1.0 INTRODUCTION

Millennium Science and Engineering, Inc. (MSE) has been contracted by the U.S. Department of Agriculture Forest Service (USFS) to perform an Engineering Evaluation/Cost Analysis (EE/CA) for a contemplated non-time critical removal action at the Idol City Mine ("the site") on the Malheur National Forest.

- This EE/CA is being performed by the USFS under its cleanup authorities (42 USC 9604(a), 7 Code of Federal Regulations (CFR) 2.60(m) and Federal Executive Order 12580). The purpose of this EE/CA is to select an alternative to minimize or eliminate any release or threat of release of a hazardous substance into the environment or impact on public health and welfare as outlined in 40 CFR 300.415(b)(2)(i)-(viii).
- This EE/CA has been prepared utilizing the U.S. Environmental Protection Agency (EPA) *"Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA"* and is in general accordance with the provisions of National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300.415(b)(4)(i).
- The purpose of a removal action is to "abate, prevent, minimize, stabilize, mitigate or eliminate the release or the threat of a release" (40 CFR 300.415). The EE/CA for a removal action is intended to:
  - Satisfy environmental review requirements for removal actions;
  - Satisfy administrative record requirements for documentation of removal action selection; and
  - Provide a framework for evaluating and selecting alternative technologies.
- To meet those purposes, this EE/CA identifies objectives for the removal action and evaluates the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives.
- The primary source of data used to evaluate site conditions and potential human health and ecological risks at the site, and to develop removal action alternatives, is the Site Inspection (SI) report prepared by EA Engineering, Science, and Technology, Inc. (EA 2003). Information and analytical results presented in the SI report is referred to in this EE/CA, but is not repeated.

2.0 SITE CHARACTERIZATION

A detailed site characterization is presented in the SI (EA 2003). Please refer to the SI for additional information.

2.1 Data Gap Investigation

No additional site data were collected during this EE/CA. Climate data for the site was obtained from the Western Regional Climate Center (WRCC 2006). The nearest climate station is located in Burns, Oregon, at an elevation of about 4,150 feet. Average annual precipitation in Burns is about 11.6 inches. Annual precipitation at the site is estimated to be about 15 inches based on a review of other stations in the region and because the site is about 1,500 feet higher in elevation than Burns. The climate data is summarized in Table 1.

2.2 Source, Nature and Extent of Contamination

Based on information provided in the SI, contaminants of interest (COIs) at the site include: silver, aluminum, arsenic, barium, beryllium, cadmium, cobalt, chromium, copper, iron, mercury, manganese, nickel, lead, antimony, selenium, thallium, vanadium, and zinc. Analytical results of samples collected

during the SI indicated concentrations of several COIs were above screening levels in the mine waste/soil, sediment, pore water, and surface water. The most notable exceedances included arsenic, barium, lead, manganese, mercury, selenium, vanadium, and zinc. The highest concentrations appeared to be in mine waste from underground workings. A summary of the estimated volumes of waste rock, contaminated soil, and sediment, along with selected metal concentrations, is provided in Table 2.

A vicinity map is provided in Figure 1, and an overall site map is provided in Figure 2. The main working area (Figure 3) is near the north end of Gold Gulch and covers about 3 acres. The remainder of the site extends south up Gold Gulch for about 0.8 miles and covers about 12 acres (EA 2003). The site does not support viable fish habitat and the benthic habitat is severely limited because of the intermittent nature of Gold Gulch and Trout Creek. However, amphibian and avian species of concern (SOC) were observed on site during the SI field investigation.

The source, nature and extent of contamination at the site are briefly described in the following paragraphs by media type. Refer to the SI (EA 2003) for more detailed information and analytical results of samples collected during the SI.

Surface Water

- Nearly all COIs were elevated above background levels. The single background sample was taken from the Gold Gulch stream, about 75 feet upstream of the site, but downstream of an active mining claim and other disturbances.
- The adit discharge sample had a pH of 8.2 and a hardness of 860 milligram per liter (mg/L) calcium carbonate ($CaCO_3$). The other surface water samples had pH values ranging from 7.4 to 7.6, and hardness values ranging from 216 to 500 mg/L $CaCO_3$.
- Three COIs exceeded human health screening criteria: arsenic, iron, and manganese. The highest concentrations of these three metals were in the adit discharge sample.
- Several COIs exceeded ecological screening criteria: calcium, arsenic, barium, cadmium, copper, iron, manganese, lead, and zinc. The most notable exceedances were arsenic, barium, iron, and manganese.
- The results for several COIs were reported as analyzed for but not detected; however, because the method detection limits (MDLs) were not provided in the SI, it is unknown whether the MDLs were below screening criteria.
- Only three COIs were detected in the background sample and the sample collected from Trout Creek downstream of the site: barium, iron, and zinc. In general, COI concentrations in the downstream sample were consistent with background levels and lower than in samples collected from the site.

Sediment and Pore Water

- Two COIs in sediment exceeded human health screening criteria: arsenic and lead. All samples exceeded the arsenic criteria, and lead exceeded the criteria in one sample from Gold Gulch in the main working area.
    - Several COIs exceeded one or more ecological screening criteria: arsenic, cadmium, copper, mercury, manganese, nickel, lead, antimony, selenium, thallium, and zinc. The most notable exceedances were arsenic, copper, mercury, selenium, and zinc.
    - Nearly all COIs were elevated above background levels.
    - In general, COI concentrations in the downstream sample were consistent with background levels and lower than in samples collected from the site.
- Seven COIs in pore water exceeded ecological screening criteria: aluminum, barium, cadmium, iron, lead, manganese, and zinc. The most notable exceedance was zinc, which exceeded criteria in every sample.
    - pH values ranged from 7.2 to 8 and hardness values ranged from 216 to 580 mg/L CaCO3.
    - In general, most metals were elevated above background levels.

Groundwater

Groundwater conditions at the site are not well documented and no groundwater samples were collected during the SI. According to the SI report, "no release of hazardous substances from the site to local groundwater systems is suspected." There are no uses of groundwater at the site and the nearest well is located more than 4 miles from the site (EA 2003). Therefore, the groundwater pathway is considered incomplete.

Air

Air quality at the site has not been characterized and no air samples were collected during the SI. The most likely source of air contamination at the site is windblown dust particulates from the waste rock piles. Because COI concentrations in the waste rock were all below EPA's soil screening level for inhalation of particulates (EPA 2004a), the air pathway is considered complete but insignificant.

Mine Waste and Soil

- Mine waste and soil piles are spread throughout the Gold Gulch drainage. The mine waste appears to consist of a mixture of waste rock excavated during underground operations, dredge spoils from placer operations, tailings from milling, and overburden from exploratory trenches and surface excavations.
- Fifteen waste rock piles believed to be from underground mining and placer mining were identified in the SI. There are also several piles presumably from exploratory trenches and surface excavations.
- The total estimated volume of waste rock from underground mining (WP-1 through 15) is about 2,000 cubic yards (cy) (EA 2003).
- Waste rock pH values ranged from 2.7 to 4.2, and soil pH values ranged from 6.4 to 7.6.
- Two COIs exceeded human health screening criteria: arsenic and lead. All samples exceeded the arsenic criteria, and lead exceeded the criteria in two waste rock samples from the main working area.
- Several COIs exceeded one or more ecological screening criteria: silver, aluminum, arsenic, barium, cadmium, cobalt, chromium, copper, iron, mercury, manganese, lead, antimony, selenium, thallium, vanadium, and zinc. The most notable exceedances were arsenic, barium, iron, mercury, lead, vanadium, and zinc.
- COI concentrations in the single background soil sample are generally consistent with the other soil samples and do not appear to be representative of true background concentrations.
- The highest concentration of several COIs were in a sample from waste rock pile WP-5 in the main working area.
- Acid-base accounting (ABA) and synthetic precipitation leaching procedure (SPLP) tests were conducted on the background soil sample and three of the waste rock samples. The waste rock sample results indicated acid generating potential (AGP) values ranging from 4.4 to 14.4 kilograms of calcium carbonate per ton of waste (kg $CaCO_3$/ton) and net neutralization potential (NNP) values ranging from –12.0 to +2.3 kg $CaCO_3$/ton. According to these results, acid generation seems unlikely.

Buildings and Equipment

According to the SI, the State Historic Preservation Office (SHPO) has concurred with the USFS that the site is eligible for the National Register of Historic Places (EA 2003). There are several wooden structures on site, many of which are collapsed or partially collapsed, including:

- Main house – large wooden building near the entrance to the site
- Bunkhouse – small wooden building across Forest Service (FS) Road 630 from the main house
- Collapsed log structure – near the main house

- Small wood framed fruit cellar – near east side of main working area
- Large partially collapsed wooden head frame – in the main working area
- Collapsed log structure surrounding the open shaft – in the main working area
- Small wooden building – south end of the main working area
- Collapsed wooden building – across from open adit at south end of the site

There is also some equipment and debris on site, including:

- Trash pit filled with bottles, cans, and other debris – east side of the main working area
- Old truck with a portable ball mill – south end of the main working area
- Miscellaneous debris (logs, timber, metal, and rusted drums) primarily near the main house and in the main working area

3.0 STREAMLINED RISK EVALUATION AND ASSESSMENT

The risk evaluation process was streamlined to qualitatively evaluate rather than quantify potential risks, and to focus on identifying hot spots and developing cleanup levels. Potential risks to human and ecological receptors at the site were qualitatively evaluated by comparing COI concentrations in samples collected during the SI to Oregon state and federal risk screening criteria. Human health risk equations were used to develop risk-based hot spot concentrations and cleanup levels for mine waste and soil at the site. Risk-based hot spot concentrations and cleanup levels for sediment and surface water were not developed because they typically default to state or federal criteria.

The risk evaluations were conducted in general accordance with Oregon state and federal regulations and guidelines, including:

- Comprehensive Environmental Restoration and Compensation Liability Act (CERCLA);
- Superfund Amendments and Reauthorization Act (SARA);
- NCP 40CFR 300.415(b)(4)(i);
- EPA's *"Risk Assessment Guidance for Superfund Volume I – Human Health Evaluation Manual Part (A)",* 1991;
- Oregon Department of Environmental Quality (ODEQ) *"Guidance for Conduct of Deterministic Human Health Risk Assessment"* (2000a); and
- ODEQ *"Guidance for Ecological Risk Assessment"* (2001).

The streamlined human health and ecological risk evaluations are discussed in the following sections, and the hot spot assessment and cleanup levels are discussed in Section 4.3.

3.1 Streamlined Human Health Risk Evaluation

Human health risks were qualitatively evaluated to assess potential hazards and risks to human receptors from exposure to mine waste and contaminated media at the site. The risk evaluation used analytical data and other information gathered during the SI by EA in 2003, and site-specific exposure factors (EFs) based on the anticipated receptors and future land uses. Analytical results from the SI were tabulated and COI concentrations in all media were compared to Oregon state and federal risk screening criteria. The human health risk evaluation also involved identifying potentially exposed populations and exposure pathways at the site, human health contaminant of potential concern (COPC) screening, and developing a set of EFs and assumptions for use in the risk-based cleanup level calculations.

3.1.1 Potential Receptors and Exposure Routes

The site is in a relatively remote location with limited human access. Recreational use of the site likely includes hiking, hunting, and camping. The site may also be occasionally used for cattle grazing. Although the site is inactive, there may be mining on nearby active claims. Future uses of the site are expected to remain the same as current uses, and residential development of the site is unlikely; therefore, the risk of long-term exposure to contaminants at the site is considered low.

The primary receptors most likely to visit the site are an adult recreationalist and a worker (such as a cattle worker or USFS field staff). Potential exposure pathways at the site include:

- Incidental ingestion of mine waste (waste rock), soil, and sediment;
- Incidental ingestion of surface water;
- Dermal contact with mine waste, soil, surface water, and sediment; and
- Inhalation of mine waste particulates.

Other potential pathways, such as groundwater, plant, and fish tissue ingestion were determined to be incomplete or insignificant. The groundwater pathway is considered incomplete because there are no groundwater uses at the site and the nearest well is more than 4 miles away. While palatable plants inhabit the site and may contain elevated levels of metals, the fruit is relatively small and it is unlikely that a large quantity would be consumed. It's also unlikely that the site will be used for agricultural cultivation; therefore, plant ingestion was determined to be a potentially complete but insignificant pathway. Ingestion of fish is considered to be an incomplete pathway because no fish were observed in Gold Gulch or Trout Creek during the SI, and neither stream appears to support a viable fish habitat.

3.1.2 Contaminants of Potential Concern

Analytical results of mine waste, sediment, and surface water samples collected during the SI were screened in accordance with EPA guidance (EPA 2001) to identify COPCs. Analytical data from the site for each media were screened to identify site-specific COPCs on the basis of:

- Frequency of Detection – COIs detected in fewer than 5 percent of the samples site-wide for a given media were eliminated from further screening.
- Comparison with Background Concentrations – COIs with maximum detected concentrations (MDCs) below background concentrations were eliminated from further screening.
- Comparison to Screening Critiera – The COI MDCs were compared to EPA Region 9 Industrial Soil preliminary remediation goals (PRGs) and Tap Water PRGs (2004b); industrial soil criteria were used for mine waste and sediment because there are no established criteria for a recreational use scenario and residential development of the site is unlikely. The concentration risk screening also evaluated potential cumulative effects from exposure to individual COIs across multiple media, as well as exposure to multiple COIs within each media and across multiple media.

The screening process is summarized in Table 3. Four COPCs were identified: arsenic, iron, lead, and manganese. Arsenic and lead were identified as COPCs in soil (waste rock) and sediment; arsenic and manganese were identified as COPCs in surface water. A fourth COPC, iron, was identified based on cumulative exposure to multiple media.

3.1.3 Physical Hazards

According to the SI (EA 2003), physical hazards at the site include:

- Open and collapsed adits and shafts;
- Collapsed or unstable structures and head frame; and
- Miscellaneous equipment and debris.

3.1.4 Potential Human Health Risk Screening

Potential human health risks at the site were qualitatively evaluated by comparing COI concentrations in the samples collected during the SI to Oregon state and federal human health risk screening criteria. Because human health screening criteria for sediment have not been established, soil-screening criteria were used, although the anticipated land uses do not typically involve significant exposure to sediment. Oregon defaults to EPA Region 9 Industrial Soil PRGs as the acceptable human health risk-based concentrations for industrial land use (ODEQ 2005). Industrial PRGs were used because there are currently no available screening criteria for a recreational-based scenario. However, it should be noted that the industrial PRGs are based on an exposure frequency of 250 days per year which is much greater than the anticipated land use; therefore, these criteria should provide a very conservative estimate of potential risk at the site. The PRGs are based on a chronic non-carcinogenic hazard quotient (HQ) of 1, and an excess cancer risk (ECR) of 1.E-06 (EPA 2004a). PRGs for soil and sediment were taken from EPA Region 9's Industrial Soil PRG Intercalc Tables (2004a), which provide separate acceptable risk level concentrations for each exposure pathway:

- Ingestion,
- Dermal contact, and
- Inhalation of particulates.

The human health risk screening criteria for surface water consisted of:

- EPA's recommended chronic ambient water quality criteria (AWQC) for human consumption of water and fish (EPA 2004c); and
- Oregon's Human Health Water Quality Criteria for water and fish consumption (ODEQ 2005).

Although these criteria are the same for many contaminants, there are a few differences. It should be noted that these criteria are conservative because they include risk from consumption of fish and surface water at the site does not support a viable fish habitat.

The results of the human health risk screening are summarized in Table 4 and described below by media type. To assist in the risk evaluation, relative risk classifications were developed based on the following:

- Contaminant MDC < screening criteria = no risk
- Contaminant MDC = 1 to 10X screening criteria = relatively low risk
- Contaminant MDC = 10 to 100X screening criteria = relatively moderate risk
- Contaminant MDC > 100X screening criteria = relatively high risk

Soil and Mine Waste

- Arsenic and lead were identified as COPCs in soil and waste rock at the site.
- Arsenic poses the highest relative risk (601 times the screening criteria); concentrations exceeded the EPA Industrial Soil PRG (1.6 milligram per kilogram [mg/kg]) in every sample and ranged from 26.2 to 961 mg/kg.
- Based on a background arsenic concentration of 107 mg/kg, exposure to arsenic in native soils at the site may also pose a human health risk; however, relatively high concentrations of several

metals in the single background sample suggests the sample may not accurately represent actual background levels.

- Lead poses moderate relative risk (32 times the screening criteria); concentrations exceeded the EPA Industrial Soil PRG (800 mg/kg) in two samples from two waste rock piles in the main working area: WP-5 = 25,300 mg/kg, and WP-3 = 1,360 mg/kg.

Sediment

- Arsenic and lead were identified as COPCs in sediment at the site.
- Arsenic poses the highest relative risk (319 times the screening criteria); concentrations exceeded the EPA Industrial Soil PRG (1.6 mg/kg) in every sample and ranged from 20.3 to 510 mg/kg. At these concentrations, arsenic presents both a non-carcinogenic hazard from ingestion, and carcinogenic risk from ingestion and dermal contact.
- Based on a background arsenic concentration of 46 mg/kg, exposure to arsenic in background stream sediments at the site may also pose a human health risk; however, relatively high concentrations of several metals in the single background sample suggests the sample may not accurately represent actual background levels.
- Lead poses a low relative risk (1.5 times the screening criteria); lead concentrations exceeded the EPA Industrial Soil PRG (800 mg/kg) in one sample from the Gold Gulch stream.

Surface Water

- Arsenic and manganese were identified as COPCs in surface water at the site.
- Arsenic in surface water poses a relatively high risk from ingestion (nearly 20,000 times the screening criteria); detected concentrations exceeded both Oregon and EPA screening criteria (0.018 and 0.0022 microgram per liter [μg/L], respectively) in three samples:
  - Adit discharge,
  - Big pond, and
  - Gold Gulch stream in the main working area.
- Arsenic concentrations in the three remaining samples were reported as not detected; however, the reporting limit (4.8 μg/L) is several orders of magnitude above the screening criteria.
- Manganese concentrations in the same three samples were also above screening criteria (both 50 μg/L); however, manganese is a secondary pollutant based on cosmetic or aesthetic effects (taste, odor, color, etc.) rather than adverse health effects.
- Iron concentrations in the adit discharge sample also exceeded screening criteria (both 300 μg/L). However, like manganese, iron is a secondary pollutant and likely does not pose a significant health risk.

Multiple Media

- Arsenic, manganese, lead, and iron were identified during the screening process as COPCs based on cumulative exposure to multiple media at the site. However, in all media, the maximum detected iron concentrations were well below human health risk screening criteria. Therefore, iron does not appear to pose a risk to human receptors at the site.

3.1.5 Human Health Risk Summary

There appears to be significant potential risk to human receptors at the site from exposure to arsenic and lead in the soil, mine waste, and sediment; and arsenic in surface water. Arsenic concentrations exceeded human health screening criteria in nearly all samples collected during the SI, and very high lead concentrations were observed in a few mine waste and sediment samples. The most significant exposure pathway appears to be ingestion of arsenic in mine waste, soil, sediment, and surface water at the site. Dermal contact with arsenic in soil, mine waste, and sediment also poses a potential health risk. There

also appears to be isolated risk from exposure to lead at the site, particularly in the main working area. Dermal contact with surface water and inhalation of soil particulates does not appear to pose a risk to human receptors at the site.

3.2 Ecological Risk Assessment

A streamlined ecological risk evaluation was completed to qualitatively evaluate potential risk to ecological receptors at the site from exposure to COIs in soil and mine waste, surface water, sediment, and pore water. The SI was reviewed to determine whether there are sensitive environments or threatened and endangered (T&E) species in the area, and to identify potential ecological receptors and exposure pathways at the site. Potential ecological risks were qualitatively evaluated by comparing maximum COI concentrations in samples collected during the SI to Oregon state and federal ecological risk screening criteria. COIs with MDCs exceeding the screening criteria were identified as contaminants of potential ecological concern (CPECs). The sensitive environments, T&E species, ecological risk screening and results are discussed in the following sections.

3.2.1 Sensitive Environments

According to Oregon Administrative Rule (OAR) 340-122-045, a sensitive environment is *"an area of particular environmental value where a hazardous substance could pose a greater threat than in other non-sensitive areas. Sensitive environments include but are not limited to: critical habitat for federally endangered or threatened species; National Park, Monument, National Marine Sanctuary, National Recreational Area, National Wildlife Refuge, National Forest Campgrounds, recreational areas, game management areas, wildlife management areas; designated federal Wilderness Areas; wetlands (freshwater, estuarine, or coastal); wild and scenic rivers; state parks; state wildlife refuges; habitat designated for state endangered species; fishery resources; state designated natural areas; county or municipal parks; and other significant open spaces and natural resources protected under Goal 5 of Oregon's Statewide Planning Goals."*

Based on this definition, sensitive environments within the locality of the site include:

- Jurisdictional emergent and riverine wetlands in Gold Gulch and along Trout Creek; and
- Habitat of various federally T&E species, as well as candidate and SOC that occur within Harney County and may be potentially present on site.

3.2.2 Threatened and Endangered Species

According to the SI, several sensitive or T&E species are listed for Harney County and have the potential to inhabit or traverse the site. In addition, four sensitive species were observed during the site visit conducted by EA in July 2003, including: *Dryocopus pileatus* (pileated woodpecker), *Picodies arcticus* (Black-backed woodpecker), *Rana aurora* (red-legged frog), and *Rana pretisoa* (spotted frog). A list of T&E and SOC wildlife and plant species potentially occurring in Harney County was obtained from the Oregon Natural Heritage Program (ORNHP 2006) and is presented in Appendix A. Trout Creek and Gold Gulch do not support fisheries habitat; therefore, T&E fish species are not listed. The grizzly bear and gray wolf are not likely to inhabit central Oregon due to the isolation of these species to recovery areas in Idaho, Montana, Wyoming, and northern Washington. Selected species are listed below and a complete list is provided in Appendix A.

- Federal Species Listed as Threatened:
  - Ursus arctos horribilis (Grizzly Bear)
  - Canis lupus (Gray Wolf)

    - Haliaeetus leucocephalus (Bald Eagle)
- Federal Species Listed as Candidate or Species of Concern:
    - Rana luteiventris (Columbia spotted frog)
    - Ovis Canadensis nelsoni (Desert Bighorn Sheep)
    - Accipiter gentiles (Northern goshawk)
    - Athene cunicularia hypugaea (Western burrowing owl)
    - Buteo regalis (Ferruginous hawk)
    - Centrocercus urophasianus (Greater Sage Grouse)
    - Oreortyx pictus (Mountain quail)
    - Several myotis and bat species

3.2.3 Potential Ecological Receptors and Exposure Routes

Potential ecological receptors at the site include terrestrial wildlife (plants, birds, invertebrates, reptiles, amphibians, and mammals) and aquatic biota (invertebrates). No fish were observed during the SI and the site does not appear to support a viable fish habitat. Several of the potential receptors may be sensitive or T&E species as discussed above. Ecological exposure pathways at the site consist of:

- Incidental ingestion of waster rock, soil and sediment;
- Direct contact with waste rock, soil, sediment, surface water, and pore water; and
- Ingestion of surface water.

3.2.4 Potential Ecological Risk Screening

Contaminant concentrations in soil, surface water, pore water, and sediment samples collected during the SI were compared to Oregon state and federal ecological risk screening criteria.

- The maximum detected COI concentrations in soil and mine waste were compared to:
    - EPA's Ecological Soil Screening Levels (ECO-SSLs) (2005); and
    - Oregon Level II Ecological Screening Level Values (SLVs) for Soil (ODEQ 2001).
- The maximum detected COI concentrations in surface water and pore water were compared to:
    - EPA Recommended Chronic AWQC for Freshwater Aquatic Life (2004b);
    - Tier II Secondary Chronic Values (NOAA 1999);
    - Oregon AQWC, Freshwater Chronic Criteria (ODEQ 2005);
    - Oregon Level II SLVs for Surface Water (ODEQ 2001); and
    - Oak Ridge National Laboratory (ORNL) Ecological Screening Levels for Freshwater (Suter and Tsao 1996).
- The maximum detected COI concentrations in sediment were compared to:
    - EPA Threshold Effects Levels (TELs);
    - EPA Probable Effects Levels (PELs) (NOAA 1999);
    - Oregon Level II SLVs for Sediment (ODEQ 2001); and
    - ORNL Ecological Screening Levels for sediment (Efroymson 1997).

Contaminants with MDCs above ecological risk screening criteria were identified as CPECs (Table 5). The results of the ecological risk screening are summarized in Table 6 and described below by media type. To assist in the risk evaluation, relative risk classifications were developed based on the following:

- Contaminant MDC < screening criteria = no risk
- Contaminant MDC = 1 to 10X screening criteria = relatively low risk
- Contaminant MDC = 10 to 100X screening criteria = relatively moderate risk
- Contaminant MDC > 100X screening criteria = relatively high risk

Soil and Mine Waste

- Seventeen COIs in mine waste and soil exceeded the ecological risk screening criteria and were identified as CPECs: silver, aluminum, arsenic, barium, cadmium, cobalt, chromium, copper, iron, mercury, manganese, lead, antimony, selenium, thallium, vanadium, and zinc.
  - CPECs posing a relatively high risk to one or more ecological receptors include aluminum, iron, mercury, and lead.
  - CPECs posing a relatively moderate risk to one or more ecological receptors include silver, arsenic, barium, cadmium, manganese, thallium, vanadium, and zinc.
  - Cobalt, chromium, copper, antimony, and selenium pose relatively low risk (less than 10 times the screening criteria).
- Plants are the most sensitive receptor with relatively high risk from aluminum, iron, mercury, and lead; and moderate risk from silver, arsenic, thallium, vanadium, and zinc. Iron poses the highest risk with an MDC more than 4,500 times the screening criteria.
- Invertebrates are also sensitive with relatively high risk from iron and mercury, and moderate risk from aluminum, manganese, lead, and zinc. Mercury poses the highest risk with an MDC more than 1,000 times the screening criteria and a tendency to bioaccumulate.
- Birds are posed with relatively high risk from lead, and moderate risk from aluminum, arsenic, barium, cadmium, mercury, and zinc. The lead MDC is 2,300 times the screening criteria.
- Mammals are the least sensitive receptor with relatively high risk from aluminum and lead, and moderate risk from arsenic, cadmium, and thallium. The lead MDC is more than 500 times the screening criteria.

Sediment

- Ten COIs in sediment exceeded the ecological risk screening criteria and were identified as CPECs: arsenic, cadmium, copper, manganese, nickel, lead, antimony, selenium, thallium, and zinc.
  - CPECs posing a relatively high risk to one or more ecological receptors include cadmium and zinc.
  - CPECs posing a relatively moderate risk to one or more ecological receptors include arsenic, mercury, lead, and selenium. Copper, manganese, nickel, antimony, and thallium pose relatively low ecological risk (less than 10 times the screening criteria).
- The highest relative risk to aquatic receptors is from the bioaccumulation of cadmium (nearly 4,000 times the screening criteria) and zinc (683 times the screening criteria).

Surface Water and Pore Water

- All COI concentrations in surface water and pore water were below Oregon state and federal risk screening criteria for birds and mammals; however, six COIs pose a risk to aquatic receptors and were identified as CPECs: barium, cadmium, iron, manganese, lead, and zinc.
- Barium in surface water poses a relatively moderate risk to aquatic receptors (39 times the screening criteria). Cadmium, iron, manganese, lead and zinc pose a relatively low risk (less than 10 times the screening criteria) to aquatic receptors.
- In pore water, barium and lead pose a relatively moderate risk (36 and 25 times the screening criteria, respectively). Aluminum, cadmium, iron, manganese, and zinc pose a relatively low risk (less than 10 times the screening criteria) to aquatic receptors.

3.2.5 Ecological Risk Summary

Results of the streamlined ecological risk evaluation indicate significant potential risk to ecological receptors at the site and a total of 18 CPECs were identified. The primary pathway is exposure to CPECs in the mine waste and sediment. There also appears to be risk to aquatic receptors from exposure to

CPECs in surface water and pore water. Aluminum, iron, mercury, and lead pose the most relative risk to terrestrial receptors. Plants appear to be the most sensitive receptor with relatively low to high risk from 17 CPECs. Cadmium and zinc in sediment pose a relatively high risk to aquatic receptors from bioaccumulation. In surface water and pore water, there appears to be no risk to birds and mammals, and relatively low to moderate risk to aquatic receptors, primarily from barium and lead.

While individual receptors may be at risk, their populations are unlikely to be significantly impacted in the vicinity of the mine because:

(1) The home range for most receptors is significantly larger than the site and it is improbable that entire populations of receptors reside strictly within the site boundaries, and
(2) Contaminated areas on the site offer lower habitat quality compared to the adjoining habitat and it is unlikely that a receptor would regularly utilize habitat within the contaminated areas. It should be noted however, that for some sensitive species, particularly amphibians such as the Oregon spotted frog or Northern red-legged frog, the site may constitute their entire home range. This is critical because T&E species are to be protected to the individual level.

4.0 SITE CLEANUP CRITERIA

There are two general types of cleanup criteria:

(1) ARAR-based, and
(2) Risk-based developed from human health risk equations using acceptable risk levels and site-specific factors.

ARARs and both types of cleanup criteria are discussed below. Proposed site cleanup criteria for the site are presented in Table 7.

4.1 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; and
(3) Guide the implementation and operation of the preferred alternative.

The NCP (40CFR 300.415(j)) establishes that a removal action shall "to the extent practical, considering the exigencies of the situation, attain applicable or relevant and appropriate requirements 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, and
- Scope of the removal action.
    - The scope of the removal action is often directed at minimizing and mitigating 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.

A list of ARARs generated and evaluated for the site is presented in Appendix B. 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.

- Administrative requirements are not ARARs and thus do not apply to actions conducted entirely on-site. 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 the removal action.

4.2 ARAR–based Cleanup Concentrations

ARAR-based cleanup criteria for the site are limited to surface water and sediment. Groundwater is not used for drinking water at the site and future use as a drinking source is not anticipated; therefore, no cleanup criteria were identified for groundwater. Cleanup criteria for soils and waste rock were developed from human health risk equations and are discussed in the following section. Because cleanup levels for lead cannot be calculated using standard risk assessment algorithms, EPA Region 9's Industrial Soil PRG for lead (800 mg/kg) was identified as an ARAR-based cleanup level.

The proposed site cleanup criteria for surface water (Table 7) are based on Oregon state and federal standards for the protection of aquatic life and human health:

- EPA's recommended chronic AWQC for fish and water consumption (2004c);
- Oregon's human health water quality criteria for water and fish consumption (ODEQ 2005); and
- EPA's recommended chronic AWQC for freshwater aquatic life (EPA 2004c) (or Tier II Secondary Chronic Values if AWQC not available [NOAA 1999]).

Several COIs in surface water at the site exceed human health and ecological water quality criteria:

- The adit discharge exceeds the cleanup levels for arsenic (10 μg/L), iron (1,000 μg/L), and manganese (50 μg/L).
- The big pond south of the main working area exceeds the cleanup levels for arsenic (10 μg/L) and manganese (50 μg/L).
- The small pond in the main working area exceeds cleanup levels for cadmium (1.1 μg/L), lead (3.2 μg/L), manganese (50 μg/L) and zinc (110 μg/L).

Based on results of the risk evaluations, COIs in sediment pose a potential risk to both human and ecological receptors. However, the anticipated land uses do not typically result in a significant human exposure to sediment; ecological receptors, particularly aquatic life, tend to be at a much greater risk. Therefore, the proposed cleanup levels for sediment are ARAR-based and consist of ORNL sediment PRGs, summarized in Table 7.

- Six COIs exceed the ORNL sediment PRGs: arsenic, cadmium, copper, mercury, lead, and zinc. Except for arsenic, all of the COIs exceed the PRGs at the same two locations in the main working area:
  - Small pond, and
  - Gold Gulch stream.
- Arsenic exceeds the PRG in the background sample and at all but one location, downstream on Trout Creek.

- Because the ORNL arsenic PRG (42 mg/kg) is slightly below the background concentration of 46 mg/kg, the background concentration is proposed as the cleanup level. Arsenic concentrations in sediment range from 20 to 510 mg/kg and the highest arsenic concentration (510 mg/kg) was at the adit discharge.

4.3 Risk–based Cleanup Concentrations

Risk-based cleanup levels and hot spot concentrations were developed for COPCs in soil using standard human health risk equations and site-specific EFs. EFs are variables that determine the chronic daily intake rate, and include receptor body weight, exposure frequency and duration, averaging time, intake rates, chemical bioavailability, and other factors.

- EFs consist of a combination of site-specific conditions and standard default values presented in risk assessment guidance documents (ODEQ 2000a, EPA 1997).
- EFs are based on an adult worker receptor under a reasonable maximum exposure (RME) scenario.

Typically, exposure point concentrations (EPCs) are developed based on COPC concentrations at the site and are used in the risk equations to determine risk levels at the site. However, if an acceptable risk level is known, the corresponding acceptable EPC (i.e., hot spot concentration or cleanup level) can be back-calculated. Oregon's Environmental Cleanup Rules (OAR 340-122) defines "hot spots" as areas that present unacceptable risk and where the contamination is highly concentrated, highly mobile, or cannot be reliably contained. OAR defines "highly concentrated" as corresponding to a non-carcinogenic HQ of 10, or an ECR of 1.E-04 (ODEQ 2000a). Therefore, these risk values were used to back-calculate hot spot concentrations for COPCs in soil. Lead risks cannot be quantified using standard risk equations because toxicological references values (i.e. reference doses and slope factors) have not been established. Therefore, a hot spot concentration was not calculated for lead, and Oregon's maximum allowable lead concentration for industrial soils (2,000 mg/kg) was conservatively applied as the lead hot spot concentration. The risk-based hot spot concentrations are presented in Table 8 and summarized below.

- One hot spot was identified based on a lead concentration of 25,300 mg/kg in sample WP-SSS-01 from waste rock pile WP-5 in the main working area.
- No soil or mine waste samples exceeded the arsenic hot spot concentration of 1,850 mg/kg.

Risk-based cleanup levels for soil and mine waste were developed based on Oregon's acceptable risk levels for soil cleanup: a non-carcinogenic HQ of 1, and an ECR of 1.E-05 for multiple COPCs. These risk levels were used to back-calculate soil cleanup levels for the COPCs identified during the streamlined human health risk evaluation. The total cumulative risk from the following exposure pathways was used:

- Incidental ingestion of soil,
- Dermal contact with soil, and
- Inhalation of soil particulates.

Because lead risks cannot be quantified using standard risk equations, a risk-based cleanup level was not calculated for lead. Therefore, EPA's Industrial Soil PRG (800 mg/kg) is proposed as the ARAR-based cleanup level for lead. The cleanup levels are presented in Table 7, and areas exceeding the cleanup levels are summarized in Table 9.

- Three areas exceed the arsenic cleanup level of 185 mg/kg:
  - Soil near the big pond south of the main working area,
  - Waste rock pile WP-5 in the main working, and
  - Waste rock piles WP-13 and WP-14 near the south end of the site.

- Two waste rock piles in the main working area exceed the lead cleanup level of 800 mg/kg:
  - WP-5 (25,300 mg/kg), and
  - WP-3 (1,360 mg/kg).
- COI concentrations in waste rock piles WP-1, WP-2, WP-4, WP-6, WP-7, and WP-8 are unknown because these piles were not sampled during the SI. However, they are all located in the main working area; therefore, because of their proximity to waste rock piles WP-3 and WP-5, they are all considered to have similar COI concentrations and, thus, exceed the cleanup levels.

5.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

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

5.1 Removal Action Justification

According to 40 CFR 300.415(b), a removal action is justified if there is a threat to human health or the environment based on the eight factors listed below:

Factor	Site Condition	Justification
(1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants, or contaminants	Public access to soil, waste rock, sediment, and surface water with high concentrations of metals	**Yes**
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	No public water supply but ponds are drinking source for wildlife and cattle; emergent wetlands and sensitive amphibian species on site	**Yes**
(3) Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release	No drums, barrels, tanks, or bulk storage containers on site	No
(4) High levels of hazardous substances, pollutants, or contaminants in soils largely at, or near, the surface that may migrate	High concentrations of metals in soil and waste rock subject to erosion and migration	**Yes**
(5) Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released	Waste rock and tailings in a drainage and subject to erosion during rain events and snowmelt	**Yes**
(6) Threat of fire or explosion	No flammable materials on site	No
(7) The availability of other appropriate federal or state response mechanisms to respond to the release	Site is on USFS land	**Yes**
(8) Other situations or factors that may pose threats to public health or the environment	Physical hazards such as open adits and shafts	**Yes**

The streamlined risk evaluation indicated significant potential risk to human and ecological receptors from exposure to metals in the mine waste, surface water, and sediment. The average arsenic concentration in the mine waste samples exceeds EPA's Region 9 Industrial Soil PRG by a factor of more than 100; the maximum lead concentration exceeds the Industrial Soil PRG by a factor of more than 30. In surface water samples from the site, arsenic concentrations exceeded both human health and ecological risk screening criteria by a factor of more than 2,000. The mine waste is located in, or adjacent to, an ephemeral stream channel and wetland area, and there is evidence of erosion and transport of fine-grained materials from the waste rock piles during periods of high rainfall or snowmelt (EA 2003). There are also several significant physical hazards at the site, including an open adit, open shaft, several collapsed or partially collapsed structures, and miscellaneous debris (lumber, metal, and rusted drums).

5.2 Scope of Removal Action

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

(1) Eliminating direct contact with high concentrations of COIs in the waste rock, soil, and sediment;
(2) Reducing or eliminating the migration of contaminants to the environment;
(3) Improving surface water quality; and
(4) Mitigating physical hazards at the site.

The primary source of contaminants at the site is the waste rock and tailings, which contain high concentrations of metals. The adit discharge, which contributes metals loading to surface waters at the site, is also considered a primary contaminant source. The fine-grained materials that may have been deposited in, or migrated to, the Gold Gulch drainage, ponds, and wetlands are considered a secondary contaminant source. Addressing environmental impacts associated with the primary contaminant sources at the site presumes that some reduction in COI concentrations in surface water, groundwater, and sediment will occur as a result of removing or controlling the primary contaminant source. However, because there are other mining disturbances in the area, including an active mining claim upstream of the site, surface water and sediment at the site may be subject to continued degradation from sources outside the scope of this removal action. If future water quality monitoring indicates that a significant risk from surface water or sediment remains, additional removal actions may be necessary.

5.3 Removal Action Schedule

The removal action is tentatively scheduled for 2008; however, the date is dependent on federal funding and may be subject to change by the USFS.

6.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section describes the selection of a removal action using a three–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; and
(3) Identify existing data gaps that are relevant to the selected alternatives.

6.1 Identification and Screening of Removal Action Options and Alternatives

Removal action technologies applicable to the site were identified based on a review of technical literature and previous experience at similar mine sites. The technologies, described in Table 10, were screened to eliminate inappropriate, ineffective, infeasible or cost prohibitive methods. In addition, technologies with unproven or uncertain performance were eliminated if they have 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. For this EE/CA, a potentially cost effective technology is one that could provide protection comparable to other standard methods utilized in mine reclamation, at a cost similar to or less than the costs of those methods. All components not screened out were retained as potential technologies that could be implemented at the site.

The technologies 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 10 summarizes the results of the removal action technology screening process, including the technologies retained for incorporation into removal action alternatives.

Conceptual removal alternative designs (Figures 4, 5, 6) were developed from the technologies that passed the screening process. Key design features are estimates only and provided for comparison purposes. The material quantities and flow rates provided in this section are estimates only and should be more accurately quantified for final design and removal action. The referenced figures are conceptual only.

Based on results of the removal action technology screening process, four removal action alternatives were selected for detailed analysis. The alternatives include:

- **ALTERNATIVE 1 – NO ACTION**
- **ALTERNATIVE 2 – EXCAVATION AND OFF-SITE DISPOSAL**
- **ALTERNATIVE 3 – EXCAVATION AND ON-SITE DISPOSAL**
- **ALTERNATIVE 4 – TREATMENT OF ADIT DISCHARGE**

Each of the alternatives is discussed below.

Removal Action Elements Common to all Action Alternatives

- **Best Management Practices.** During removal activities, best management practices (BMPs) will be employed to contain run-off, minimize erosion, and prevent sedimentation of the streams during the removal action. Specific BMPs will depend on the removal action selected and may include, but not be limited to: silt fencing, straw bales, check dams, temporary surface water diversions, sediment retention, and dust suppression.
- **Open Adit.** A bat gate, shown in Figure 6, will be installed in the open adit to prevent public access while maintaining potential bat habitat. A 6-inch diameter HDPE pipe will be installed in the adit and extend about 50 feet behind the bat gate to collect adit discharge and allow for continual drainage should the adit collapse.
- **Open Vertical Shaft.** Waste rock from the site will be used to backfill the shaft.
  - Push in ~100 cy (based on an assumed shaft depth of 50 feet) of waste rock material from WP-10 and backfill the last 5 feet at the surface with clean soil (~10 cy). All backfill material shall be placed at a rate to ensure bridging does not occur.
  - Grade to blend with surrounding contours and mound to promote positive drainage.
  - Compact backfill, cover with 6 inches of topsoil (~10 cy), fertilize, seed, and mulch.
- **Collapsed Inclined Shaft.** It is unknown whether the inclined shaft has been backfilled or the opening has simply collapsed, in which case there may be a risk of the material caving in and re-exposing the shaft opening. To minimize potential remaining risks, soil and debris in the shaft will be excavated to a depth of 20 feet below grade to determine whether there is any bridging of material in the shaft and whether the subsequent floor is solid.
  - With excavator, excavate ~50 cubic yards (cy) of material out of the shaft up to 20 feet below grade.
  - If there is a solid floor at 20 feet below grade, replace the ~50 cy of excavated material, compact, cover with 6 inches of topsoil (~10 cy), fertilize, seed, and mulch.
  - If the shaft opens and can accept more material, push in ~110 cy (based on depth of 70 feet) of contaminated sediment from the main working area and backfill the last 5 feet at the surface with clean soil (~10 cy). All backfill material shall be placed at a rate to ensure bridging does not occur.
  - Grade to blend with surrounding contours and promote positive drainage.

- Compact backfill by tamping, cover with 6 inches of topsoil (~10 cy), fertilize, seed, and mulch.

- **Collapsed Adits/Surface Excavations.** According to the SI (EA 2003), there are three apparent collapsed adits or surface excavations in the main working area. These areas pose a potential physical hazard at the site.
  - With excavator, knock down highwalls surrounding the collapsed features (~90 cy) and grade the area to blend with surrounding topography.
  - Assume topsoil not required for these areas. Apply fertilizer, seed, and mulch (~10,000 sf).
- **Collapsed Structures, Equipment, and Debris**. The USFS archaeologist responsible for this site should be consulted to evaluate the historical and cultural significance of the existing structures, collapsed structures, head frame, and other features at the site (Figure 3). If deemed to have no historical significance, the structures and other remnants would be demolished.
  - The debris would be loaded into 20-cyd roll-off bins and transported to an off-site sanitary landfill for disposal. Untreated small timbers could potentially be burned on site, if fire conditions allow.
  - It is assumed that the structures do not contain hazardous materials; however, the structures should be inspected for lead-based paint and asbestos before demolition.
  - Trash and debris from the trash pit, and contents of the fruit cellar are assumed to be non-hazardous and will be removed and loaded into a 20-cyd roll-off bin for transport to an off-site sanitary landfill.
  - There are six sanitary landfills in Harney County and the nearest appears to be the Riley Landfill, about 40 miles from the site.
  - The resulting surface depressions will be filled in with clean soil, compacted, fertilized, seeded, and mulched. The old truck, portable ball mill, and any remaining equipment will be transported to the nearest salvage yard (~200 mile).

ALTERNATIVE 1 – No Action

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

- Waste rock would remain in its current location;
- Site safety issues (i.e. open shaft and adit, etc.) would remain as is; and
- Adit discharge would remain untreated.

ALTERNATIVE 2 – Excavation and Off-site Disposal

This alternative involves excavating soil, waste rock, and sediment with COI concentrations above the cleanup criteria, and transporting to an off-site Treatment, Storage, and Disposal Facility (TSDF), for disposal. Tasks specific to this alternative include:

- Excavating waste rock and soil with arsenic or lead concentrations above the risk-based cleanup criteria of 185 mg/kg and 800 mg/kg, respectively (WP-1, WP-2, WP-3, WP-4, WP-5, WP-6, WP-7, WP-8, WP-13/14, and soil around the big pond).
- Excavating waste rock from three piles that have COI concentrations below the cleanup levels, but are located in the Gold Gulch drainage and subject to erosion into the stream:
  - WP-9 and WP-10 in the main working area, and
  - WP-15 across from the open adit at the south end of the site.
- Excavating sediment from four areas with COI concentrations above the ARAR-based cleanup criteria of 42 mg/kg arsenic, 4.2 mg/kg cadmium, 77.7 mg/kg copper, 0.7 mg/kg mercury, 110 mg/kg lead, and 270 mg/kg zinc:
  - Adit discharge,
  - Big pond,
  - Small pond in main working area, and
  - Gold Gulch stream in main working area.

- Loading the contaminated soil, waste rock, and sediment, and transporting to a commercial TSDF, such as the one at Arlington, Oregon (220 miles from the site) or at Grand View, Idaho (240 miles from the site).
- Use a Niton XRF to assist in delineating the extent of excavation and to field check removal efforts. Collect a minimum of one composite confirmation sample from each area for verification of contaminant removal.
- Grade the areas from which waste rock and soil has been excavated to blend with the surrounding topography and promote drainage. Cover disturbed areas with 6 inches of topsoil (~325 cy), fertilize, seed, and mulch.
- Specifics to each area are as follows:
  - Push ~100 cy of waste rock from WP-10 into the open shaft.
  - Assumes the inclined shaft will be determined to be adequately plugged and no additional waste material will be placed in the inclined shaft.
  - Excavate the remaining ~1,400 cy of waste rock material from WP-1, WP-2, WP-3, WP-4, WP-5, WP-6, WP-7, WP-8, WP-9, and WP-10; ~300 cy of contaminated sediment from main area, and ~10 cy of contaminated sediment from the adit discharge area using an excavator.
  - Reconstruct the wetlands and ~250 feet of stream channel in the main area. Following removal of the waste material, a 1 to 2-foot wide, and 1 to 2-foot deep v-channel (Figure 4) will be excavated and filled with ~10 cy of streambed material to mimic a natural stream channel. The disturbed areas will be covered with a 6 to 12 inch layer of clean soil (~225 cy) mixed with 30 percent gravel and cobbles (~75 cy), and a thin layer (2 to 3 inches of hydric soil (~60 cy) collected from on-site ponds. Approximately 100 cuttings of existing native wetlands vegetation will be selectively gathered from undisturbed wetlands on the site and replanted in the area. The area will be seeded with a native wetlands vegetation species seed mix and covered with mulch.
  - Excavate ~15 cy of contaminated soils from the area around the big pond using an excavator.
  - Excavate ~120 cy of waste rock from WP-13 and WP-14 using an excavator.
  - Reconstruct ~50 feet of stream channel where disturbed during removal of WP-13 and WP-14. Following removal of the waste material, a defined channel will be excavated to the approximate configuration shown on Figure 4, and filled with ~5 cy of streambed material to mimic a natural stream channel. It's anticipated that stream bank reconstruction will not be required because of the small size and intermittent nature of the stream.
  - Excavate ~120 cy of waste rock from WP-15 using an excavator.
  - Reconstruct ~50 feet of stream channel where disturbed during removal of WP-15. Following removal of the waste material, a defined channel will be excavated to the approximate configuration shown on Figure 4, and filled with ~5 cy of streambed material to mimic a natural stream channel. It's anticipated that stream bank reconstruction will not be required because of the small size and intermittent nature of the stream.
  - See Alternative 4 for treatment of adit discharge.

ALTERNATIVE 3 – Excavation and On-site Disposal

This alternative involves excavating soil, waste rock, and sediment with COI concentrations above the cleanup criteria, and disposing in an on-site repository. Tasks specific to this alternative include:

- Excavating waste rock and soil with arsenic or lead concentrations above the risk-based cleanup criteria of 185 mg/kg and 800 mg/kg, respectively (WP-1, WP-2, WP-3, WP-4, WP-5, WP-6, WP-7, WP-8, WP-13/14, and soil around the big pond).
- Excavating waste rock from three piles that have COI concentrations below the cleanup levels, but are located in the Gold Gulch drainage and subject to erosion into the stream:
  - WP-9 and WP-10 in the main working area, and
  - WP-15 across from the open adit at the south end of the site.

- Excavating sediment from four areas with COI concentrations above the ARAR-based cleanup criteria of 42 mg/kg arsenic, 4.2 mg/kg cadmium, 77.7 mg/kg copper, 0.7 mg/kg mercury, 110 mg/kg lead, and 270 mg/kg zinc:
  - Adit discharge,
  - Big pond,
  - Small pond in main working area, and
  - Gold Gulch stream in main working area.
- Loading the contaminated soil, waste rock, and sediment, and transporting to an on-site repository to be located along FS Road 630, about 500 feet south of the main working area (Figure 2).
- Use a Niton XRF to assist in delineating the extent of excavation and to field check removal efforts. Collect a minimum of one composite confirmation sample from each area for verification of contaminant removal.
- Grade the areas from which waste rock and soil has been excavated to blend with the surrounding topography and promote drainage. Cover disturbed areas with 6 inches of topsoil (~325 cy), fertilize, seed, and mulch.
- Specifics to each area are as follows:
  - Push ~100 cy of waste rock from WP-10 into the open shaft.
  - Excavate the remaining ~1,400 cy of waste rock material from WP-1, WP-2, WP-3, WP-4, WP-5, WP-6, WP-7, WP-8, WP-9, and WP-10; ~300 of contaminated sediment from main area, and ~10 cy of contaminated sediment from the adit discharge area using an excavator.
  - Reconstruct the wetlands and ~250 feet of stream channel in the main area. Following removal of the waste material, a 1 to 2-foot wide, and 1 to 2-foot deep v-channel (Figure 4) will be excavated and filled with ~10 cy of streambed material to mimic a natural stream channel. The disturbed areas will be covered with a 6 to 12 inch layer of clean soil (~225 cy) mixed with 30 percent gravel and cobbles (~75 cy), and a thin layer (2 to 3 inches of hydric soil (~60 cy) collected from on-site ponds. Approximately 100 cuttings of existing native wetlands vegetation will be selectively gathered from undisturbed wetlands on the site and replanted in the area. The area will be seeded with a native wetlands vegetation species seed mix and covered with mulch.
  - Excavate ~15 cy of impacted soils from the area around the big pond using an excavator.
  - Excavate ~120 cy of waste rock from WP-13 and WP-14 using an excavator.
  - Reconstruct ~50 feet of stream channel where disturbed during removal of WP-13 and WP-14. Following removal of the waste material, a defined channel will be excavated to the approximate configuration shown on Figure 4, and filled with ~5 cy of streambed material to mimic a natural stream channel. It's anticipated that stream bank reconstruction will not be required because of the small size and intermittent nature of the stream.
  - Excavate ~120 cy of waste rock from WP-15 using an excavator.
  - Reconstruct ~50 feet of stream channel where disturbed during removal of WP-15. Following removal of the waste material, a defined channel will be excavated to the approximate configuration shown on Figure 4, and filled with ~5 cy of streambed material to mimic a natural stream channel. It's anticipated that stream bank reconstruction will not be required because of the small size and intermittent nature of the stream.
  - See Alternative 4 for treatment of adit discharge.
- The proposed on-site repository would be located along FS Road 630, about 500 feet south of the main working area (Figure 2), and cover approximately 0.5 acre. It is assumed that access will be directly via FS Road 630 and that additional access roads will not be required. The area appears to be relatively flat and above the floodplain. It is assumed that some tree felling will be required. The proposed site was selected based on a review of a USGS topographic map of the site because no candidate locations were identified in the SI, and a site visit was not conducted under this EE/CA. Before commencing final design, the site should be inspected and additional information

gathered regarding the suitability of the proposed site. In addition, it is possible that a more suitable location may exist; therefore, the proposed design presented here is very conceptual and the actual engineered design may differ considerably based on site-specific conditions and constraints. However, the general design configuration and site preparation tasks described in the following bullets will likely be very similar independent of location.

- The repository should have a minimum available storage capacity of 2,400 cy (estimated volume of waste material plus 20 percent). Assuming an average waste depth of 3 feet, the repository will cover about 20,000 square feet (sf).
- The repository should be shaped to blend with the surrounding topography. The foundation slope should not exceed 10 percent. The repository side slopes should not exceed a 3:1 horizontal to vertical (3H:1V) ratio and the top surface should be graded to minimize erosion, promote drainage, and prevent ponding on the repository surface.
- A small diversion channel should be installed immediately uphill of the repository to intercept run on during storm events.
- The site will be cleared and grubbed and ~2,625 to ~3,375 cy of topsoil (depending on selected repository cover option) will be excavated from the repository footprint and stockpiled for use in the repository cover and to cover the excavated waste areas, wetlands, and other disturbed areas.
- Place and compact waste rock in the repository in 6-inch lifts.

- Two cover alternatives were evaluated for the repository:
  - **Repository Cover Option 1 – Geosynthetic Cover**
    - Engineered cover consisting of a geosynthetic membrane sandwiched between a 12-inch thick screened bedding layer and a 6-inch thick drainage layer, overlain by 2 feet of soil (Figure 4).
    - Approximately 750 cy of fine bedding material would be generated on-site by selectively screening the waste rock material (70 percent passed a #4 screen). The material would be placed and compacted in one 12-inch thick lift.
    - Approximately 2,700 square yards (sy) of geosynthetic membrane would be required, including ~20 percent overage. The liner would be installed and tested per the manufacturer's specifications.
    - Approximately 375 cy of coarse (<3/4-inch) drainage material would be generated on-site by selectively screening the topsoil material. The material would be carefully placed over the liner in one loose 6-inch thick lift.
    - Approximately 2,700 sy of filter fabric would be installed between the drainage layer and cover soil to prevent piping of fines into the coarse material.
    - The 24-inch thick soil cover would be composed of ~1,500 cy of topsoil stockpiled during excavation of the repository. The soil would be placed in one lightly compacted 12-inch lift and one loose 12-inch lift. Soil amendments would be added and the cover would be seeded and mulched.
  - **Repository Cover Option 2 – Soil Cover**
    - Soil cover consisting of a 6-inch thick capillary break of coarse material, overlain by 3 feet of soil (Figure 4). The capillary break minimizes downward infiltration of water under unsaturated conditions and provides a root barrier (ITRC 2003). This cover configuration is designed to minimize infiltration by maximizing evapotranspiration.
    - Approximately 375 cy of coarse material for the capillary break would be generated on-site by selectively screening the waste rock material. The material would be placed in one loose 6-inch lift.
    - Approximately 2,700 sy of filter fabric would be installed between the capillary break layer and cover soil to prevent piping of fines into the coarse material.
    - The 3-foot thick soil cover would be composed of ~2,250 cy of topsoil stockpiled during excavation of the repository. The soil would be placed in two compacted 12-inch lifts,

and one loose 12-inch lift. Soil amendments would be added and the cover would be seeded and mulched.

- Excavate a diversion channel along the uphill edge of the repository to intercept surface water run on. The earth-lined, v-shaped channel should be 1 to 2 feet deep, with 2H:1V side slopes. The channel should have a slope of 1 to 2 percent and be self-cleaning (i.e., sufficient flow velocity to prevent plugging without requiring riprap erosion protection). For cost estimation purposes, the assumed channel length is 200 feet. Approximately 4 cy of riprap protection would be installed at the channel outlet to prevent erosion. Presumably, the riprap would be obtained from material screened on site.
- Place wood debris generated from the tree felling over the final repository cover surface to prevent erosion.

ALTERNATIVE 4 – Treatment of Adit Discharge

This alternative consists of treating water discharging from the open adit near the south end of the site. Water discharging from the adit currently exceeds the cleanup criteria for arsenic, iron, and, manganese. The proposed alternative is based on a two-phased approach and consists of a settling pond and aerobic wetland as described below. Because a site visit was not conducted and the area around the open adit is not well characterized in the SI, the proposed design is based on some gross assumptions regarding the site configuration and suitability for removal action. The proposed location is immediately outside of the open adit, along the Gold Gulch drainage. The proposed design assumes that there is a sufficiently large and relatively level area to construct the treatment system near the adit and above the floodplain. If not, the adit discharge may need to be piped to a more suitable location, presumably near the main working area, using gravity flow. The proposed design presented here is very conceptual and the actual engineered design may differ considerably based on site-specific conditions and constraints. However, the general design configuration and site preparation tasks described in the following bullets will likely be very similar, independent of location. Tasks specific to this alternative include:

- The proposed alternative for treating the adit discharge consists of a two-phased approach. The first phase involves constructing a settling pond to collect sediment and oxyhydroxide precipitates that form when the adit discharge contacts the outside air. This step should reduce metals concentrations and significantly improve the overall water quality. Effluent from the settling pond would be monitored to assess water quality improvement. If monitoring data indicates that the effluent remains above cleanup criteria, the second phase consisting of an aerobic wetland would be constructed. The aerobic wetland would be composed of a mixture of organic material and gravel, placed over an impervious synthetic liner. The wetland should significantly remove iron, arsenic, and manganese by oxidation and precipitation. Both the pond and wetland would require periodic maintenance and sludge removal.
- The proposed conceptual settling pond was designed to provide 24-hour retention time with allowance for freeboard (Figure 5).
- The proposed conceptual aerobic wetland was designed based on a loading factor of 200 square feet per gallon per minute (sf/gpm) (Colorado Division of Minerals and Geology 2002).
- Specifics are as follows:
  - Estimated peak flow rate ~5 gpm.
  - The settling pond and aerobic wetland would be constructed adjacent to Gold Gulch within the footprint of WP-15, if possible (Figure 5). Depending on the site topography, fill material may be required to provide a bench for constructing the pond and wetland above the Gold Gulch stream channel floodplain. The pond and wetland bottoms should be constructed a minimum of 4 feet above the bottom of the Gold Gulch stream channel. For the conceptual design, it was assumed that additional fill will not be required.
  - The 720-sf settling pond will be 3-feet deep with 2H:1V side slopes and a storage capacity of ~10,230 gallons (gal). The pond will be lined with 45-mil high-density polyethylene (HDPE)

to prevent infiltration and contain the metals-laden sludge that will form as a byproduct of the aerobic water treatment process. Construction of the pond will require excavation of ~25 cy of soil. The excavation will consist of a balanced cut-and-fill, i.e., the excavated material will be compacted and used for the perimeter berm.

- The 1,000-sf aerobic wetland will be 2-feet deep with vertical sides. The wetland will be lined with 45-mil HDPE and filled with ~75 cy of organic material mixed with gravel and varying in depth from 8 to 24 inches. Construction of the wetlands will require excavation of ~40 cy of soil. The excavation will consist of a balanced cut-and-fill, i.e., the excavated material will be compacted and used for the perimeter berm.
- The excavated areas will be lightly compacted and prepared for installation of the HDPE liners. Cobble and rocks > ¾-inch will be removed from the prepared surface and a 6-inch thick sand bedding layer (~50 cy) will be placed under the liner to prevent puncturing. The HDPE liners will be installed, tested, and anchored per the manufacturer's specifications.
- Riprap erosion protection (~15 cy) will be selectively placed along the outer berm on the upstream side and in areas subject to potential erosion from Gold Gulch stream flows.
- A 12-inch diameter HDPE pipe will be installed to convey the adit discharge from the adit, under FS Road 630, to the settling pond (~30 feet). The pipe will be sloped to promote drainage and both ends will be screened to prevent plugging.
- A diversion channel will be excavated along the up gradient edge of the road to intercept surface water run on. The earth-lined, v-shaped channel would be ~140-feet long, 1 to 2 feet deep, with 2H:1V side slopes. Riprap protection (~4 cy) would be installed at the channel outlet to prevent erosion. Construction of the wetland would require extending the channel ~40 feet.
- Excavate a discharge channel from the settling pond to the Gold Gulch stream channel (Figure 5). The earth-lined, v-shaped channel would be ~30-feet long, 1-foot deep, with 2H:1V side slopes. Riprap protection (~4 cy) would be installed at the channel outlet to prevent erosion. If the wetland is constructed, a new discharge channel would need to be constructed.
- Removal of waste material from WP-15 and reconstruction of the Gold Gulch stream channel is discussed under Alternatives 2 and 3.

6.2 Analysis of Selected Removal Action Alternatives

The removal action alternatives were evaluated based on the following criteria:

- Effectiveness
- Implementability
- Relative 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; and
- 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, and whether it can be implemented within 1 year.
- 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 estimated costs for each task are summarized in Table 11. Costs are based on experience at similar sites, on published data and reports, and on inquiries to possible vendors. Many removal action unit costs were obtained from R.S. Means data for the Pendleton, Oregon area, and include overhead and profit. Estimated costs relied on several significant assumptions regarding site conditions and are based on conceptual design only. The estimated costs are intended for alternative comparison only and are not suitable for removal action.

Assumptions made in preparing the cost estimate include:

- All removal actions can be completed in one field season using standard removal action equipment. Because the wetlands are considered optional, a separate field season was included in the estimated costs for a wetlands removal action.
- All borrow soil for covering the repository and excavated waste areas will be available on site within the repository footprint. The borrow soil will be screened on-site to provide the fine and coarse materials needed in the repository cover and for the liner bedding layer for the settling pond.
- The proposed sites for the repository and water treatment system are suitable and accessible, and will not require significant modification.
- Gravel and cobbles needed for reconstruction of wetlands in the main working area will be purchased and transported from an off-site source. Assumed available source within 60 miles of the site.
- Because of the small volume of riprap and streambed material required (<50 cy total), assumed that there is sufficient material available on site.
- There is a sufficient volume (~60 cy) of suitable hydric soil available in on-site ponds for use in reconstruction of wetlands in the main working area.
- All areas are easily accessible from FS Road 630, no major road improvements will be required for equipment access, and no temporary access roads will be required.
- The inclined shaft is adequately plugged and will not require backfilling with waste material.
- Waste material will be loaded directly into trucks for transport to the off-site TSDF or on-site repository for disposal, and temporary stockpiling will not be required.
- All non-hazardous debris can be disposed of at the nearest sanitary landfill.
- The USFS archaeologist will approve the demolition of all site structures.

- The on-site structures do not contain any hazardous materials, including but not limited to lead-based paint and asbestos.
- All trees and brush felled during the removal action will be placed over the seeded areas to minimize erosion, or burned on site.
- Maintenance and monitoring costs are based on biannual site visits for a 3-year period following completion of removal action. Costs for maintenance activities spanning more than 3 years, such as periodic removal of the settling pond sludge, were prorated based on the anticipated maintenance interval.
- Fees based on removal action costs included 20 percent for design, and 10 percent for construction management, plus a 20 percent contingency on total project costs.
- Present value corrections were not calculated because of the short duration of the removal action and monitoring.

6.3 Identification of Data Gaps

Several data gaps were identified during the preparation of this EE/CA, including:

- Lack of sufficient background samples to develop reasonably accurate average background COI concentrations for all media;
- Several unsampled mine waste piles, surface water features, and wetlands on the site;
- Quantity of wood and metal debris, rusted drums, and garbage (in the trash pit) is unknown;
- Uncertainties associated with the mine waste volume estimate;
- Very limited surface water flow information;
- Shaft and adit features and dimensions not well defined;
- Potential waste repository locations and borrow sources not identified and characterized;
- Monitor adit discharge through the winter and early spring for flows and chemical composition; and
- Enter underground workings to assess feasibility of installing a high-pressurized concrete plug or using piping to divert water from mineralized zones in the adit.

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. However, additional data that is critical to the removal action should be collected before preparing the final design. The data gaps, potential issues, and recommended actions are discussed below.

Data Gap	Potential Issues	Recommended Action
Lack of sufficient background samples: • Only one background sample collected for each media type • Active mining claim upstream of the site • Analytical results suggest samples may not accurately represent true background levels	• Background surface water, pore water, and sediment samples may have been impacted by mining activities upstream of the site • Prevents establishing statistically representative background concentrations for any media at the site • May result in applying site cleanup criteria that are below background levels	None. Although it is generally good practice to have a thorough understanding of background concentrations for all media, it is not critical to developing removal action alternatives and it is unlikely that the risk-based cleanup criteria are below background levels.

Data Gap	Potential Issues	Recommended Action
Several unsampled mine features, including: • Waste rock and dredging piles • Ponds and seeps • Wetlands downstream of the main working area • Surface water from the Pardee Spring drainage	• Can significantly increase uncertainty in the human and ecological risk evaluations • Surface water from Pardee Spring drainage may be contributing contaminant loading to the site • May significantly underestimate the volume of waste material exceeding site cleanup criteria and the estimated cost of a removal action • May result in an undersized waste repository and ineffective and/or undersized water treatment system	Samples collected during the SI were intended to target areas with the highest COI concentrations, and assumptions can be made regarding COI concentrations in many site features. Therefore, additional sampling of on-site features is probably not necessary. However, water samples should be collected from the Pardee Spring drainage to determine potential impacts to the site.
Quantity and composition of wood and metal debris is unknown: • The structures are not well characterized and the SI refers to debris and several collapsed features at the site but does not provide any estimate of material quantities. Assumes that all materials are non-hazardous.	• May significantly underestimate or overestimate removal action costs, particularly if the material is hazardous and requires special handling and disposal. • The structures and fruit cellar were not inspected for hazardous materials.	Collapsed features and debris piles should be inspected to segregate and quantify materials that can be potentially burned on site, from items that require off-site disposal. The structures should be inspected for the presence of lead-based paint and asbestos.
Uncertainties in mine waste volume estimate: • Estimated volume in SI based on waste piles from underground mining and does not include dredging spoils or tailings • Does not account for contaminated soils or sediment	• May underestimate the extent and quantity of contamination at the site • May significantly underestimate removal action costs • May result in an under-designed and inadequately sized mine waste repository	None. Gross assumptions can be made regarding the extent and quantity of waste rock, contaminated soil, and sediment at the site; and, a conservative factor of safety can be incorporated in the design to accommodate additional volume, if needed. However, this may result in significantly overestimating the removal action cost.
Limited surface water quality and flow data: • Flows during the SI were very low and difficult to assess • No flow data for Pardee Spring drainage • Flow data limited to low flow period • Adit discharge quality based on a single sample	• Flows may differ significantly during spring runoff or high flow conditions • The flow contribution and water quality influences from Pardee Spring are unknown • Difficult to delineate floodplain • Water treatment system may be inadequately sized • Water treatment system may be improperly designed based on limited water quality data • Removal action costs may be significantly underestimated	Measure flows during spring runoff or high flow conditions, particularly from the adit discharge. Quantify flows from Pardee Spring drainage. Inspect the site for indications of high flow levels and floodplain extents. Water quality samples should also be collected, particularly from the adit discharge.
Shaft and adit features not well defined: • The open shaft and adit features and dimensions are not well defined in the SI • Integrity of adit opening and underground workings not characterized in the SI	• Difficult to prepare an engineered design for suitable closures • May be possible to contain adit discharge in a pipe and convey around mineralized zones • May or may not provide potential habitat for bats	Features should be inspected and measured to assist in the final design. Adit should be inspected to determine if bats inhabit the adit, the viability of using a concrete or foam plug to seal the adit, and the feasibility of diverting the discharge from mineralized zones with piping.
Waste repository location and borrow sources: • Potential repository locations not identified in the SI • Potential borrow sources not identified in the SI	• Difficult to prepare an engineered design without site-specific information • May result in an improperly designed repository • Removal action costs may be significantly underestimated	Site should be inspected to identify potential repository locations and suitable borrow sources for soil, growth medium, riprap, and gravel. Most borrow sources assumed to be available on site; costs will be significantly higher if borrow materials must be imported.

7.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

The removal action alternatives were compared based on the following criteria:

- **Effectiveness**
  - Protective of human health and the environment
  - Complies with ARARs
  - Achieves removal action objectives
- **Implementability**
  - Technical Feasibility
  - Administrative Feasibility
  - Availability of Resources
- **Cost**

The comparative analysis of removal action alternatives is summarized in Table 12. Alternative 1 is the least expensive and easiest to implement; however, it is the least effective and does not comply with ARARs or provide protection to human health or the environment. Alternative 2 complies with ARARs and provides the most protection by removing the waste from the site, but is also the most expensive. Alternative 3 costs significantly less than Alternative 2, complies with ARARs, and affords a reasonable level of protection. Both Alternatives 2 and 3 are easy to implement, technically and administratively feasible, and provide comparable effectiveness. Under Alternative 3, the geosynthetic cover would be slightly more effective than the soil cover in reducing infiltration through the waste material. However, because the waste does not appear to be highly leachable, the additional protection afforded by a geosynthetic cover is not necessary. Alternative 4 is technically and administratively feasible, can be easily implemented, and is the only alternative that directly addresses water quality at the site However, its effectiveness is speculative and will need to be evaluated through periodic surface water quality monitoring. In addition, long-term maintenance will be required to ensure continued effectiveness and permanence. While the settling pond and wetland combined would provide the most effectiveness, it's possible that the settling pond alone will adequately treat the adit discharge and achieve compliance with ARARs.

8.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Key features of the preferred removal action alternative are discussed below. Details are provided in Section 6.2 and on Figures 2 through 6. The preference expressed here is based on the analysis discussed in Sections 6.3 and 7.0, and summarized in Table 12. The preferred alternative is a combination of:

- **Alternative 3 – Excavation and On-site Disposal; and**
- **Alternative 4 – Adit Discharge Treatment.**

Mine waste, soil and sediment exceeding site cleanup levels would be excavated and disposed of in an on-site repository. Additional mine waste with COI concentrations below cleanup levels but located in Gold Gulch and susceptible to erosion, will also be removed and disposed of in the on-site repository. Physical hazards would be addressed by installing a bat gate in the open adit; backfilling the open shaft with waste rock; and knocking down highwalls around the collapsed adits in the main working area and grading to blend with the surrounding topography. The backfilled areas and excavated waste areas would be covered with topsoil, seeded, and mulched. The head frame and structures would be demolished and all debris would be hauled to a sanitary landfill. Untreated woody debris will be burned on site, if possible. The abandoned truck and equipment would be loaded and transported to a salvage facility (~200 miles) for disposal or recycling. A settling pond would be constructed to treat the adit discharge from the open adit. Effluent from the settling pond would be monitored to assess water quality. For the first 3 years following

construction of the settling pond, samples should be collected twice a year from the adit discharge entering the settling pond and the water exiting the settling pond. If arsenic and iron concentrations continue to exceed the cleanup levels, an aerobic wetland will be constructed adjacent to the settling pond to provide additional treatment and the need for additional long-term monitoring will be evaluated.

The preferred alternative would dispose of a total of ~2,200 cy of waste rock/soil/sediment and treat up to 7,200 gallons of adit discharge per day. The total estimated removal action cost is $229,373. The potential cost for addition of the aerobic wetland would be $30,562.

The proposed alternative will satisfy 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	Public access to contaminated soil, waste rock, sediment, will be eliminated by removing the source. Overall surface water quality at the site should improve significantly following removal of the primary waste source. In addition, water discharging from the open adit would be treated.	Yes
(2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	There is no public water supply and the water discharging from the adit will be treated to the extent practical based on ARAR-based criteria. Potential impacts to the wetlands should be minimized by removing the primary waste sources and improving water quality.	Yes
(3) Hazardous substances, pollutants, or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release	No drums, barrels, tanks, or bulk storage containers on site	Yes
(4) High levels of hazardous substances, pollutants, or contaminants in soils largely at, or near, the surface that may migrate	Contaminated soil, waste rock, and sediment will be removed. Waste rock below cleanup levels but located in the Gold Gulch floodplain also will be removed.	Yes
(5) Weather conditions that may cause hazardous substances, pollutants, or contaminants to migrate or be released	The waste rock and contaminated soils will be removed. In addition, waste rock below the cleanup levels but located in areas subject to potential erosion and contaminant migration will also be removed.	Yes
(6) Threat of fire or explosion	No flammable materials on site	Yes
(7) The availability of other appropriate federal or state response mechanisms to respond to the release	The site is on USFS land and is being addressed by the USFS.	Yes
(8) Other situations or factors that may pose threats to public health or the environment	Physical hazards will be removed or mitigated	Yes

9.0 FOREST SERVICE DISCLAIMER

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

The proposed removal action designs presented in this EE/CA are conceptual only and not intended for removal action. All material quantities are estimates only and should be verified for final design.
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R1731

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