Oct-10	Discharge at 520 Adit Portal	9.3	3.03	1424	14.9	Total Rec.	ND	16.90	ND	0.019	ND	ND	ND	0.0440	ND	ND	ND	2.39	69.0	0.049	ND	ND	1.59	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.10
							Dissolved	ND	16.80	ND	0.018	ND	ND	ND	0.0440	ND	ND	ND	2.40	68.4	0.050	ND	ND	1.59	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.83
A520	20-Jan-11	Discharge at 520 Adit Portal	13.1	2.89	1516	13.8	Total Rec.	ND	21.70	ND	0.082	ND	ND	ND	0.0540	ND	ND	ND	5.05	118	0.078	ND	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.40
							Dissolved	ND	21.10	ND	0.117	ND	ND	ND	0.0560	ND	ND	ND	5.16	102	0.080	ND	ND	1.87	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.20
A520	20-Apr-11	Discharge at 520 Adit Portal	21.5	3.01	1991	14.1	Total Rec.	ND	41.80	ND	0.185	ND	ND	ND	0.0850	ND	ND	ND	7.94	169	0.181	ND	ND	2.04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16.80
							Dissolved	ND	36.90	ND	0.126	ND	ND	ND	0.0840	ND	ND	ND	7.90	116	0.170	ND	ND	1.89	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	15.70
A520	8-Aug-11	Discharge at 520 Adit Portal	14.2	3.93	1551	14.6	Total Rec.	ND	24.00	ND	0.079	ND	ND	ND	0.0590	ND	ND	ND	4.83	95.9	0.097	ND	ND	1.62	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.80
							Dissolved	ND	24.50	ND	0.028	ND	ND	ND	0.0590	ND	ND	ND	4.69	94.8	0.100	ND	ND	1.55	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.50
A520	26-Oct-11	Discharge at 520 Adit Portal	11.8	3.03	1482	13.4	Total Rec.	ND	22.10	ND	0.059	ND	ND	ND	0.0510	ND	ND	ND	3.80	94.4	0.085	ND	ND	1.54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.90
							Dissolved	ND	20.30	ND	0.054	ND	ND	ND	0.0500	ND	ND	ND	3.88	86.3	0.080	ND	ND	1.54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.20
A520	17-Jan-12	Discharge at 520 Adit Portal	9.7	3.08	1496	10.7	Total Rec.	ND	19.10	ND	0.035	ND	ND	ND	0.0460	ND	ND	ND	3.07	82.9	0.069	ND	ND	1.44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.56
							Dissolved	ND	19.20	ND	0.035	ND	ND	ND	0.0470	ND	ND	ND	3.04	80.6	0.070	ND	ND	1.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.50
A520	27-Apr-12	Discharge at 520 Adit Portal	28.3	3.31	1850	14.3	Total Rec.	ND	32.00	ND	0.096	ND	ND	ND	0.0680	ND	ND	ND	5.42	149	0.177	ND	ND	1.75	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12.90
							Dissolved	ND	28.20	ND	0.023	ND	ND	ND	0.0680	ND	ND	ND	4.66	133	0.170	ND	ND	1.56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	11.00
A520	19-Jul-12	Discharge at 520 Adit Portal	12.7	3.00	1601	14.7	Total Rec.	ND	22.20	ND	0.048	ND	ND	ND	0.0540	ND	ND	ND	2.57	98.8	0.077	ND	ND	1.44	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.70
							Dissolved	ND	21.30	ND	0.002	ND	ND	ND	0.0520	ND	ND	ND	2.46	62.3	0.080	ND	ND	1.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.50
A520	11-Oct-12	Discharge at 520 Adit Portal	9.9	2.81	1546	14.5	Total Rec.	ND	20.30	ND	0.042	ND	ND	ND	0.0490	161	ND	ND	2.71	88.4	0.075	ND	25.4	1.37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.00
							Dissolved	ND	19.90	ND	0.004	ND	ND	ND	0.0480	143	ND	ND	2.75	60.2	0.070	ND	25.4	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.53
A520	30-Jan-13	Discharge at 520 Adit Portal	10.5	3.34	1785	13.7	Total Rec.	ND	30.20	ND	0.112	ND	ND	ND	0.0650	184	ND	ND	5.30	112	0.148	ND	35.3	1.91	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13.80
							Dissolved	ND	27.40	ND	0.098	ND	ND	ND	0.0630	198	ND	ND	4.76	121	0.150	ND	32	1.74	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13.20
A520	19-Apr-13	Discharge at 520 Adit Portal	8.7	3.09	1464	14.0	Total Rec.	ND	22.40	ND	0.066	ND	ND	ND	0.0510	173	ND	ND	3.37	97.9	0.087	ND	27.5	1.47	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.60
							Dissolved	ND	21.50	ND	0.052	ND	ND	ND	0.0520	164	ND	ND	3.20	89.1	0.090	ND	36.4	1.42	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	10.10
A520	23-Jul-13	Discharge at 520 Adit Portal	9.0	3.33	1471	15.0	Total Rec.	ND	18.40	ND	0.046	ND	ND	ND	0.0480	158	ND	ND	2.83	85.3	0.074	ND	25	1.33	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.34
							Dissolved	ND	17.30	ND	0.006	ND	ND	ND	0.0420	160	ND	ND	2.79	65.8	0.070	ND	24	1.36	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	9.44
A520	23-Oct-13	Discharge at 520 Adit Portal	9.0	3.00	1441	14.4	Total Rec.	ND	14.40	ND	0.029	ND	ND	ND	0.0420	147	ND	ND	2.40	73.0	0.056	ND	23.6	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.15
							Dissolved	ND	16.80	ND	0.021	ND	ND	ND	0.0410	155	ND	ND	2.43	74.5	0.050	ND	25.9	1.34	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.44
A520	24-Jan-14	Discharge at 520 Adit Portal	8.1	3.02	1434	13.0	Total Rec.	ND	13.20	ND	0.017	ND	ND	ND	0.0370	149	ND	ND	2.62	66.8	0.047	ND	24.1	1.37	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.82
							Dissolved	ND	12.70	ND	0.013	ND	ND	ND	0.0360	142	ND	ND	2.56	62.1	0.050	ND	23.1	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.49
A520	2-Apr-14	Discharge at 520 Adit Portal	10.4	2.73	1364	14.0	Total Rec.	ND	14.20	ND	0.018	ND	ND	ND	0.0390	165	ND	ND	2.73	69.1	0.045	ND	25.5	1.38	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.34
							Dissolved	ND	14.10	ND	0.017	ND	ND	ND	0.0390	161	ND	ND	2.91	69.1	0.040	ND	25.8	1.39	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8.50
Rogue River Upstream - BLM SI (2003)																																						
Upstream	18-Jun-02	Across river width	ND	7.22	ND	ND	Total Rec.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	38.5	0.09	< 0.027	< 0.006	< 0.011	< 0.0004	< 0.003	< 0.0006	8.11	< 0.001	< 0.001	0.002	0.072	< 0.023	0.016	3.02	0.005	< 0.00030	< 0.004	0.032	< 0.009	1.1	< 0.01000	ND	ND	< 0.0006	4.04	< 0.004	< 0.01	0.002	0.0180
Rogue River Upstream - Katalyst																																						
RRRA	23-Jul-10	Across river width	ND	6.98	82	20.8	Total Rec.	ND	0.240	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0012	0.26	0.00024	ND	ND	0.017	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.029
							Dissolved	ND	0.02	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0030	0.04	< dl	ND	ND	< dl	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
RRRA	8-Aug-11	Across river width	ND	7.98	68	16.7	Total Rec.	ND	0.199	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0008	0.196	< dl	ND	ND	0.013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
							Dissolved	ND	0.03	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0020	0.033	< dl	ND	ND	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0015
RRRA	19-Jul-12	Across river width	ND	7.06	80	17.4	Total Rec.	ND	0.209	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0010	0.146	0.00010	ND	ND	0.013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002
							Dissolved	ND	0.02	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.00071	< dl	< dl	ND	ND	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0064
RRRA	23-Jul-13	Across river width	ND	8.12	88.6	23.5	Total Rec.	ND	0.100	ND	0.00065	ND	ND	ND	< dl	8.42	ND	ND	0.00090	0.022	0.00029	ND	3.59	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
							Dissolved	ND	0.01	ND	0.00093	ND	ND	ND	< dl	8.38	ND	ND	0.00078	0.03	< dl	ND	3.34	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
Rogue River Downstream - BLM SI (2003)																																						
Downstream	18-Jun-02	Across river width	ND	7.08	ND	ND	Total Rec.	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
							Dissolved	31.5	0.054	< 0.027	< 0.006	< 0.011	< 0.0004	< 0.003	< 0.0006	7.62	< 0.001	< 0.001	0.003	,064	< 0.023	0.017	2.98	0.005	< 0.00030	< 0.004	0.032	< 0.009	1.05	< 0.01000	ND	ND	< 0.0006	3.98	< 0.004	< 0.01	0.002	0.0120
Rogue River Downstream - Katalyst																																						
RRAR	23-Jul-10	Across river width	ND	7.01	79	20.8	Total Rec.	ND	0.210	ND	0.001	ND	ND	ND	< dl	ND	ND	ND	0.0011	0.24	0.00011	ND	ND	0.017	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.047
							Dissolved	ND	0.02	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0030	0.04	< dl	ND	ND	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
RRAR	8-Aug-11	Across river width	ND	7.99	69	17.6	Total Rec.	ND	0.220	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0012	0.211	0.00013	ND	ND	0.012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005
							Dissolved	ND	0.03	ND	< dl	ND	ND	ND	< dl	ND	ND	ND	0.0007	0.033	< dl	ND	ND	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
RRAR	19-Jul-12	Across river width	ND	7.08	79	17.8	Total Rec.	ND	0.235	ND	0.00068	ND	ND	ND	< dl	ND	ND	ND	0.0010	0.174	< dl	ND	ND	0.014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002
							Dissolved	ND	0.02	ND	0.00059	ND	ND	ND	< dl	ND	ND	ND	0.00086	< dl	< dl	ND	ND	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0039
RRAR	23-Jul-13	Across river width	ND	8.37	92.2	24	Total Rec.	ND	0.107	ND	< dl	ND	ND	ND	< dl	8.32	ND	ND	0.0011	0.036	0.00011	ND	3.56	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
							Dissolved	ND	0.02	ND	0 0.001	ND	ND	ND	< dl	8.65	ND	ND	0.00093	0.171	< dl	ND	3.43	< dl	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	< dl
Criteria/ARAR (Based on average hardness of			**100.00**	**mg/L**																																		
EPA Drinking Water Criteria[3]				6.5-8.5	700	NS		NS	NS	0.006	0.01	2	0.004	NS	0.005	NS	0.1	NS	1.3	AL 0.3	0.015	AL NS	NS	0.05	0.002	NS	NS	NS	NS	0.05	NS	NS	0.1	NS	0.002	NS	NS	5
Oregon Aquatic Life Standards 02/15/05			NA	6.5-8.5	NS	NS	NA	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	1	NS	NS	NS	NS	0.000012	NS	NS	NS	NS	0.035	NS	NS	NS	NS	NS	NS	NS	NS
Oregon - Human Health (Water+Organism) 10/17/11				5-9	NS	NS		NS	NS	0.064	0.0021	1000	NS	NS	NS	NS	NS	NS	1.3	NS	NS	NS	NS	NS	NS	NS	0.14	NS	NS	0.12	NS	NS	NS	NS	0.043	NS	NS	2.1

Notes:

All laboratory analyses were performed by Nielson Laboratories, Inc., Medford Oregon

0.221 = Hilite indicates exceedence

<dl = Less than detection limit

AL = Action level

ND = Not determined or analyzed

TABLE 3
Removal Action Technology Screening Matrix
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Technology Class	Process Option	Description	Effective-ness	Implement-ability	Cost	O&M	Land Impact	Pros	Cons	Retained?
No Action										
No action	No action	Leave feature(s) as is	0	0	0	None	None	Low cost, simple	No risk reduction	**Yes**
Dam, Treatment, & Simple Basin										
Simple containment; complex treatment; simple removal	Containment dam	3-ft. high containment dam 75-ft deep in 520 Adit	Moderate	High	Moderate	Minimal	Minimal	Simple	Does not stop Rogue River flood intrusion or add head to a treatment system	**No**
	Treatment	Complex base & polymer addition w/solar power & seepage return	High	Moderate	High	Moderate to High	Minimal	Very effective	Requires chemicals, possible solar power vandalism, must be water tight for flood events, difficult to operate at remote site	**No**
	Simple proximal settlement basin	Simple excavated 2,500 cy RIB	Moderate	High	Low	High	Moderate	Simple & relatively low-cost	In floodplain, low-density sludge, highest removal/disposal costs, surface overflow discharge	**No**
Bulkhead, Treatment, & Simple Basin										
Simple containment; complex treatment; simple removal	Containment bulkhead	Full span bulkhead containment 75-ft deep in 520 Adit	Moderate	High	Moderate	Minimal	Minimal	Simple	Stops Rogue River flood intrusion, but does not add head to a treatment system	**No**
	Treatment	Complex base & polymer addition w/solar power & seepage return	High	Moderate	High	Moderate to High	Minimal	Very effective	Requires chemicals, possible solar power, vandalism, must be water tight for flood events, difficult to operate at remote site	**No**
	Simple proximal settlement basin	Simple excavated 2,500 cy RIB	Moderate	High	Low	High	Moderate	Simple & relatively low-cost	In floodplain, low-density sludge, highest removal/disposal costs, surface overflow discharge	**No**

TABLE 3
Removal Action Technology Screening Matrix
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Technology Class	Process Option	Description	Effective-ness	Implement-ability	Cost	O&M	Land Impact	Pros	Cons	Retained?
Plug, Treatment, & Simple Basin										
Complex containment; complex treatment; simple removal	Adit plug	3-ft thick concrete plug with multilevel standpipes for added head	High	Moderate	High	Moderate, pipe cleaning	None	Very effective, increase treatment system head, prevents Rogue River flood encrosion	Expensive, potential standpipe damage from adit collapse, possible non-point seepage	**No**
	Treatment	Complex base & polymer addition w/solar power & seepage return	High	Moderate	High	Moderate to High	Minimal	Very effective	Requires chemicals, possible solar power vandalism, must be water tight for flood events	**No**
	Simple proximal settlement basin	Simple excavated 2,500 cy RIB	Moderate	High	Low	High	Moderate	Simple & relatively low-cost	In floodplain, low-density sludge, highest removal/disposal costs, surface overflow discharge	**No**
Plug, Treatment, & Complex Basin/RIB										
Complex containment; complex treatment; complex removal	Adit plug	3-ft thick concrete plug with multilevel standpipes for added head	High	Moderate	High	Moderate, pipe cleaning	None	Very effective, increase treatment system head, prevents Rogue River flood encrosion	Expensive, potential standpipe damage from adit collapse, possible non-point seepage	**No**
	Treatment	Complex base & polymer addition w/solar power & seepage return	High	Moderate	High	Moderate	Minimal	Very effective	Requires chemicals, possible solar power vandalism, must be water tight for flood events	**No**
	Complex settlement basin/RIB	Dual basins downgradient, one for settlement, one for sludge densification/drying (alternating) w/discharge to drainfield	High	Moderate	High	High	High	Very effective	High visual impact, prone to Rogue River flooding. High pipeline maintenance cost, may require treatment at basins	**No**

TABLE 3
Removal Action Technology Screening Matrix
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Technology Class	Process Option	Description	Effective-ness	Implement-ability	Cost	O&M	Land Impact	Pros	Cons	Retained?
Plug, Treatment, & Geotube Filters										
Complex containment; complex treatment; complex removal	Adit plug	3-ft thick concrete plug with multilevel standpipes for added head	High	Moderate	High	Moderate, pipe cleaning	None	Very effective, increase treatment system head, prevents Rogue River flood encrosion	Expensive, potential standpipe damage from adit collapse, possible non-point seepage	**Yes**
	Treatment	Complex base & polymer addition w/solar power & seepage return	High	Moderate	High	Moderate	Minimal	Very effective	Requires chemicals, possible solar power vandalism, must be water tight for flood events	**Yes**
	Geotube filters/sludge densifiers	Incorporate dual Geotubes in metal disposal containers in subsurface concrete vault w/roof w/ discharge to drainfield	High	Moderate	High	High	Moderate	Very effective, relatively small footprint, low pipeline maintenance, limited Rogue River flooding impact, no surface discharge;	Fairly expensive, some visual impact	**Yes**
Mine Waste Removal, Off-Site Disposal										
Engineering Controls	Excavation of mine waste	Excavate mine waste	High	Low	Moderate	Not Applicable	High	Very effective	Steep slopes and very limited site access for construction equipment limit this alternative	**No**
	Off-site disposal	Haul mine waste to off-site RCRA-C permitted landfill for disposal	High	Low	High	Not Applicable	Not Applicable	Very effective	Very limited site access for construction equipment limit this alternative	**No**
Mine Waste Removal, On-Site Repository										
Engineering Controls	Excavation of mine waste	Excavate mine waste	High	Low	Moderate	Not Applicable	High	Very effective	Steep slopes and very limited site access for construction equipment limit this alternative	**No**
	On-Site Repository	Construct on-site earthen repository	Moderate	Low	Moderate	Minimal	High	Effective	Lack of suitable sites for repository and very limited site access for construction equipment limit this alternative	**No**
Mine Waste Stabilization										
Engineering Controls	Grading and run-off control	Grade and construct a bench at the toe of the waste dump to reduce erosion and transport	Moderate	Moderate	Low	Minimal	Moderate	Effective	Steep slopes and proximity of 50-year flood plain	**Yes**
	Waste amendment and revegetation	Amend mine waste areas and seed to promote revegetation	Moderate	Moderate	Low	Minimal	Minimal	Low cost	Steep slopes, limited soil development and south facing aspect reduce vegetation success	**Yes**

TABLE 3
Removal Action Technology Screening Matrix
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Technology Class	Process Option	Description	Effective-ness	Implement-ability	Cost	O&M	Land Impact	Pros	Cons	Retained?
Institutional Controls										
Access Restrictions, Community Education and Outreach	Fencing and Signs	Fences Installed around Mine Waste and signs posted to notify public of risks	Moderate	Moderate	Low	Moderate	Minimal	Low cost	Fencing not feasible in flood plain area. Visual impacts	**Yes**
	Land Use Controls	Maintain locked gate on access road to control site access	Moderate	High	Low	Minimal	Minimal	Low cost	Not effective at reducing site access to rafting public	**Yes**
	Community Education/Outreach	Provide informational kiosks to inform public (rafters) on site risks	Moderate	High	Low	Minimal	Minimal	Low cost and education of public on safety / environmental issues	May not reach all site visitors	**Yes**

Table 4

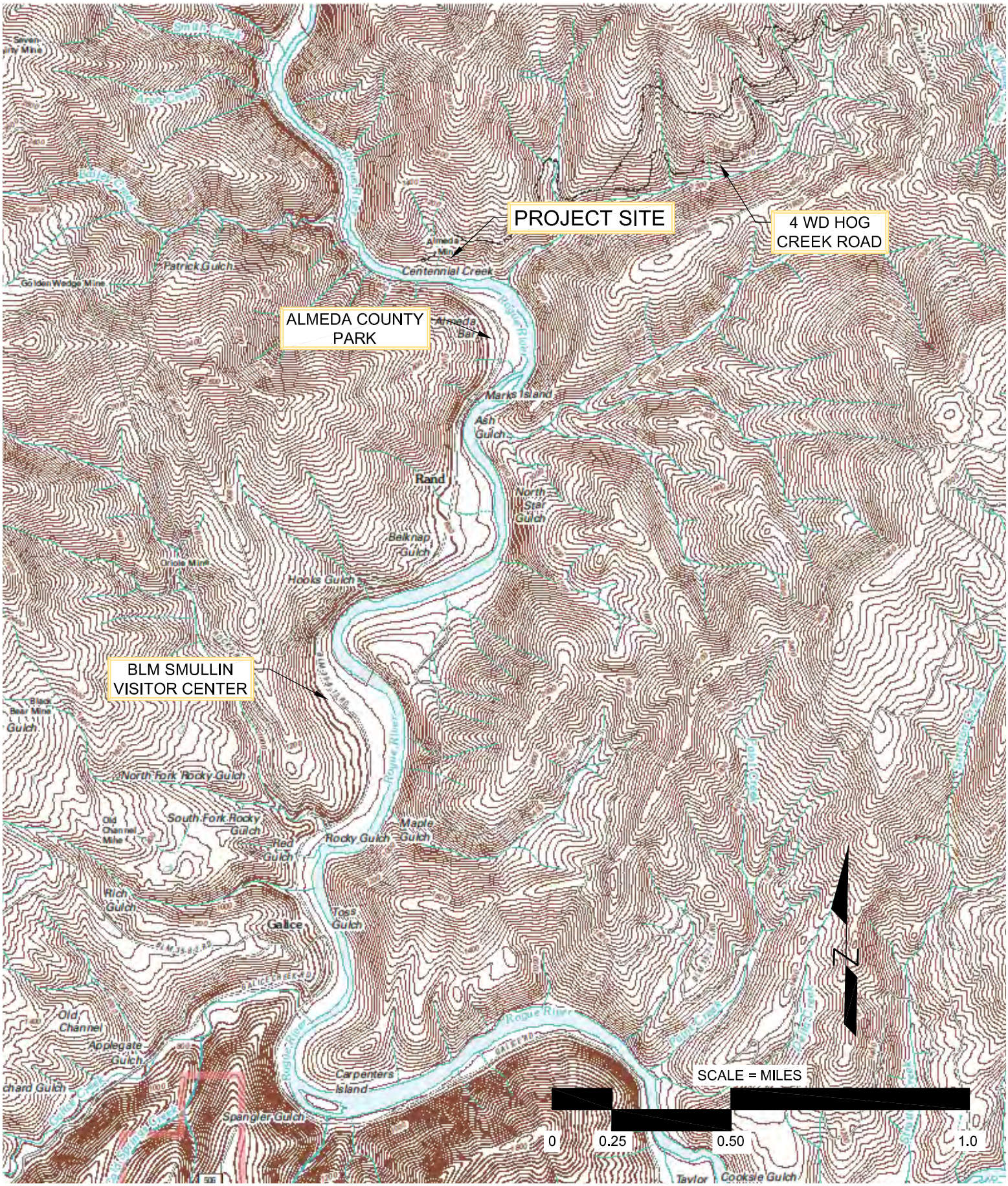
Removal Action Alternatives Developed for Analysis

Alternative		Description	Applies To
1	No Action	Site remains as is.	Entire site
2	Adit Plug, Water Treatment, Geotube Filters	A sealing plug with standpipes to add head and increase treatment option flexibility will be installed followed by a caustic/flocculent addition treatment system. All treatment equipment will be located within the adit behind secure doors to protect from periodic floods. Treatment system effluent will be piped to a GeoTube System in dumpsters with treated effluent to a subsurface drainfield. GeoTube filters are a low-pressure fabric filter system that dewaters and densifies the water system treatment sludge. The sludge will be periodically disposed of off-site.	520 Adit Discharge.
3	Mine Waste Stabilization	The stabilization alternative consists of constructing an embankment at the bottom of the waste rock pile and reclaiming the surface of the waste rock pile above the embankment. The benched embankment would armor the toe of the slope from periodic flooding by the Rogue River and contain eroded sediment from above and divert runoff upslope from the current drainage carrying adit discharge. Reclamation of the waste rock surface would be conducted by applying a mixture of solid and liquid amendments, native seed and live plants.	Waste Rock Pile.
4	Institutional Controls	Signs will be posted around the mine waste (waste rock and smelter slag) and adit discharge areas to notify the public of risks of dermal contact and ingestion. The locked gate on the site access road will be maintained to control site access. Informational kiosks will be installed at selected areas frequented by river recreationists (*e.g.* Almeda County Park and BLM Smullin Visitors Center) to inform the public of site risks. Informational posters will also be distributed to area rafting and guiding businesses.	520 Adit discharge, Smelter Slag Pile, and Waste Rock Pile.

Table 5 Comparative Analysis of Removal Action Alternatives Bureau of Land Management – Almeda Mine Josephine County, Oregon				
Assessment Criteria	**Alternative 1 No Action**	**Alternative 2 Adit Plug, Water Treatment, Geotube Filters**	**Alternative 3 Mine Waste Stabilization**	**Alternative 4 Institutional Controls**
Overall Protectiveness of Public Health, Safety, and Welfare	No protection	**High** - Eliminates exposure to adit mine drainage. Sludge is removed from the site. Treated water is discharged to subsurface drainfield.	**Moderate** - Reduces erosion and transport of metals to Rogue River during periodic river flooding and waste rock run-off. Does not significantly reduce exposure to waste material.	**Moderate to Low** - Reduces public exposure to metals in mine water/waste through community outreach and education. Not effective for ecological receptors.
Compliance with ARARs	Does not comply	**Compliant**	**Compliant**	**Compliant**
Long-term Effectiveness and Permanence	None	**Low to Moderate –** Active treatment requires ongoing and extensive O&M at remote site with limited access.	**Moderate -** Depends on vegetative success. Some maintenance required to maintain embankment over time.	**Moderate -** Signs will require periodic replacement due to vandalism and flood damage.
Reduction in Toxicity, Mobility, and Volume Through Treatment	None	**High** - Eliminates exposure to low pH and high metals concentration in adit drainage through treatment. Waste volume reduced through use of geotube filters and sludge transported off-site for disposal.	**Moderate** – Reduces mobility of metals in mine waste through re-vegetation and sediment retention. Does not reduce contaminant volume or toxicity.	**Low** – Does not reduce mobility, toxicity or volume. Applies to site access and public education. Not a treatment or reduction technology.
Short-term Effectiveness	None	**High** - Effective once the treatment system has been installed and is operating properly.	**Moderate** - Effective once the waste has been consolidated. Depends on re-vegetation success.	**Moderate** – Effective once signs and informational kiosks have been placed.
Implementability	Not applicable	**Difficult** – Relatively complex installation of treatment technology within mine adit. Use of solar power source. Uses underground construction techniques and equipment.	**Moderate -** Construction is feasible with conventional construction methods. Re-vegetation success will be difficult due to steep slopes, south facing aspect and soil conditions.	**Easy** - Implementable with placement of signs and informational kiosks. Locked road access gate in-place. Implementation of community outreach program for river recreation users.
State and Community Acceptance	Not acceptable	**Acceptable**	**Acceptable**	**Acceptable**
Cost	$0	$2,877,850	$126,200	$59,500

Figures

	DESIGNED BY **RK**	PREPARED FOR: U.S. BUREAU OF LAND MANAGEMENT MEDFORD DISTRICT 3040 BIDDLE ROAD MEDFORD, OR. 97504	E W WELLS-MSE ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES	ALMEDA MINE SITE VICINITY MAP T34S R7W S18 AND T34S R7W S13 JOSEPHINE COUNTY, OREGON	SHEET FIGURE 1
	DRAWN BY **KK**				DATE 7/02/2014
	CHK'D BY **PH**				



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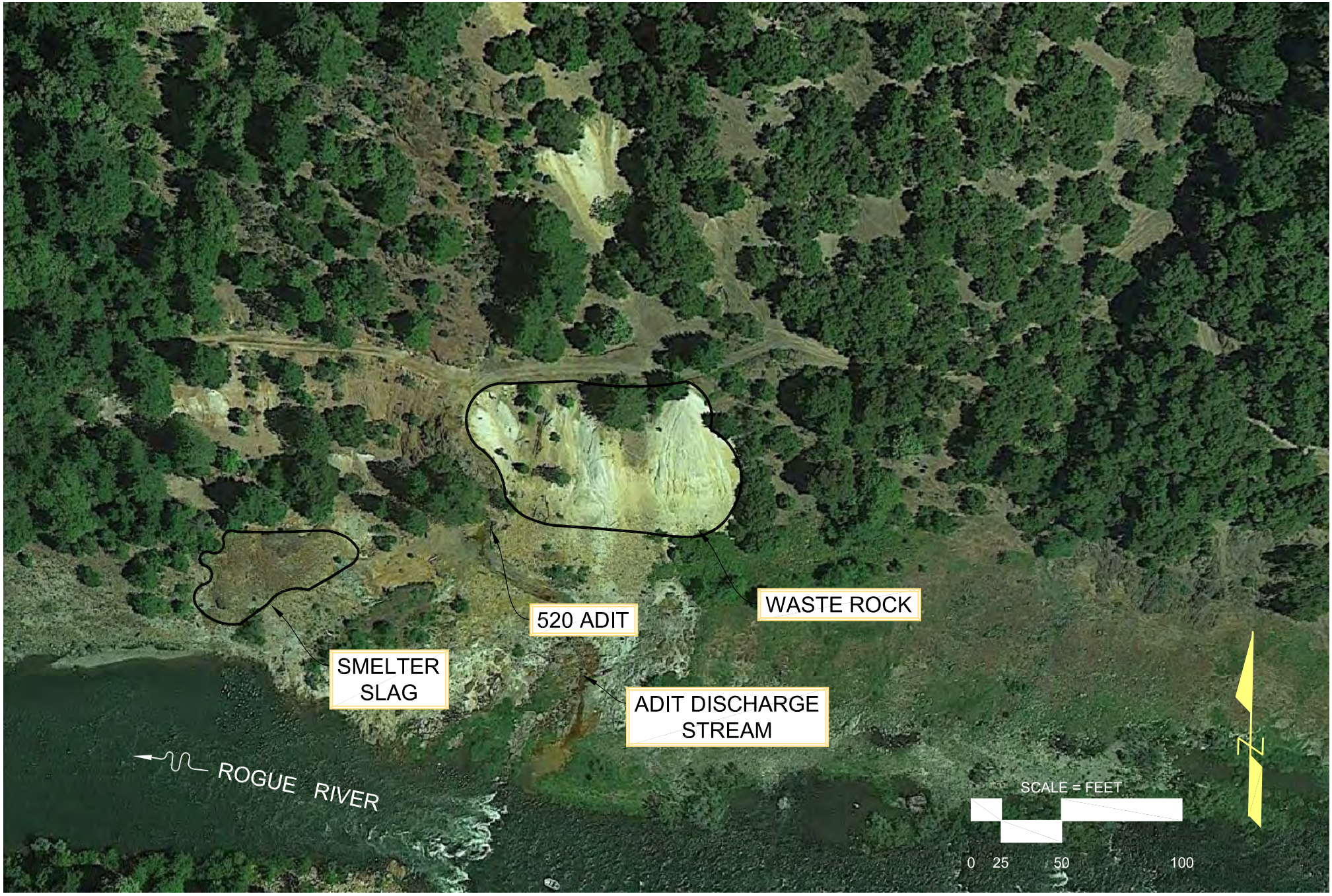
DRAWN BY KK				DATE 7/02/2014
CHK'D BY PH				



NOTES:
WASTE MATERIAL EXTENT ADAPTED FROM PBS, 2012

DESIGNED BY RK

DRAWN BY KK

CHK'D BY PH

PREPARED FOR:
U.S. BUREAU OF LAND MANAGEMENT
MEDFORD DISTRICT
3040 BIDDLE ROAD
MEDFORD, OR. 97504

E W WELLS-MSE
ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES

ALMEDA MINE SITE SITE FEATURES

T34S R7W S18 AND T34S R7W S13
JOSEPHINE COUNTY, OREGON

SHEET
FIGURE 3

DATE
7/02/2014

NOTES:
WASTE MATERIAL EXTENT ADAPTED FROM PBS, 2012
50 YEAR FLOOD LEVEL ADAPTED FROM BLM, 2003

DESIGNED BY RK
DRAWN BY KK
CHK'D BY PH

PREPARED FOR:
U.S. BUREAU OF LAND MANAGEMENT
MEDFORD DISTRICT
3040 BIDDLE ROAD
MEDFORD, OR. 97504

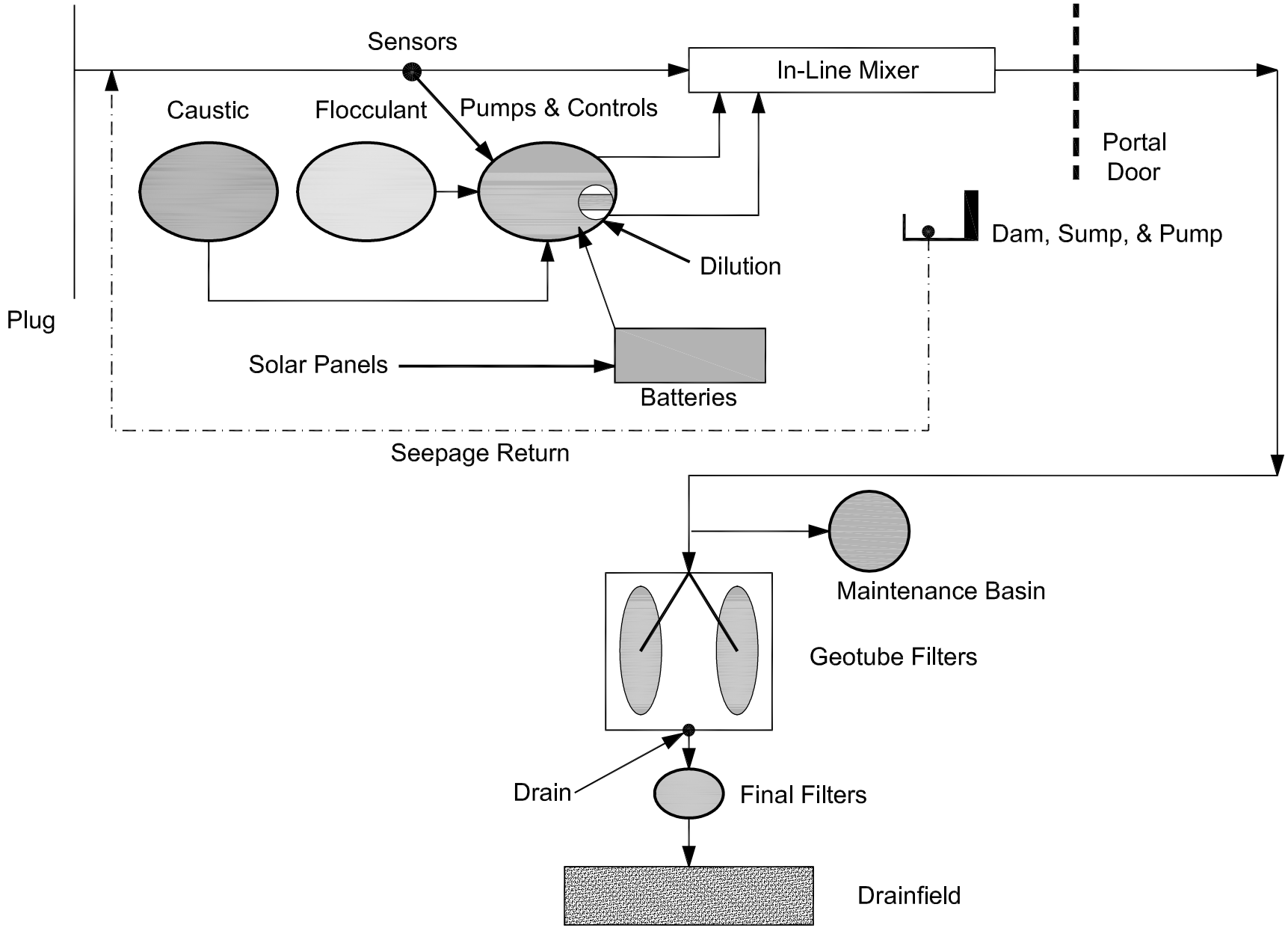
E W WELLS-MSE
ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES

ALMEDA MINE SITE
50 YEAR FLOOD LEVEL MAP

T34S R7W S18 AND T34S R7W S13
JOSEPHINE COUNTY, OREGON

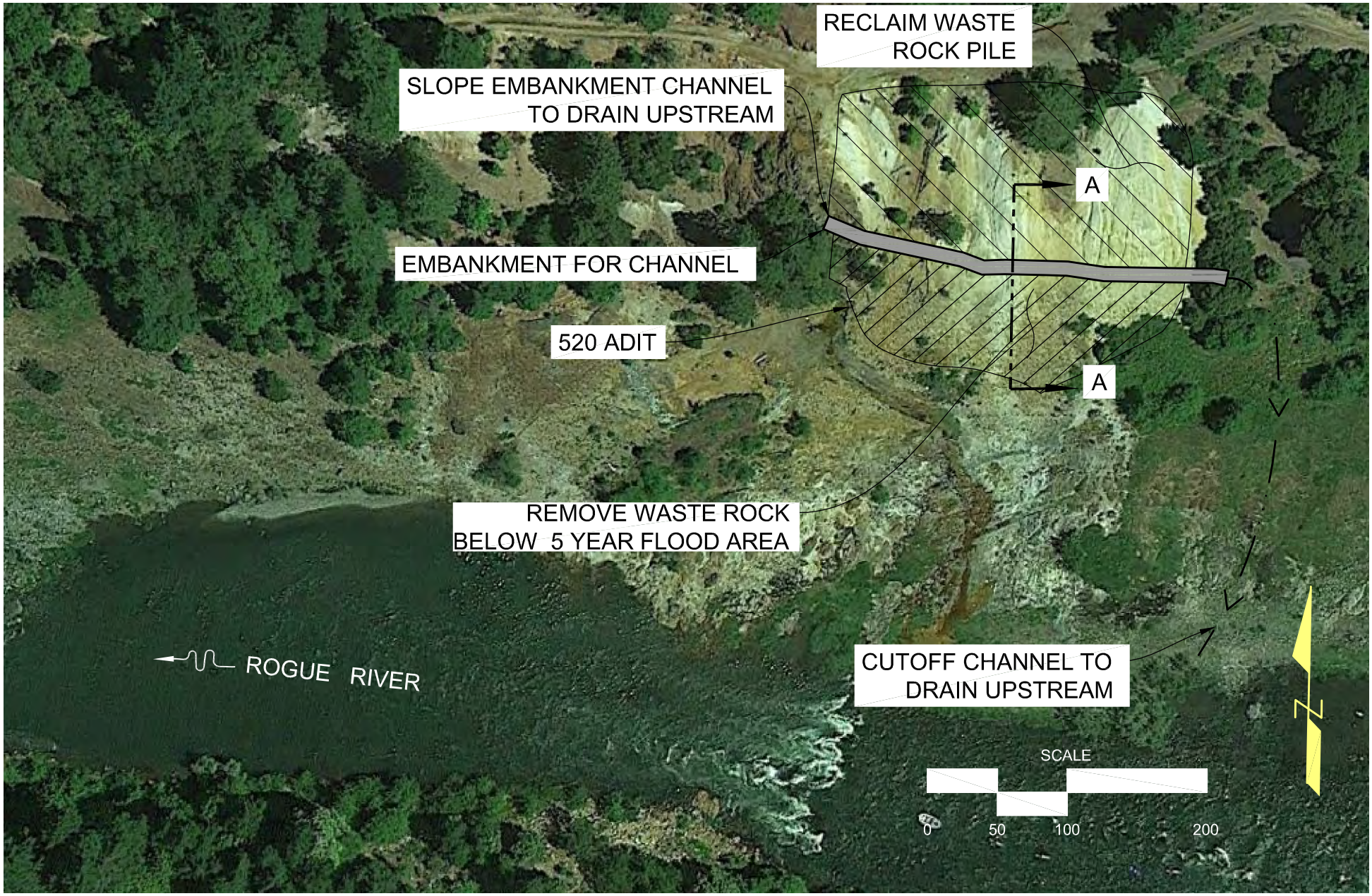
SHEET
FIGURE 4

DATE
7/02/2014

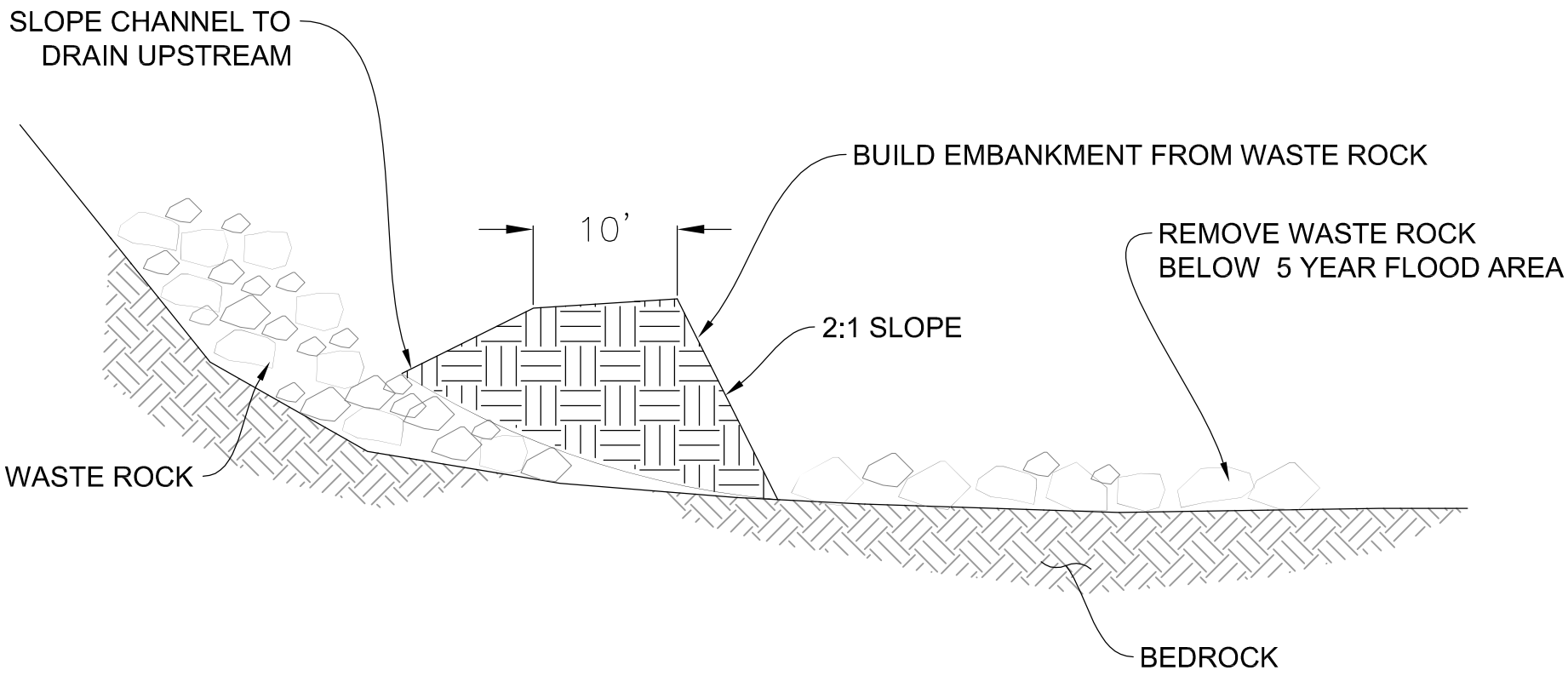


SCALE = NTS

	DESIGNED BY RK DRAWN BY KK CHK'D BY PH	PREPARED FOR: U.S. BUREAU OF LAND MANAGEMENT MEDFORD DISTRICT 3040 BIDDLE ROAD MEDFORD, OR. 97504	E W WELLS-MSE ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES	ALMEDA MINE SITE ALTERNATIVE 2 - 520 ADIT WATER TREATMENT CONCEPTUAL FLOWSHEET	SHEET FIGURE 5 DATE 7/02/2014



DESIGNED BY RK	PREPARED FOR: U.S. BUREAU OF LAND MANAGEMENT MEDFORD DISTRICT 3040 BIDDLE ROAD MEDFORD, OR. 97504	E W WELLS-MSE ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES	ALMEDA MINE SITE ALTERNATIVE 3 WASTE ROCK CONTAINMENT PLAN	SHEET FIGURE 6
DRAWN BY KK				DATE 7/02/2014
CHK'D BY PH				



	DESIGNED BY **RK**	PREPARED FOR: U.S. BUREAU OF LAND MANAGEMENT MEDFORD DISTRICT 3040 BIDDLE ROAD MEDFORD, OR. 97504	E W WELLS-MSE ENVIRONMENTAL | CONSTRUCTION | MEC SERVICES	ALMEDA MINE SITE WASTE ROCK CONTAINMENT EMBANKMENT CROSS SECTION SECTION A-A	SHEET FIGURE 7
	DRAWN BY **KK**				DATE 7/02/2014
	CHK'D BY **PH**				

Appendix 1

Site Photographs

Photo 1. – Waste Rock Dump with 520 Adit discharge in Foreground.

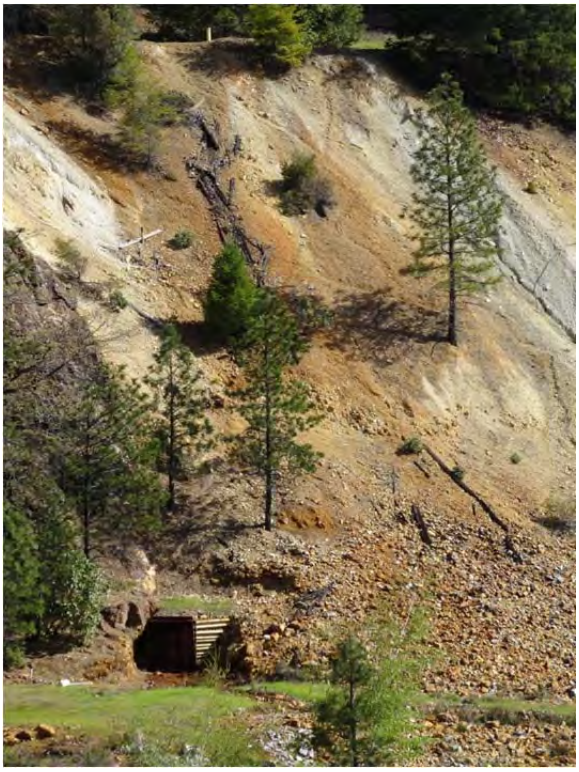


Photo 2. – Waste Rock Dump with view of 520 Adit portal.

Photo 3. – View of 520 Adit discharge flow into the Rogue River.

Photo 4. - View of 620 Adit with Bat Gate.

Photo 5. - View of Waste Rock Dump toe.

Photo 6. – View of Waste Rock Dump from above.

Photo 7. – View of 520 Adit discharge across floodplain

Photo 8. – View of Smelter Slag pile.

Photo 9. – 520 Adit with locked gate.

Photo 10. – Interior view of 520 Adit.

Appendix 2

Potential Applicable or Relevant and Appropriate Requirements

Appendix 2
Chemical-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Primary & Secondary Drinking Water Regulations	42 USC § 300f et seq. 40 CFR Part 141 40 CFR Part 142 49 CFR Part 143	No	No	No	Establishes health-based and aesthetic standards (maximum contaminant levels [MCLs]) for public drinking water systems. Groundwater will not be addressed by this removal action or any proposed removal alternatives.
National Ambient Water Quality Criteria (AWQC)	33 USC § 1314 40 CFR Part 131	Yes	No	No	Sets criteria for water quality based on toxicity to aquatic organisms and human health. The State of Oregon has been delegated this program. Applicable by reference in ORS 468B.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	42 USC § 7401 et seq. 40 CFR Part 50.6	No	No	No	Establishes air quality levels that protect public health. Sets standards on ambient concentrations of carbon monoxide, lead, nitrogen dioxide, PM_{10}, ozone and sulfur oxides. Not an ARAR—only "major" sources are subject to requirements related to NAAQS. Emissions associated with proposed removal actions will be limited to fugitive dust emissions associated with earth moving activities on site. These activities will not constitute a major source. Defer to state regulation of fugitive dust emissions. Considered applicable by reference through OAR 340-202.
National Emissions Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are anticipated for this removal action.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260-270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Defines solids wastes that are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271. Exempts mining waste from RCRA Subtitle C, Bevill exempt. Even if TCLP testing confirmed a characteristic waste (Subpart C), it is still exempt.
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258, 261.2	No	Yes	No	Regulates the storage and handling of solid waste. Wastes at this site are classified as exempt under the Bevill Amendment and therefore are considered a solid waste. Requirements for solid wastes under RCRA Subtitle D may be relevant and appropriate at this site.
Regional Screening Levels (RSL) for soil and water and air	Regional Screening Level (RSL) Table May 2010	No	Yes	No	Regional Screening Levels (RSL) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist in initial screening-level evaluations of environmental risks. RSLs should be viewed as Agency guidelines, not legally enforceable standards. They are used for site "screening" and as initial cleanup goals if applicable.
BLM Risk Management Criteria (RMC)	Technical Note 390 rev.	No	No	Yes	Suggests acceptable multimedia risk-based criteria for heavy metals as they relate to recreational use and wildlife habitat on BLM lands.

Appendix 2
Chemical-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Hazardous Waste Operations and Emergency Response (HAZWOPER)	29 CFR 1910.120 and 40 CFR 311	Yes	No	No	Worker protection during hazardous waste cleanup and CERCLA removal actions.
STATE OF OREGON					
Hazardous Substance Remedial Action Rules	OAR 340-122-0084 & 1-115	No	Yes	No	Establishes Oregon Department of Environmental Quality (ODEQ) guidelines for assessing human health and ecological risk assessments on potential adverse affects from contamination according to ODEQ risk guidelines and levels. Criteria may be relevant and appropriate for this site. however, BLM retains its CERCLA authority for work on this site.
Hazardous Substance Occupational Exposure	OAR 437	Yes	No	No	Establishes OR-OSHA Permissible Exposure Limits (PEL). OR-OSHA exposure limits mirror the federal chemical specific limits (refer to NIOSH Pocket Guide to Chemical Hazards for details on individual chemicals).
Oregon Soil Cleanup Standards	OAR 340-122-045 Residential)& OAR 340-122-046 (Industrial) ORS 465.200 through 465.455 and 465.900	No	Yes	No	Establishes standards and procedures to be used under Oregon's Environmental Cleanup Law (ORS 465.200 through 465.455 and 465.900) for the determination of removal and remedial actions necessary to assure protection of the present and future public health, safety and welfare, and the environment in the event of a release or threat of a release of a hazardous substance. Criteria may be relevant or appropriate for this site. However, BLM retains its CERCLA authority for work on this site.
Oregon Water Quality Criteria for Protection of Human Health and Aquatic Life	OAR 340-041	Yes	No	No	State of Oregon is authorized by the EPA to implement the Clean Water Act in Oregon. Establishes acceptable contaminant levels for ingestion of aquatic organisms and for intake by aquatic organisms in surface water.
Oregon Primary Drinking Water Standards	OAR 340-041	No	No	No	Health-based standards (MCL) for public drinking water systems. Groundwater is not addressed by this removal action or any proposed removal alternatives.
Oregon Water Pollution Control Statutes	ORS 468B.005 through ORS 468B.190	No	Yes	No	Addresses effluent standards, permit requirements for discharges to U.S. waters and minimum Federal water quality criteria. Covers the protection of surface water during removal activities. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Groundwater Quality Protection Program	OAR 340-040	No	No	No	Establishes the mandatory minimum groundwater quality protection requirements for federal and state agencies, cities, counties, industries, and citizens. Applicable to groundwater monitoring of a subsurface treatment system. No subsurface treatment systems are planned for this site.
Ambient Air Quality Standards and PSD Increments	OAR 340-202	Yes	No	No	Establish concentrations, exposure time, and frequency of occurrence of an air contaminant or multiple contaminants in the ambient air that must not be exceeded. Applicable to PM10 ambient air quality during removal activities.

Appendix 2
Chemical-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Oregon Emission Standards for Hazardous Air Pollutants	OAR 340-244	No	No	No	Regulates emissions of hazardous chemicals to the atmosphere from stationary sources. No stationary sources are part of this removal action.
Oregon Air Pollution Laws	ORS 468A.005-085	No	Yes	No	Provides laws governing air pollution control, abatement and prevention. Relevant and appropriate to removal action construction activities. However, BLM may invoke CERCLA authority.
Identification and Listing of Hazardous Waste	OAR 340-101	Yes	No	No	Identifies those residues which are subject to regulation as hazardous wastes. Solid waste from the extraction, beneficiation, and processing of ores and minerals are exempt under 40 CFR Part 261.4(b)(7). However, treatment sludge and discharge are not exempt.
Oregon Standards for Mining Operations	ORS 517.952-989	No	No	No	Regulations governing design, construction, operation and closure of mining operations. Not applicable to abandoned mines.

= Most Applicable ARAR

Appendix 2
Location-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
Protection of Wetlands Executive Order 11990	33 USC § 1314 40 CFR Part 6.302(a) and Appendix A	No	No	No	Minimizes impacts to wetlands. Requires Federal agencies conducting certain activities to avoid, to the extent possible, the adverse impacts associated with the destruction or loss of wetlands and to avoid support of new construction in wetlands if a practicable alternative exists. No wetlands have been identified at this site.
Floodplain Management Executive Order 11988	33 USC § 1314 40 CFR Part 6.302(b) and Appendix A	Yes	No	No	Regulates construction in floodplains. Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible. Relevant, if all or part of a treatment system or mine waste containment embankment is constructed in a floodplain.
Clean Water Act Section 404, Dredge and Fill Regulations	33 USC § 1314 33 CFR Parts 320-323 33 CFR Part 330 40 CFR Part 230	Yes	No	No	Regulates discharge of dredge or fill materials into waters of the U.S. Must take practicable steps to minimize and mitigate adverse impacts. Permits are not required for this action however the substantive portions of the regulation may be applicable.
Fish and Wildlife Coordination Act	16 USC §§ 661, et seq, 40 CFR 6.302(g)	No	No	No	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources.
Fish and Wildlife Conservation Act	16 USC §§ 2901-2912	No	Yes	No	Federal departments and agencies are encouraged to utilize their authority to conserve nongame fish and wildlife and their habitats and assist States in the development of their conservation plans, including during remedial activities.
Wild and Scenic Rivers Act	40 CFR Part 6.302(e) 36 CFR Part 297 16 USC § 1271-1287 P.L. 90-542	Yes	No	No	Establishes requirements to protect wild, scenic, or recreational rivers.
National Historic Preservation Act	16 USC § 470 et seq. 36 CFR Part 800 40 CFR Part 6.301(b) 36 CFR Part 63	No	Yes	No	Requires Federal agencies to take into account the effect of any Federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places. Regulates inventory, assessment and consultation on project effects and protection measures for cultural properties on federal lands.
The Historic and Archeological Preservation Act of 1974	16 USC § 469 40 CFR Part 6.301(c)	Yes	No	No	Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.
Native American Graves Protection and Repatriation Act.	25 USC §§ 3001-3013 43 CFR Part 10	Yes	No	No	Regulations that pertain to the identification, protection and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony. None known at Site
Historic Sites Act of 1935	16 USC §§ 461-467 40 CFR Part 6.301(a)	No	No	No	Preserves for public use historic sites, buildings, and objects of natural significance. There are no historic sites, buildings or objects of natural significance as defined in the Historic Sites Act of 1935 at the Site.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	16 USC § 470	Yes	No	No	Requires Federal agencies to consider the existence and location of potential and existing National Natural Landmarks to avoid undesirable impacts on them. None known at Site.

Appendix 2
Location-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
The Archaeological Resources Protection Act of 1979	43 CFR Part 7	No	Yes	No	Regulates requirements for authorized removal of archeological resources from public or tribal land May be relevant and appropriate if archeological resources are encountered during removal action activity.
Endangered Species Act	16 USC §§ 1531(h)-1543 40 CFR Part 6.302 (b) 50 CFR Parts 17 & 402	Yes	No	No	Regulates the protection of threatened or endangered species and critical habitat. Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat. Coho salmon are listed as a Threatened Species in the Rogue River basin.
Bald Eagle Protection Act	16 USC § 668 et seq.	Yes	No	No	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.
Migratory Bird Treaty Act	16 USC § 703 et seq.	Yes	No	No	Establishes federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.
Federal Land Policy and Management Act of 1976	43 USC § 1701	No	Yes	No	Provides for multiple use and inventory, protection, and planning for cultural resources on public lands. No cultural resources known at Site.
STATE OF OREGON					
ODNR's Plant Conservation Biology Program Plants: Wildflowers and Endangered, Threatened, and Candidate Species	OAR 603-73	Yes	No	No	Provides for protection of certain plants, wildflowers, and shrubs; guidelines on the listing, reclassification, and delisting of plant species as threatened or endangered. There are no known T&E plants at the site.
Oregon's Endangered Species Rule, Wildlife Diversity Program	OAR 635-100	Yes	No	Yes	Provides rules for maintaining Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout natural geographic ranges.
Oregon State Police Wildlife Enforcement and Penalties		No	No	Yes	Protects wildlife from detrimental actions.
Oregon Historical and Archaeological Resources Rules and Regulations	ORS 358 & 390 OAR 736-50 & 51	No	No	No	Regulations for historic and archaeological resources on State lands. No state lands at Site.
Oregon Register of Historic Places		Yes	No	No	Review of potential impacts to historic places and structures.

= Most Applicable ARAR

Appendix 2
Action-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
FEDERAL					
National Pollutant Discharge Elimination System	33 USC § 1314 40 CFR Parts 122 - 125, 131	No	Yes	No	Regulates the discharge of treated effluent and storm water runoff to waters of the U.S. Defer to ORS 468B. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Effluent Limitations	33 USC § 1311 40 CFR Part 440	No	Yes	No	Sets standards for discharge of treated effluent to waters of the U.S.
Toxic Pollutant Effluent Standards	33 USC § 1317 40 CFR Part 129	No	Yes	No	Establishes standards or sets prohibitions for certain hazardous constituents.
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328 30 CFR Part 816	No	No	No	Performance standards for surface mining activities.
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 40 49 CFR Parts 107, 171-177	No	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous material offsite to a hazardous waste landfill.
Standards Applicable to Transporters of Hazardous Waste	40 CFR Part 263	No	Yes	No	Regulates the transportation of hazardous material. May be considered relevant and appropriate for transportation of hazardous waste offsite to a hazardous waste landfill.
RCRA Subtitle C	42 USC §§ 6901-6992k 40 CFR Parts 260 - 270 RCRA Section 3001(b) (Bevill Amendment)	No	No	No	Establishes requirements for hazardous waste treatment, storage, and disposal of hazardous wastes. Excludes certain solid waste resulting from mining operations from the definition of hazardous wastes and Subtitle C requirements (Bevill Exemption).
RCRA Subtitle D	42 USC §§ 6901 et seq. 40 CFR Parts 258 & 261.2	No	Yes	No	Establishes definitions of solid wastes and establishes requirements for municipal solid waste landfills. Requirements may be relevant or appropriate for repository design.
Off-site Disposal	40 CFR Part 300.440	No	No	No	Establishes criteria and procedures for determining whether facilities are acceptable for the receipt of CERCLA wastes from response actions authorized or funded under CERCLA.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	42 USC §§ 6924 & 6925 40 CFR Part ~~264.13.14~~ 264	No	No	No	Requirements for proper handling, treatment, storage, and disposal of hazardous wastes. General regulations for the design, operation, and maintenance of hazardous waste treatment, storage, and disposal (TSD) facilities.
Closure Requirements	40 CFR Part 264, Subpart G	No	No	No	Closure of hazardous waste repositories must meet protective standards. Regulations to minimize contaminant migration, provide leachate collection and prevent contaminant exposure will be met.

Appendix 2
Action-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Landfill Design and Construction	40 CFR Part 264, Subpart N	No	No	No	Hazardous waste landfills must meet minimum design standards.
Groundwater Monitoring	40 CFR Part 264, Subparts F & X	No	No	No	Establishes standards for detection and compliance monitoring.
Criteria for Municipal Solid Waste Landfills	40 CFR Part 258 40 CFR Part 257.3-1 through 257.3-4	No	Yes	No	Establishes criteria for municipal solid waste landfills. Criteria may be relevant or appropriate for repository design, if used. Defer to OAR 340-95.
Standards Applicable to Generation of Hazardous Waste	40 CFR Part 262	No	No	No	Establishes standards for the generation of hazardous waste. Exempt through 40 CFR Part 261.4(b)(7).
Land Disposal Restrictions (LDR)	40 CFR Part 268	No	Yes	No	LDRs place specific restrictions (conc. or trmt) on RCRA hazardous wastes prior to their placement in a land disposal unit. Relevant and appropriate LDR requirements will be met if any material accumulations are treated *ex situ* .
Disposal of Solid Waste Criteria for Classification of Solid Waste Disposal Facilities and Practices	42 USC §§ 6901 et seq. 40 CFR 257	No	Yes	No	Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste. Establishes criteria for determining which solid waste disposal practices pose threats to human health and the environment. May be considered relevant and appropriate for any repository.
Occupational Safety and Health Act	29 USC §§ 651-678	Yes	No	No	Regulates worker health and safety.
Federal Mine Safety and Health Act	30 USC §§ 801-962	No	No	Yes	Regulates worker safety at active mine sites.
STATE OF OREGON					
Oregon Mined Land Reclamation Rules	OAR 632-30	No	No	Yes	Regulates permitting of surface mining activities and specifies reclamation plan requirements as part of the permitting process. Though this is applicable to permitting of surface mining activities, minimum standards for reclamation will be considered.
Solid Waste: Land Disposal Sites other than MSW Landfills	OAR 340-95	No	Yes	No	Regulates the siting, operation and maintenance of any non-municipal land disposal site. Criteria may be relevant or appropriate for the siting of a repository.
Oregon Statutes on Solid Waste Disposal and Recycling	ORS 459-459A	No	No	No	Regulates the storage and handling of solid waste.
Oregon Hazardous Waste Regulations	OAR 340-100 to 340-135	No	No	No	Regulates the storage and handling of hazardous waste.
Storage, Treatment and Disposal of Hazardous Waste	ORS 466	No	No	No	Regulates the transportation and disposal of hazardous waste.

Appendix 2
Action-specific ARARs
Almeda Mine 520 Adit

Standard, Requirement Criteria, or Limitation	Citation	Potentially Applicable	Potentially Relevant and Appropriate	To Be Considered	Description
Standards for Owner and Operators of Hazardous Waste TSDF	OAR 340-104	No	No	No	Establishes minimum State standards which define the acceptable management of hazardous waste.
Oil and Hazardous Materials Spills and Releases	OAR 340-108	No	Yes	No	Specifies the reporting requirements, cleanup standards and liability that attaches to a spill or release or threatened spill or release involving oil or hazardous material. Specified cleanup standards of hazardous substances apply to removal actions. May be relevant and appropriate for or site spills of petroleum products related to construction activities.
Oregon Soil Cleanup Standards	OAR 340-122 ORS 465.200 through 465.455 and 465.900	No	Yes	No	Establish the standards and procedures to be used under Oregon's Environmental Cleanup Law (ORS 465.200 through 465.455 and 465.900) for the determination of removal and remedial actions necessary to assure protection of the present and future public health, safety and welfare, and the environment in the event of a release or threat of a release of a hazardous substance. Criteria may be relevant or appropriate for this site. However, BLM retains its CERCLA authority for work on this site.
Regulations Pertaining to NPDES and WPCF Permits	OAR 340-45	No	Yes	No	Prescribe limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the ODEQ. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.
Well Construction Standards	OAR 690-200 & 210	Yes	No	No	Provides well construction and maintenance and construction standards applicable to water wells. Applicable to site monitoring wells.
Water Control Regulations	OAR 340-045	No	Yes	No	Regulations and statutes governing water pollution control permits, and general storm water permits. Permits are not required for this action however the substantive portions of the regulation may be relevant and appropriate.

= Most Applicable ARAR

Appendix 3

Portal and Discharge Sludge Analytical Results Summary

Appendix 3
Treatment Test Sludge Sample Laboratory Analytical Results
EPA Method 1311 Leach Procedure
Bureau Of Land Management - Almeda Mine
Galice, Oregon

Sample Number	Sample Date	Description	Procedure	Arsenic	Cadmium	Copper	Lead	Selenium	Silver	Zinc
				mg/L						
Aquafix Treatment Sludge - BLM SI (2003)										
NA	1-Jun-02	Sludge from Aquafix lime treatment system	EPA Method 1311 (TCLP)	< 0.004	0.10	3.61	0.016	0.076	0.003	25.7
Criteria/ARARs										
EPA TCLP Limits			NA	5	1	NS	5	1	5	NS
Oregon Aquatic Life Standards 02/15/05				NS	NS	NS	NS	0.035	NS	NS
Oregon & EPA - Human Health (Water+Organism) 06/01/10				2.2E-06	NS	NS	NS	0.01	NS	NS

Notes:

All laboratory analyses were performed by Nielson Laboratories, Inc., Medford Oregon

0.076 = Hilite indicates exceedence

< = Less than detection limit

NA = Not Applicable

NS = No Standard

Appendix 4

Detailed Cost Summary of Proposed Alternatives

Appendix 4
Estimated Removal Action Cost Summary
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Task	Description	Alternative 1 No Action	Alternative 2a Plug	Alternative 2b Treatment & Geotubes	Alternative 3 Mine Waste Stabilization	Alternative 4 Institutional Controls
Planning and Permitting						
Erosion Control Plan and Materials	Preparation of plans		$5,000.00	$0.00	$5,000.00	
SWPP Plan	Preparation of plans		$5,000.00	$0.00	$5,000.00	
Stream Alteration Permit Exemption	Development of project documents		$5,000.00	$0.00	$5,000.00	
Workplans/HS Plans	Preparation of plans		$10,000.00	$0.00	$4,000.00	$2,000.00
Remediation Contracting	Project contracting		$5,000.00	$0.00	$2,000.00	
	Subtotal:	**$0.00**	**$30,000.00**	**$0.00**	**$21,000.00**	**$2,000.00**
Construction/Installation Costs						
Access	Improve Site Access	-	Not Determined	Not Determined	10,000	
Mobilization	Mobilization	$ -	$ -	$ -	$ 10,000	$ 2,500
Dozer	Equipment to construct embankment				$ 6,400	
Excavator	Equipment to construct embankment				$ 5,600	
Procure and place humic shale	solid soil amendment				$ 5,000	
Procure liquid amendments/seed	liquid soil amendment and BLM approved seed mix				$ 6,000	
Hydroseed liquid amendments	application of amendments and seed				$ 5,000	
Live planting	live planting of trees/shrubs at selected locations				$ 5,000	
Road Closure	Site restoration activities				$ 5,000	
Field Oversight	Construction oversight				$ 10,000	
Procure and place signs						$ 10,000
Procure and place kiosks						$ 20,000
Implement community outreach flyer						$ 5,000
Seepage dam	Seepage dam construction	$ -	$ -	$ 5,000		
Dam Construction	Construction of 3-ft. dam or coffer dam	$ -	$ -	$ 10,000		
Mobilization	Plug construction mobilization (Assumes Colorado)	$ -	$ 60,000	$ -		
Plug construction	Installation of 3-ft. reinforced plug	$ -	$ 300,000	$ -		
Water treatment	Treatment system	$ -	$ -	$ 130,000		
Simple basin	Small basin/maintenance basin	$ -	$ -	$ 5,000		
Site road construction	Pond access road	$ -	$ -	$ -		
Pipeline	HDPE line w/cleanouts ($20/ft.+$1,000/cleanout, 300ft. & 1,100 ft.)	$ -	$ -	$ 14,000		
Discharge filters	Drainfield protection filters	$ -	$ -	$ 20,000		
Drainfield	Protected drainfield in floodplain	$ -	$ -	$ 48,000		
Geotube excavation	Excavate to 6'd x75'x50'w@$10/yd.	$ -	$ -	$ 225,000		
Geotube enclosure	In-ground concrete enclosure 6'd x75'lx30'w w/roof @ $20/sf	$ -	$ -	$ 270,000		
Geotube installation	Seven Geotubes plus containers	$ -	$ -	$ 125,000		
Monitoring well	Monitoring well installation	$ -	$ -	$ 7,500		
Contingency	20% of capital cost	$ -	$ 72,000	$ 170,400		
	Subtotal:	**$0.00**	**$ 432,000**	**$ 1,029,900**	**$ 68,000**	**$ 37,500**

Appendix 4
Estimated Removal Action Cost Summary
Bureau Of Land Management - Almeda Mine
Josephine County, Oregon

Task	Description	Alternative 1 No Action	Alternative 2a Plug	Alternative 2b Treatment & Geotubes	Alternative 3 Mine Waste Stabilization	Alternative 4 Institutional Controls
Final design	20% Subtotal	$ -	$ 86,400	$ 205,980	$ 13,600	$ 7,500
Construction oversight	10% of Subtotal	$ -	$ 43,200	$ 102,990	$ 6,800	$ 3,750
Removal Action Reporting			$ 25,000	$ -	$ 10,000	$ 5,000
	Subtotal:	**$0.00**	**$ 154,600**	**$ 308,970**	**$ 30,400**	**$ 16,250**
	Total Construction Cost:	**$0.00**	**$ 586,600**	**$ 1,338,870**	**$ 98,400**	**$ 53,750**
Treatment operations	Reagents, inspections, repair	$ -	**$ 8,640**	**$ 47,598**		
Simple basin pipeline maintenance	Scale & sludge removal	$ -	$ -	$ 12,000		
Geotube replacement	Replacement of Geotubes (28/yr.)	$ -	$ -	$ 62,000		
Sludge removal	Remove treatment sludge	$ -	$ -	$ -		
Sludge disposal	Landfill disposal	$ -	$ -	$ 25,000		
	Total O&M:	**$0.00**	**$ 8,640**	**$ 146,598**	**$0.00**	**$0.00**
Annual Sinking Fund:	Repairs & reconstruction (2% capital cost/yr., 5yr. life)	$ -	$ 8,640	$ 20,598	$ 1,360	$ 750
	Total Annual Cost:	**$0.00**	**$17,280**	**$167,196**	**$1,360**	**$750**
	TOTAL MINIMUM COST OVER 5-YEAR PERIOD =	**$0.00**	**$703,000**	**$2,174,850**	**$ 126,200**	**$ 59,500**