Non-Time Critical Removal Action Engineering Evaluation /Cost Analysis Mayflower-Ochoco Mine Complex Ochoco National Forest Crook County, Oregon

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NON-TIME CRITICAL REMOVAL ACTION ENGINEERING EVALUATION / COST ANALYSIS MAYFLOWER-OCHOCO MINE COMPLEX OCHOCO NATIONAL FOREST CROOK COUNTY, OREGON

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Ochoco National Forest
Crook County, Oregon

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Cover Photos: Informational sign near the Mayflower Mine (upper left), and Mayflower Adit and drainage (lower right).

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LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response and Liability Act
CES	Cascade Earth Sciences
COPC	Contaminants of Potential Concern
COPEC	Contaminants of Potential Ecological Concern
cy	cubic yards
EECA	Engineering Evaluation / Cost Analysis
ERA	Ecological Risk Assessment
HHRA	Human Health Risk Assessment
mg/kg	milligrams per kilogram
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ODEQ	Oregon Department of Environmental Quality
SI	Site Inspection
µg/L	micrograms per liter
ONF	Ochoco National Forest
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

- Cascade Earth Sciences (CES) has prepared an Engineering Evaluation / Cost Analysis (EECA) for completing a Non-Time-Critical Removal Action related to metal contaminated media at the abandoned Mayflower–Ochoco Mine Complex (Site) in Crook County, Oregon.
- The Site consists of five abandoned gold mines, a mill site, and wasterock and tailings material located in the Ochoco National Forest, approximately 26 miles east of Prineville, Oregon.
- The EECA is being performed by the United States Department of Agriculture, Forest Service under the Comprehensive Environmental Response and Liability Act cleanup authorities [42 USC 9604(a) and 7 CFR 2.60(m)] and Federal Executive Order 12580.
- The purpose of the EECA is to develop alternatives, make comparative analysis between the alternatives, and recommend a preferred alternative based upon the comparative analysis of the alternatives, to minimize or eliminate any release or threat of release of a hazardous substance into the environment or impact on public health and welfare.
- Per the Site Inspection Report, the human health risk-based cleanup concentration for soil, wasterock, and tailings is 53 milligrams per kilogram (mg/kg) total arsenic. Because this is below the average background total arsenic concentration of 96 mg/kg, the cleanup concentration was adjusted to 96 mg/kg, to be no more stringent than background concentrations expected around the Site.
- The scope of the Removal Action for the Site is to achieve cleanup of Site related hazardous substances to acceptable levels of risk to humans and the environment.
- The following three alternatives were evaluated and compared as potential Removal Actions and were evaluated individually and collectively against the three criteria (effectiveness, implementability, and cost).
  - Alternative 1: No Action ($0)
  - Alternative 2: Excavation and Onsite Containment in Two Repositories ($654,000)
  - Alternative 3: Excavation and Offsite Disposal ($2,410,000)
- Alternative 2 – Excavation and Onsite Containment in Two Repositories (along with the common items) is considered the most appropriate and cost-effective alternative because of the following advantages:
  - Reduces risk to human health and ecological receptors to an acceptable level compared to Alternative 1;
  - Provides a reduction in the mobility of containments compared to Alternative 1;
  - Removes wasterock/tailings from the Ochoco Creek floodplain compared to Alternative 1;
  - No liability associated with future offsite disposal facility cleanup compared to Alternative 3;
  - Significantly reduces potential spillage along highways and eliminates potential spillage along residential areas that could impact human health and the environment compared to Alternative 3;
  - No waste generator fees associated with offsite disposal compared to Alternative 3; and
  - Cost savings of $1,756,000 compared to Alternative 3.

1.0 INTRODUCTION

- On behalf of the United States Department of Agriculture, Forest Service (Forest Service), Cascade Earth Sciences (CES) has prepared an Engineering Evaluation / Cost Analysis (EECA) for completing a Non-Time-Critical Removal Action at the abandoned Mayflower-Ochoco Mine Complex (Site) in the Ochoco National Forest (ONF) and in accordance with the following:
  - Comprehensive Environmental Response and Liability Act (CERCLA) cleanup authorities [42 USC 9604(a) and 7 CFR 2.60(m)] and Federal Executive Order 12580;
  - The provisions of National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300.415(b)(4)(i);
  - U.S. Environmental Protection Agency (USEPA) "Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA" (USEPA, 1993).
- The purpose of the EECA is to develop alternatives, make comparative analysis between the alternatives, and recommend a preferred alternative based upon the comparative analysis of the alternatives to minimize or eliminate any release or threat of release of a hazardous substance into the environment or impact on public health and welfare.

2.0 SITE CHARACTERIZATION

- For additional information, the reader is referred to "*Site Inspection of the Mayflower- Ochoco Mine Complex, Ochoco National Forest, Crook County, Oregon*" (CES, 2005).

2.1 Source, Nature, and Extent of Contamination

- This section gives a brief overview of the contaminants of concern that will be addressed during the Removal Action, as well as anticipated volumes for each mine.

- **Mayflower Mine**
  - Total recoverable arsenic (3.3 micrograms per liter [μg/L]) and manganese (4,870 μg/L), which exceeded the Oregon human health water quality criteria (0.0022 μg/L and 0.05 μg/L, respectively), were documented discharging from the Mayflower Adit at ~2 gallons per minute (gpm).
  - 12,000 cubic yards (cy) of wasterock associated with the Mayflower Adit exhibited arsenic concentrations ranging from 183 milligrams per kilogram (mg/kg) to 1,840 mg/kg, which exceeds the average background arsenic concentration of 96 mg/kg.
  - 500 cy of metals-impacted soil, concentrates, and tailings in and around the former mill exhibited arsenic concentrations ranging from 332 mg/kg to 5,140 mg/kg, which exceeds the average background arsenic concentration of 96 mg/kg.
  - 600 cy tailings adjacent to Ochoco Creek exhibited arsenic concentrations ranging from 107 mg/kg to 5,350 mg/kg, which exceeds the average background arsenic concentration of 96 mg/kg.
  - 70 cy of wasterock associated with the Upper Adit exhibited arsenic concentrations ranging from 71.1 mg/kg to 76.7 mg/kg, which did not exceed the average background arsenic concentration of 96 mg/kg.

Ochoco Mine
  - 600 cy of wasterock located adjacent to and within the Ochoco Creek floodplain did not exceed the average background arsenic concentration, but all samples did exceed the average background concentrations for mercury (0.0504 mg/kg) and selenium (0.35 mg/kg).

- **Street Adit**
  - 1,000 cy of wasterock, located adjacent to the FR 2200-100, exhibited an arsenic concentration of 235 mg/kg, which exceeds the average background arsenic concentration of 96 mg/kg.
  - Lead (558 mg/kg) and zinc (560 mg/kg) were also detected above average background concentrations of 12.3 mg/kg (lead) and 74 mg/kg (zinc).

- **Brian O'Lynn Adit**
  - 450 cy of wasterock, with toe of pile located adjacent to Scissors Creek, exhibited arsenic concentrations of 290 mg/kg and 357 mg/kg, which exceeds the average background arsenic concentration of 96 mg/kg.
  - Lead (40 and 719 mg/kg) and zinc (111 and 541 mg/kg) were also detected above average background concentrations of 12.3 mg/kg (lead) and 74 mg/kg (zinc).

- **Little Giant Adit**
  - 60 cy of wasterock, located upgradient of the Street Adit, did not appear to be migrating downslope and offsite.
  - Arsenic, lead, and zinc were detected above average background concentrations.
  - Arsenic (200 mg/kg), lead (748 mg/kg) and zinc (300 mg/kg) were also detected above average background concentrations of 96 mg/kg (arsenic), 12.3 mg/kg (lead) and 74 mg/kg (zinc).

- **Aquatic Summary**
  - Concentrations of arsenic and other metals in surface water, pore water, and sediment in Ochoco and Scissors Creeks indicates that the Site is impacting the aquatic environment.
  - Decreases in the number of benthic macroinvertebrates species in pool habitats at Station OC-04 (downstream from the Ochoco Mine) and Station OC-05 (downstream from the Mayflower Mine) compared to the other stations suggests the possibility that the Site is impacting benthic macroinvertebrates in Ochoco Creek.

2.2 Human Health Risk Assessment Summary

- A human health risk assessment (HHRA) was performed as part of the SI and included as Appendix D in the SI Report (CES, 2005). A brief summary of the conclusions is presented below.
- There were numerous contaminants of potential concern (COPCs) in all media at the Site, with arsenic being the main COPC.
- Quantitative risk assessment determined that no unacceptable non-carcinogenic health effects are anticipated for exposure to COPCs in all media.
- Arsenic was the only carcinogenic COPC identified at the Site in soil, wasterock, and tailings.
  - No unacceptable human health risks were identified from exposure to arsenic under the Central Tendency Exposure, which are more realistic exposure conditions.
  - Risks from ingestion and dermal contact with arsenic-impacted soil, wasterock, and tailings under the Reasonable Maximum Exposure, worst-case conservative estimate of exposure, exceeded the Oregon Department of Environmental Quality's (ODEQ) regulatory standard of 1×10^{-6} excess cancer risk at the Site.
- Per OAR 340-122-0040(2)(a) and OAR 340-122-0084, risk-based cleanup concentrations can be calculated to mitigate a hazardous substance release.
  - A risk-based cleanup concentration for soil, wasterock, and tailings was calculated to be 53 mg/kg total arsenic.
  - 53 mg/kg is below the average background arsenic concentration of 96 mg/kg.
  - Per OAR 34-122-0040(2)(c), the cleanup concentration was adjusted to 96 mg/kg, to be no more stringent than that average background concentration determined around the Site.

2.3 Ecological Risk Assessment Summary

- A Screening Level Ecological Risk Assessment (ERA) was completed in accordance with ODEQ guidance (ODEQ, 2001) and presented in Appendix D of the SI Report (CES, 2005). A brief summary of conclusions is presented below.
- Elevated concentrations of several COPECs (antimony, arsenic V, total arsenic, chromium III, total chromium, copper, iron, lead, manganese, mercury, methyl mercury, silver, and zinc) are present primarily in soil, wasterock, tailings, and sediment at the Site.
- Immobile receptors (i.e., plants and invertebrates) are likely to be impacted within the boundaries of the Site; more so at the Mayflower Mine where there were more exceedances of ecological risk based screening concentrations and several ecological hot spots identified.
- Individual birds and mammals that consistently inhabit and/or forage at the Mayflower Mine may also be impacted due to the COPECs.
- Concentrations of several COPECs are elevated in the Mayflower Adit seep water, but ecological risks are not expected due to the limited size and nature of the drainage.
- Birds and mammals are unlikely to be impacted due to COPECs in surface water and pore water of Ochoco Creek and Scissors Creek.
- In sediment, arsenic V and total arsenic have the greatest potential to cause ecological impacts at OC-05 (adjacent to Mayflower Mine) and SC-02 (Scissors Creek drainage).
  - Given the results of the benthic macroinvertebrate survey which suggested potential impacts at OC-SS-5 and SC-02, there is a weight of evidence suggesting that elevated concentrations of Site-related chemicals are impacting benthic macroinvertebrates.
  - Given the relatively limited distribution of these elevated COPEC concentrations in sediments, impacts to bird and wildlife populations are considered unlikely.
- The total arsenic cleanup concentration of 96 mg/kg recommended to reduce human health risks is expected to reduce the ecological impacts that were predicted for the Site to within acceptable levels.

2.4 Human and Ecological Hot Spots

- A hot spot is generally defined as an area that presents an unacceptable risk and the contamination is highly concentrated, highly mobile or cannot be reliably contained (ODEQ, 1998).
  - No human health hot spots were identified because the areas that indicated human health risk were not deemed to be highly concentrated and/or highly mobile, and they could be reliably contained with proper engineering controls.
  - Numerous ecological hot spots were identified in all media at the Site because the areas that indicated ecological risk were deemed to be highly concentrated (i.e., > 10 times the ecological risk-based screening concentration).
- OAR 340-122 (Hazardous Substance Remedial Action Rules), require that certain actions be taken for "hot spots" of contamination, which includes the "treatment" of hot spots, to the extent feasible, as part of a remedial action selected or approved by the Director of the ODEQ.

3.0 SITE CLEANUP CRITERIA

3.1 Applicable or Relevant and Appropriate Requirements

- Federal, state, and local applicable or relevant and appropriate requirements (ARARs) are used to:
  - Evaluate the extent of site cleanup needed;
  - Scope and develop Removal Action alternatives; and
  - Guide the implementation and operation of the preferred alternative.

- The NCP (40 CFR 300.415(j)) establishes that Removal Actions shall "to the extent practicable, 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); the 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 (e.g., removal of a contaminant source that may improve groundwater or surface water quality, but not meet water quality criteria, thus not meeting the ARARs due to residual contamination).
  - ARARs are either chemical, location, or action specific.
  - The list of ARARs evaluated for the Site are presented in Appendix A.

3.2 Risk-Based Cleanup Concentrations

- Human health risk-based cleanup concentration for soil, wasterock, and tailings was calculated at 56 mg/kg total arsenic.
- Per OAR 34-122-0040(2)(c), the cleanup concentration was adjusted to 96 mg/kg, to be no more stringent than that average background concentration expected around the Site.
- Ecological risk-based cleanup concentrations can not be calculated unless a more detailed species specific ecological risk assessment is performed.
- Removal or containment of wasterock, tailings, and soil to the cleanup concentration of 96 mg/kg should control migration of contaminants and exposure routes and will be considered protective of ecological receptors.

4.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

4.1 Removal Action Justification

- The NCP states that an appropriate Removal Action may be conducted at a site when a threat to human health or welfare or the environment is identified.
- The Removal Action is undertaken to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or the threat of a release at a site.
- Section 300.415(b)(2) of the NCP outlines eight factors to be considered when determining the appropriateness of a Removal Action; these factors are assessed against the preferred alternative in Section 7.0:
  1. **"Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants"**
     - Complete exposure pathways to human (recreational) and ecological receptors (aquatic and terrestrial) were documented during the SI from exposure to metal-impacted wasterock, soil, tailings, and stream sediment.
  2. **"Actual or potential contamination of drinking water supplies or sensitive ecosystems"**
     - No known drinking water supplies exist around the Site.
     - Ochoco and Scissors Creeks and associated ecological receptors in the vicinity of the Site, are being impacted by the erosion of wasterock, soil, tailings, and sediment located adjacent to the creeks.
  3. **"Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release"**
     - No drums or barrels were observed onsite, but the remains of a cyanide vat is present.
     - Soil samples from the vat area exhibited some of the highest concentrations of several metals (arsenic, lead, manganese, silver, and zinc).

4. **"High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate"**
   - Surficial wasterock, soil, and tailings are contaminated with metals; erosion of this material has been documented in Ochoco and Scissors Creeks.
5. **"Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released"**
   - Wasterock and tailings that are located within the floodplain have the potential to continue to migrate during flood events.
6. **"Threat of fire or explosion"**
   - No known fire or explosion threat is present at the Site.
7. **"The availability of other appropriate federal or state mechanisms to respond to the release"**
   - No other federal or state agency has the jurisdiction to implement a Removal Action on Forest Service administered land.
8. **"Other situations or factors that may pose threats to public health or welfare of the United States or the environment."**
   - Site is located in the ONF, along a maintained county road where Site access is readily available to the public.

4.2 Scope of the Removal Action

- Scope of the Removal Action for the Site is to achieve cleanup of Site-related hazardous substances to acceptable levels of risk to humans and the environment.
- Scope does not include removal of naturally occurring (undisturbed by historic human activities) metal-enriched soil, rocks, or groundwater.

4.3 Removal Action Schedule

- Removal Action process should be completed in a period of 18 to 24 months, not including the post monitoring, which should be conducted for three years following the Removal Action.
- Time period includes allotment for assessing data gaps, design of the recommended Removal Action; review by the client and appropriate regulatory bodies; public comment; preparation of bid documents; completion of the Removal Action; and completion of the final Removal Action Report.

5.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

- This section describes the selection of a Removal Action using a four step process:
  - Identify technologies and processes potentially applicable to the Site;
  - Screen technologies and processes to eliminate ineffective or unfeasible technologies;
  - Develop alternatives using combinations of technologies that pass the screening process; and
  - Evaluate the alternatives according to criteria described in Section 5.2.

5.1 Identification and Screening of Removal Action Options and Alternatives

- The purpose of identifying and screening technology types and processes is to eliminate those technologies and process options that are unfeasible and/or do not meet ARARs.
- General Removal Actions are refined into technology types and process options:
  - Multiple treatment technologies and process options have been evaluated for mine/mill solid waste, most of these are not considered feasible because they would require extensive treatability studies, which are cost prohibitive, and not considered appropriate.
  - Table 1 summarizes the results of the screening process for developing alternatives.

5.1.1 Identification and Description Alternatives For Further Evaluation

- Conceptual alternatives were developed from the technologies that passed the screening process.
- Key design features are estimates only and provided for comparison purposes.
- Using the retained process options, the following alternatives were selected for detailed analysis:
  - Alternative 1 – No Action
  - Alternative 2 – Excavation and Onsite Containment in Two Repositories
  - Alternative 3 – Excavation and Offsite Disposal

5.1.1.1 Alternative 1: No Action

- No Removal Action would be completed to control contaminant migration, or reduce the toxicity or volume.
- Would require no further investigation or monitoring action.
- Used as baseline against which other removal options can be compared as suggested by the NCP.

5.1.1.2 Common Items for Alternatives 2 and 3

- Several items are common to Alternatives 2 and 3, and will be discussed and outlined in this section.
- Evaluation of these common items against the evaluation criteria is included in the overall evaluation of each of the alternatives.
- A summary of the common items is outlined in the following:

  - **Building Material, Equipment, and Debris Demolition / Disposal**.
    - All metal, wood, equipment, and other miscellaneous nuisance debris that pose a potential physical or chemical hazard to Site users will be removed from the Site.
    - To the extent possible and practicable, the Mayflower Mill area will be left intact; tailings and concentrations above the cleanup concentration will be removed using hand tools.
    - CES estimates that 10 cy of material will be disposed offsite at the local Subtitle D Landfill.

  - **Mayflower Adit Discharge**
    - Water discharging from the Mayflower Adit currently infiltrates into the soils near the upper access road, there is no evidence that the adit discharges directly to Ochoco Creek.
    - Discharge water will be diverted to an infiltration basin located in the vicinity of the adit and in native material deemed to be stable.
    - For budgeting purposes, the dimensions of the infiltration basin will be 3-feet wide by 3-feet long by 3-feet deep, filled with 3-inch minus rock.
    - Exact dimensions and layout will be determined during the Removal Action.

  - **Mayflower Mine Upper Adit and Possible Shaft**
    - Samples collected from the Upper Adit during the SI indicate that the arsenic concentrations (71.7 mg/kg and 76.7 mg/kg) are below the cleanup concentration of 96 mg/kg.
    - Based on this, the wasterock associated with this adit (~70 cy) and the possible shaft will be recontoured to blend in with the surrounding terrain.
    - If bats are determined to inhabit the Upper Adit during the data gap investigation (Section 5.4), a bar gate will be installed, otherwise wasterock will be backfilled in the adit. For budgeting purposes, CES assumes that bats will not be present and a bar gate will not be installed.
    - The recontoured wasterock will be covered with non-impacted soil that can be scavenged from around the immediate area and revegetated in the same manner as the other areas.
    - Access to the Upper Adit will be an old logging road located about 40-feet above the adit.

- **Little Giant Adit and Wasterock**
  - A wasterock sample collected during the SI indicated that arsenic (200 mg/kg) was above the cleanup concentration of 96 mg/kg.
  - The adit is collapsed with no signs of water discharge.
  - Equipment access to the adit and wasterock is currently not feasible without constructing a new road which would disturb a significant amount of the hillside.
  - Based on this and the small amount of wasterock (60 cy), no action would be taken at this area during the Removal Action.

- **Ochoco Mine Adit and Wasterock**
  - Samples collected during the SI indicate that the arsenic concentrations (ranging from 1.21 mg/kg and 25.5 mg/kg) are below the cleanup concentration of 96 mg/kg.
  - Wasterock within the 100-year floodplain of Ochoco Creek (~300 cy) will be excavated to reduce sedimentation and metal loading.
  - Portal area will be backfilled with the excavated wasterock, the remaining material will be recontoured to blend in with the surrounding terrain outside of the 100-year floodplain.
  - 100-year floodplain limits are estimated on Figure 3 and will be finalized during the Removal Action
  - At the request of the Forest Service, CES evaluated using a "Spider Excavator" to try to minimize disturbance on Ochoco Creek and the riparian area.
    - Based on research and discussions with contractors' familiar with these types of excavators, we determined that they are not well suited or equipped to excavate and grade large quantities of material.
    - CES proposes using a small excavator with rubber tracks to excavate and place the wasterock, special care will be taken to minimize disturbance to Ochoco Creek, associated riparian areas, and large trees.
  - Recontoured wasterock will be covered with non-impacted soil that can be scavenged from around the immediate area and revegetated in the same manner as the other areas.
  - After the wasterock pile has been removed, the short section of Ochoco Creek that is channelized by the wasterock pile will be reconstructed to match the upstream and downstream channels.
    - Willows from around the area will be used in the revegetation process.
    - Details associated with the reconstruction and stabilization will be determined during the Removal Action.

- **Road Maintenance and Decommissioning**
  - During the Removal Action, FR 2200-100 (Scissors Creek Road) will be closed to traffic.
  - All other Forest Service and county roads will be left open using signs/flagging; Oregon Department of Transportation approved signs will be used on county roads.
  - Water will also be applied as needed to control fugitive emissions.
  - Upon completion of the Removal Action activities, roads within the limits of the Site and other access roads constructed during the Removal Action will be decommissioned.
  - Decommissioning will consist of recontouring the road for proper drainage, ripping to 6-inches, seeding, and mulching; CES estimates a total of 2,000 lineal feet of roads to be decommissioned.
  - Following decommissioning, large boulders or trees will be placed to limit unauthorized vehicle access.

5.1.1.3 Alternative 2: Excavation and Onsite Containment in Two Repositories

- CES and the Forest Service have selected two repository locations.
  - Repository #1 is an old quarry and located across the road from the Mayflower Mine on FR 2200-125, and has the potential to hold up to 16,000 cy of waste material.
  - Repository #2 is an old quarry and located along FR 2200-120, and has the potential to hold up to 10,000 cy of waste material.
  - Capacity of the repositories will be refined during the Removal Action.
  - There appears to be sufficient cover material at each location to construct the repository covers.
- Wasterock, tailings, and impacted soil at the Mayflower Mine (~13,200 cy) will be excavated and transported to Repository #1.
  - Estimated round trip haul is 1.0 mile.
  - Material would be excavated using a standard excavator and transported using standard 10-cy dump trucks.
- Wasterock at the Street Adit (~1,000 cy) will be excavated and transported to Repository #2.
  - Estimated round trip haul is 2.8 miles.
  - Access to the Street Adit and top of the wasterock pile will be using the old mining road located on the northeast side, with minimal improvements.
  - Wasterock would be pushed downhill using a small bulldozer to the base of the slope along FR 2200-100 (Scissors Creek Road), loaded with a standard excavator and transported using 10-cy dump trucks.
- Wasterock at the Brian O'Lynn Adit (~450 cy) will be excavated and transported to Repository #2.
  - Estimated round trip haul is 2.4 miles.
  - A bridge will be placed over Scissors Creek for access.
  - Due to the location of Scissors Creek at the toe of the slope, it will be difficult to remove the wasterock using conventional methods.
  - CES will assess removal options (e.g., using a conveyor belt system or two bridges) during the Removal Action.
- Visual observations and a Niton XRF will be used to delineate the extent of the excavations; confirmation samples will be collected and sent to the laboratory to document the removal.
- Both repositories will be contoured to blend with surrounding contours; the exact layout and slopes of the repositories will be determined during the Removal Action.
- Leaching results from the SI suggest that significant metal leaching does not appear to be occurring in the waste material. Based on this:
  - A water-balanced or impervious cover is not warranted.
  - Repositories will be covered with a 1-foot soil cover (6-inch equipment compacted lift and 6-inch loose lift).
  - Amount of cover soil needed is estimated at 2,200 cy for Repository #1 and 550 cy for Repository #2.
- All disturbed areas and the repositories (~8 acres) would be recontoured and revegetated.
  - Revegetation consists of fertilizing, seeding (including tree seedlings), and mulching to all disturbed areas.
  - Certified weed-free mulch would be applied to control erosion during plant establishment.
  - Seed mix and types of seedlings will be selected following consultation with the Forest Service.
- Storm water and snowmelt run-on would be controlled on the upgradient side by constructing run-on control berms; these will be incorporate into the grading activities so separate run-on ditches will not be required.

5.1.1.4 Alternative 3: Excavation and Offsite Disposal

- Under this alternative, all waste material at the Site that exceeds the cleanup concentration of 96 mg/kg total arsenic would be excavated and transported offsite for disposal.
  - Mayflower Mine – 13,200 cy of wasterock, tailings, and soil
  - Street Adit – 1,000 cy of wasterock
  - Brian O-Lynn – 450 cy of wasterock
  - Material would be removed using the same equipment and methods as outlined in Alternative 2.
- Since the material did not exceed the RCRA disposal limits, the material can technically be disposed in a Subtitle D facility.
  - Subtitle D facilities are not willing to accept the material and potential liability of mining waste.
  - CES assumes the material would have to be disposed at the Arlington, Oregon Subtitle C facility (round trip haul of ~300 miles).
- Excavated areas will be recontoured to blend into the surrounding contours.
- Visual observations and a Niton XRF will be used to delineate the extent of the excavations; confirmation samples will be collected and sent to the laboratory to document the removal.
- All disturbed areas (~6 acres) would be recontoured and revegetated.
  - Revegetation consists of fertilizing, seeding, and mulching to all disturbed areas.
  - Certified weed free mulch would be applied to control erosion during plant establishment.
  - Seed mix will be selected following consultation with the Forest Service, and will include small trees in the planting plan.
- Storm water and snowmelt run-on would be controlled on the upgradient side by constructing run-on control berms; these will be incorporate into the grading activities so separate run-on ditches will not be required.

5.2 Analysis of Selected Removal Action Alternatives

- As required by the CERCLA guidance (USEPA, 1993) and the NCP (40 CFR 300.415), Removal Action alternatives that were retained after the initial evaluation and screening have been evaluated individually against the following three criteria (effectiveness, implementability, and cost), and listed subcriteria.

  - **Effectiveness**
    - Compliance with Removal Action goals and objectives
    - Overall protection of human health and the environment
    - Compliance with ARARs
    - Long-term effectiveness and permanence
    - Reduction of toxicity, mobility, or volume through treatment
    - Short-term effectiveness
  - **Implementability**
    - Administrative feasibility
    - Technical feasibility
    - Availability of services and materials
    - State and community acceptance
  - **Cost**
    - Direct capital costs
    - Indirect capital costs
    - Annual maintenance and inspection costs
- Table 2 outlines the comparative analysis of the retained alternatives against the listed criteria.

5.3 Cost Estimates

- Evaluation of costs consists of developing conservative, order-of-magnitude estimates based on the description of work items developed for each Removal Action alternative.
- A similar set of assumptions is used for all the alternatives, so that the *relative* difference in cost between alternatives is represented.
- Appendix B provides detailed cost estimates with the capital, indirect, operation and maintenance costs, as well as the 20 year Net Present Value (NPV) of each of the alternatives.
- Costs are presented below, from least to most expensive:

Alternative	Estimated Cost (NPV)
Alternative 1	$0
Alternative 2	$654,000
Alternative 3	$2,410,000

5.4 Identification of Data Gaps

- None of the data gaps identified appear to be significant enough to warrant stopping the EECA process in order to investigate.
- Data gaps listed should be completed and evaluated as part of the Removal Action.
- Costs associated with these data gaps are estimated at $23,000.
  - **Background Soil Samples –** CES recommends additional background samples (~six) be collected from around the Site to further quantify the statistical concentrations, and to check the accuracy of the one background sample that exhibited a high concentration of arsenic (609 mg/kg). Estimated costs are $5,000.
  - **Topographic Survey –** As part of the Removal Action, CES recommends detailed topographic surveys be completed at the Street Adit, Brian O'Lynn Adit, and both repositories to document the existing conditions. Estimated costs are $15,000.
  - **Bat Study –** During the Removal Action, a study will be performed to assess the presence of bats (particularly Townsend big-eared bats). Estimated cost for the study is $3,000, if combined with the other data gaps.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

- This section compares each of the retained alternatives evaluated in Section 5 to identify a preferred alternative.
- Effectiveness of the retained alternatives was evaluated in terms of what advantages each alternative has in each of the evaluation criteria outlined in Table 3.
- Alternative 2 – Excavation and Onsite Containment in Two Repositories (along with the common items) is considered the most appropriate and cost-effective alternative because of the following advantages:
  - Reduces risk to human health and ecological receptors to an acceptable level compared to Alternative 1;
  - Provides a reduction in the mobility of containments compared to Alternative 1;
  - Removes wasterock/tailings from the Ochoco Creek floodplain compared to Alternative 1;
  - No liability associated with future offsite disposal facility cleanup compared to Alternative 3;
  - Significantly reduces potential spillage along highways and eliminates potential spillage along residential areas that could impact human health and the environment compared to Alternative 3;
  - No waste generator fees associated with offsite disposal compared to Alternative 3; and
  - Cost savings of $1,756,000 compared to Alternative 3.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

- Based on the conclusions of the detailed analysis and comparative analysis of alternatives above, Alternative 2 – Excavation and Onsite Containment in Two Repositories is proposed as the preferred alternative for the Site.
- The total estimated cost to implement the recommended Removal Action is $654,000, which includes the data gaps estimated at $23,000.
- The eight factors that were outlined under Section 3.1 as justification for completing a Removal Action are further assessed below with the preferred alternative.

1. **"Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants"**
   - Exposure to human and ecological receptors is reduced by consolidating the wasterock, tailings, and soil that exceed the risk-based cleanup concentration into two repositories covering with a soil cover.
   - Wasterock and tailings from the Ochoco Creek floodplain are removed and incorporated in the repositories.
2. **"Actual or potential contamination of drinking water supplies or sensitive ecosystems"**
   - By consolidating the wasterock, tailings, and soil into two repositories, including removal of the wasterock and tailings from Ochoco Creek floodplain, the impact on the sensitive ecosystems (Ochoco Creek, Scissors Creek, and ecological receptors) is greatly reduced.
3. **"Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release"**
   - No drums or barrels were observed onsite; the remains of a cyanide vat and associated metal-impacted soil will be consolidated into Repository #1.
4. **"High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate"**
   - Surficial wasterock, tailings, and soil will be consolidated into two covered repositories, which will reduce future migration of metals into Ochoco and Scissors Creeks.
5. **"Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released"**
   - Wasterock and tailings is removed from the Ochoco Creek floodplain and transport and migration of wasterock and tailings during flood events is greatly reduced.
6. **"Threat of fire or explosion"**
   - No known fire or explosion threat is present at the Site.
7. **"The availability of other appropriate federal or state mechanisms to respond to the release"**
   - No other federal or state agency has the jurisdiction to implement a Removal Action on Forest Service administered land.
8. **"Other situations or factors that may pose threats to public health or welfare of the United States or the environment."**
   - Public use of the Site will not be controlled following implementation of the preferred alternative, but risk to recreational receptors will be controlled by soil covers and signs.

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 Forest Service. The Forest Service 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, Forest Service believes that this site should not be considered a "federal facility" within the meaning of CERCLA Section 120 and should not be listed on the Federal Agency Hazardous Waste Compliance Docket. Instead, this site should be included on EPA's CERCLIS database. Consistent with the June 24, 2003 OECA/FFEO "Policy on Listing Mixed Ownership Mine or Mill Sites Created as a Result of the General Mining Law of 1872 on the Federal Agency Hazardous Waste Compliance Docket," we respectfully request that the EPA Regional Docket Coordinator consult with the Forest Service and EPA Headquarters before making a determination to include this site on the Federal Agency Hazardous Waste Compliance Docket.

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2. ODEQ, 1998. *Guidance for Identification of Hot Spots.* Waste Management and Cleanup Division, Oregon Department of Environmental Quality. (Final, April 23, 1998).

3. ODEQ, 2001. *Guidance for Ecological Risk Assessment.* Waste Management and Cleanup Division, Oregon Department of Environmental Quality. December.

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TABLES

Table 1. **Removal Action Technology Screening Summary**
Table 2. **Comparative Analysis of Retained Removal Action Alternatives**
Table 3. **Attributes and Advantages of Removal Action Alternatives**

Table 1. Removal Action Technology Screening Summary
Mayflower – Ochoco Mine Complex, Ochoco National Forest

Technology Class	Process Option	Description	Effectiveness	Implementability	Cost	Operation and Maintenance	Land Impacts	Pros	Cons	Retained?
No Action										
No Action	**No Action**	**No Action**	**NA**	**NA**	**NA**	**NA**	**None**	**No Cost**	**Does not address risk**	**Yes**
Institutional Controls										
Access Restrictions	Fencing	Security fences installed around contaminated areas and adits to limit access	Medium	High	Medium	High - Due to vandalism	Minimal impact to undisturbed areas	Exposure to humans and terrestrial ecological receptors reduced	High potential for vandalism	No
	Land Use Controls	Legal restrictions to control current and future land use	Medium	Low	Low	None	None	Low Cost	Difficult to implement	No
Engineering Controls										
Solid Containment	Water- Balanced Topsoil Cover	Apply topsoil and establish vegetation to contain source using cover designed around annual precipitation (rain and snow)	High	High	Medium to High	Low - Inspect for erosion	Would impact 0.5-1 acres of undisturbed areas for stockpile and access	Surface infiltration into source material controlled by evapotranspiration	High cost if high quality topsoil not available onsite, effective if combined with other options.	No
	Soil Cover	**Soil cover (not topsoil) to provide medium for vegetation, does not control leaching through source**	**Medium**	**High**	**Low**	**Low - Inspect for erosion**	**Would impact 0.5-1 acres of undisturbed areas for stockpile and access**	**Easily implemented with onsite cover soil, for use when SPLP does indicate significant leaching**	**Does not control infiltration into waste material, effective if combined with other options**	**Yes**
	Geosynthetic Cover	Multilayer with geomembrane, cover soil, and seed	High	High	High	Low - Inspect for erosion	Would impact 1-2 acres of undisturbed areas for materials and access	Surface infiltration would be eliminated	Difficult to install and test, high cost	No
	Multi-Layered RCRA Cap	Compacted clay layer covered with soil and vegetation in contaminated surface areas	High	High	High	Low - Inspect for erosion	Would impact 1-2 acres of undisturbed areas for materials and access	Effective for isolated wastes, surface infiltration would be eliminated	Difficult to install and test, high cost	No
Surface Controls	**Consolidation**	**Combining wasterock/tailings into single area**	**High**	**High**	**Medium**	**Low - Inspect for erosion**	**Would impact 1-2 acres of undisturbed areas for grading and repository construction.**	**Easily implemented, waste material consolidated**	**Effectiveness dependent on combining with other options**	**Yes**
	Grading	**Level wasterock/tailings to reduce slopes for managing runoff, erosion, and surface infiltration**	**Medium**	**High**	**Medium**	**Low - Inspect for erosion**		**Easily implemented, offsite transport of waste greatly reduced**	**Effectiveness dependent on combining with other options**	**Yes**
	Revegetation	**Add amendments to wasterock/tailings and seed to promote vegetation for controlling water infiltration and erosion**	**High**	**High**	**Medium**	**Low - Inspect for erosion**	**Minimal impact to undisturbed areas**		**Effectiveness dependent on combining with other options, highly dependent on quantity and quality of cover soil.**	**Yes**
	Erosion Protection/ Run-on Control	**Erosion resistant materials, commercial fabrics placed on steep slopes; run-on diversion structures to channel water away from revegetation areas.**	**High**	**High**	**Low**	**Low - Inspect for erosion**			**Effectiveness dependent on combining with other options. Diverted water needs to be managed.**	**Yes**
Land Disposal										
Onsite Disposal	**Constructed Repository**	**Excavate wasterock/tailings and place in onsite repository with cover**	**High**	**High**	**Medium**	**Medium – Inspect stability of cap and erosion.**	**Would impact 1-2 acres of forest for suitable location**	**Human and ecological risk and exposure reduced**	**Medium cost, long term liability**	**Yes**
Offsite Disposal	**RCRA Landfill**	**Excavate wasterock/tailings/soil and disposed in RCRA-C landfill**	**High**	**High**	**High**	**None – Material hauled off site**	**Minor impacts to transport material off site**	**Easily implementable, risk and exposure eliminated**	**High transport and disposal costs**	**Yes**
	Solid Waste Landfill	**Excavate wasterock/tailings/soil and disposed in solid waste landfill**	**High**	**High**	**Medium**	**None – Material hauled off site**	**Minor impacts to transport material off site**	**Easily implementable, risk and exposure eliminated**	**High transport costs, Subtitle D facility may not accept material**	**Yes**
Treatment										
Solid Treatment	Reprocessing - Milling And Smelting	Shipping waste material to operating mill and/or smelter facility for extraction of metals	Medium	Low	High	Low – Inspect for erosion	Minor impact to transport material to be processed or process at mine	Human and ecological risk and exposure eliminated	High Costs, difficult to locate a facility willing to accept material, spent material must be disposed	No
	Thermal Treatment	Thermal treatment of waste material onsite	High	Medium	High	Low – Inspect for erosion	Minor impact to transport thermal unit onsite	Human and ecological risk and exposure eliminated	High Cost and spent material must be disposed	No
	Cement/ Pozzolan Additive	Tailings and ore/wasterock are solidified with non-leachable cement or pozzolan	High	High	High	Low – Inspect for erosion	Would impact 1-2 acres of undisturbed areas for repository construction.	Toxicity and mobility reduced, risk and exposure reduced	Volume of material will increase, need to be combined with water balance cap to control infiltration	No
	Physical/ Chemical Stabilization	Waste material treated in place when injected with stabilizing agent(s)	Medium	Low	Medium	Medium – May need to re inject agent	Minor impact to transport material to be injected	Toxicity and mobility reduced, risk and exposure reduced	Difficult to implement and mix thoroughly, need to be combined with water balance cap	No
Water Treatment / Control	Lined Settling Pond	Construct lined settling pond to remove suspected solids from the Mayflower Adit discharge	Medium	High	Medium	Medium – Excavate and dispose sludge every 5-10 years	Minimal < 0.1 acres	Passive system that reduces sediment load to Ochoco Creek, no pumps and motors	Only reduces sediments and precipitates formed on air contact. Sludge removal required	No
	Infiltration Basin	**Construct an infiltration basin to infiltrate Mayflower Adit seep into native soils**	**High**	**High**	**Low**	**Low – Inspect for erosion and sludge build-up**	**Minimal < 0.1 acres**	**Passive system that reduces sediment load to Ochoco Creek, no pumps and motors**	**Infiltration basin may clog over the years and need to be cleaned out**	**Yes**
	Anaerobic Wetland	Anaerobic wetlands to reduce metals from the Mayflower Adit discharge	Low	Medium	Medium	Medium – Dredge and replace media every 5-10 years & baffles every 2 years	~ 0.2 – 0.5 acres	Passive system that reduces metal load to Ochoco Creek, no pumps and motors	Less effective in winter, size requirement	No
	Aerobic Wetland	Aerobic wetlands to reduce metals from the Mayflower Adit discharge	Medium	Medium	Medium	Low – Inspect for erosion and sludge build-up	~ 0.3 acres	Passive system that reduces metal load to Ochoco Creek, no pumps and motors	Less effective in winter	No

NOTES:
NA = not applicable
Bold items retained for evaluation

TABLE 2: Comparative Analysis of Removal Action Alternatives
Mayflower – Ochoco Mine Complex, Ochoco National Forest

Assessment Criteria	Alternative 1: No Action	Alternative 2: Excavation and Onsite Containment in Two Repositories	Alternative 3: Excavation and Offsite Disposal
EFFECTIVENESS			
Compliance with Removal Action Goals and Objectives	Does not comply	Complies	Complies
Overall Protection of Public Health and the Environment	No Protection	Provides overall protection to humans and ecological receptors by containment of waste material exceeding the risk based cleanup concentrations in two repositories. Physical hazards and offsite migration are controlled.	Provides overall protection to humans and ecological receptors by removal and offsite disposal of waste material exceeding risk based cleanup concentrations. Physical hazards are controlled and offsite migration is eliminated.
Compliance with ARARs	Does not comply	Complies with all ARARs, including "treatment" of ecological hot spots.	Complies with all ARARs, including "treatment" of ecological hot spots.
Long Term Effectiveness and Permanence	None	Provides long term effectiveness and permanence, minimal maintenance expected.	Provides long term effectiveness and permanence, minimal maintenance expected.
Reduction of Toxicity, Mobility, or Volume	None	Toxicity and volume not reduced; mobility is reduced by containing waste material onsite in two respositories.	Toxicity, volume, and mobility is reduced by offsite disposal of waste.
Short Term Effectiveness	None	Easily constructed within one field season, risks to community/workers will be minimal.	Easily constructed within one field season, risks to community/workers will be minimal.
IMPLEMENTABILITY			
Technical Feasibility	Not Applicable	Difficult to construct due to excavation and removal of the wasterock at the Street and Brian O'Lynn wasterock. Other areas are easy to construct.	Difficult to construct due to excavation and removal of the wasterock at the Street and Brian O'Lynn wasterock. Other areas are easy to construct.
Administrative Feasibility	Not Applicable	Easily implemented; no permits are required.	Easily implemented. No permits required. Generator fees with offsite disposal.
Availability of Services and Materials	Not Applicable	Services and materials are available locally.	Services and materials are available locally, except disposal services, which are located in Arlington, Oregon.
State and Community Acceptance	Not acceptable, because continued migratation of arsenic into creeks.	Acceptable because waste material is contained onsite in two repositories.	Acceptable because waste material is contained offsite in a permitted facility.
COST			
Estimated Total Present Worth Cost	$0	$654,000	$2,410,000

TABLE 3: Attributes and Advantages of Removal Action Alternatives
Mayflower – Ochoco Mine Complex, Ochoco National Forest

Assessment Criteria		Alternative 1: No Action	Alternative 2: Excavation and Onsite Containment in Two Repositories	Alternative 3: Excavation and Offsite Disposal
EFFECTIVENESS				
Overall Protectiveness of Public Health, Safety and Environment	**Attributes**		All waste material greater than cleanup concentration contained onsite in two repositories.	All waste material greater than cleanup concentration removed.
	Advantages		+ Provides high level of human and ecological protection.	+ Provides highest level of human and ecological protection.
Compliance with ARARs	**Attributes**		All waste material greater than the cleanup concentration contained onsite in two repositories.	All waste material greater than cleanup concentration removed.
	Advantages		+ Complies, including "treatment" of hot spots	+ Complies, including "treatment" of hot spots
Long Term Effectiveness and Permanence	**Attributes**		Waste material consolidated onsite in properly designed and constructed repositories.	All waste material greater than cleanup concentration removed.
	Advantages		+ No liability with future offsite disposal facility cleanup. + Waste material is removed from the floodplain.	+ Less annual maintenance + No ATV damage to soil cover + Waste material is removed from the floodplain.
Reduction of Toxicity, Mobility and Volume	**Attributes**		Mobility and exposure controlled by onsite containment in two respositories. No reduction in toxicity and volume.	Mobility and exposure is eliminated by offsite disposal. No physical reduction in toxicity and volume, but material is transported offsite.
	Advantages		+ Mobility is significantly reduced in onsite repository.	+ Mobility is eliminated by offsite disposal in approved facility.
Short-Term Effectiveness	**Attributes**		No short term affect with onsite containment of waste material.	No short term affect with offsite disposal of waste material.
	Advantages		+ No risk to workers or community. + Significantly reduces potential spillage along highway and eliminates potential spillage along residential areas that could impact humans and the environment.	+ No risk to workers or community.
IMPLEMENTABILITY				
Technical Feasibility	**Attributes**		Moderately difficult to construct due to removing the waste material from the steep terrain.	Moderately difficult to construct due to removing the waste material from the steep terrain and long haul routes.
	Advantages			+ Easier to construct because no repositories.
Administrative Feasibility	**Attributes**		Easy to implement	Easy to moderately difficult to implement
	Advantages		+ Admin feasibility easier because no offsite disposal + No generator fees for offsite disposal charges.	
Availability of Services and Materials	**Attributes**		Services and materials available locally	Services and materials available locally, except offsite disposal
	Advantages		+ No offsite disposal, locally available supplies	
State and Community Acceptance	**Attributes**		Onsite containment is proven method.	Offsite disposal is proven method.
	Advantages			+ Highest level of acceptance
COST				
Estimated Total Present Worth Cost	**Attributes**	$0	$654,000	$2,410,000
	Advantages	+ $2,410,000	+ $1,756,000	

FIGURES

Figure 1. **Site Map and Repository Locations**
Figure 2. **Mayflower Mine Site Layout**
Figure 3. **Ochoco Mine Site Layout**

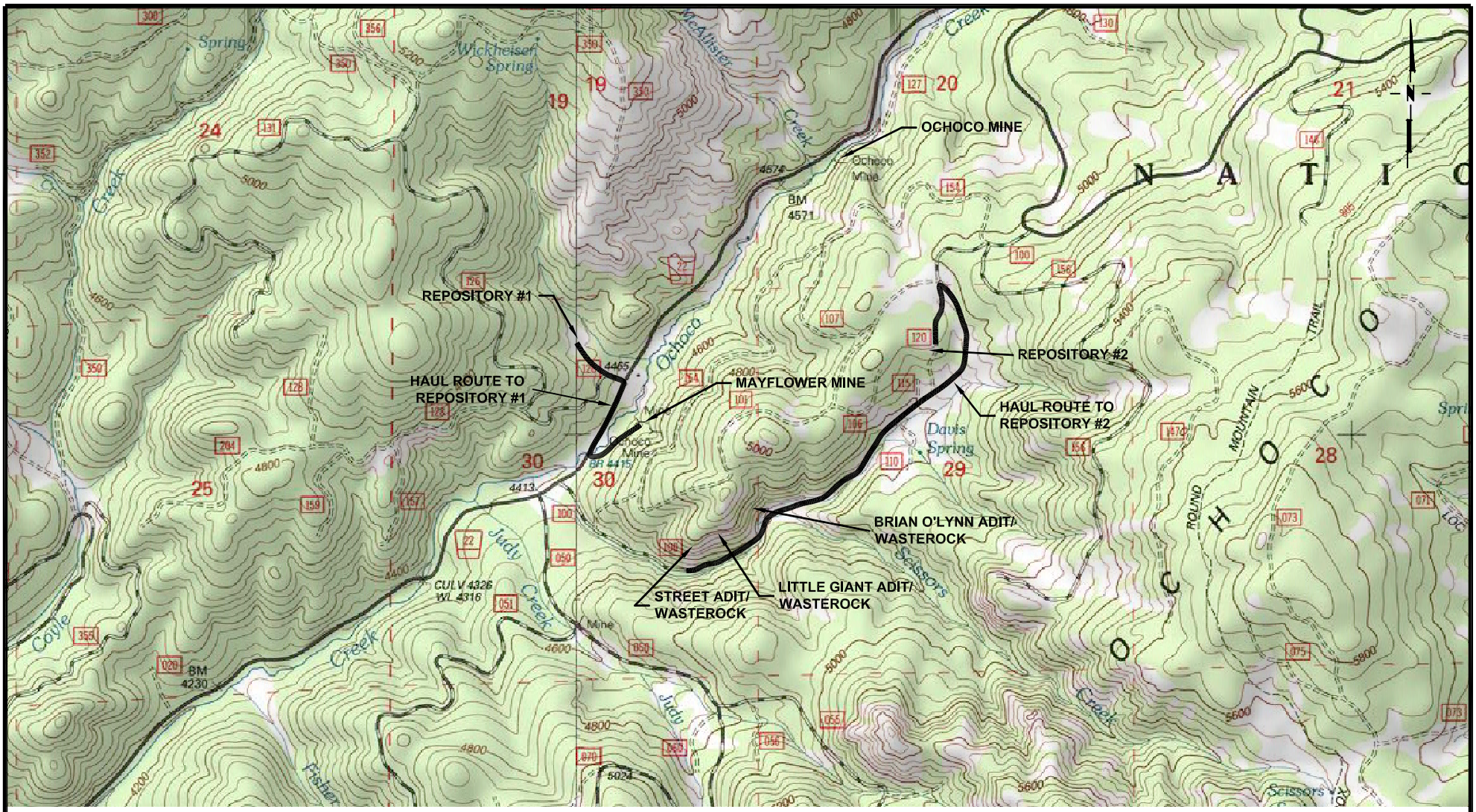


Figure 1. Site Map and Repository Locations

0 2000 FEET

(SCALE & LOCATIONS ARE APPROXIMATE)

CONTOUR INTERVAL = 40 FEET

PROJECT NUMBER: 2723011	MAYFLOWER - OCHOCO MINE COMPLEX EECA
DATE: 05-01-07	
DWG BY 6DGW / DWG NO: 2723011F1.DWG	USDA FOREST SERVICE OCHOCO NATIONAL FOREST, OREGON
PROJECT MANAGER: 6DGW	
REVISED:	CES CASCADE EARTH SCIENCES A Valmont Industries Company

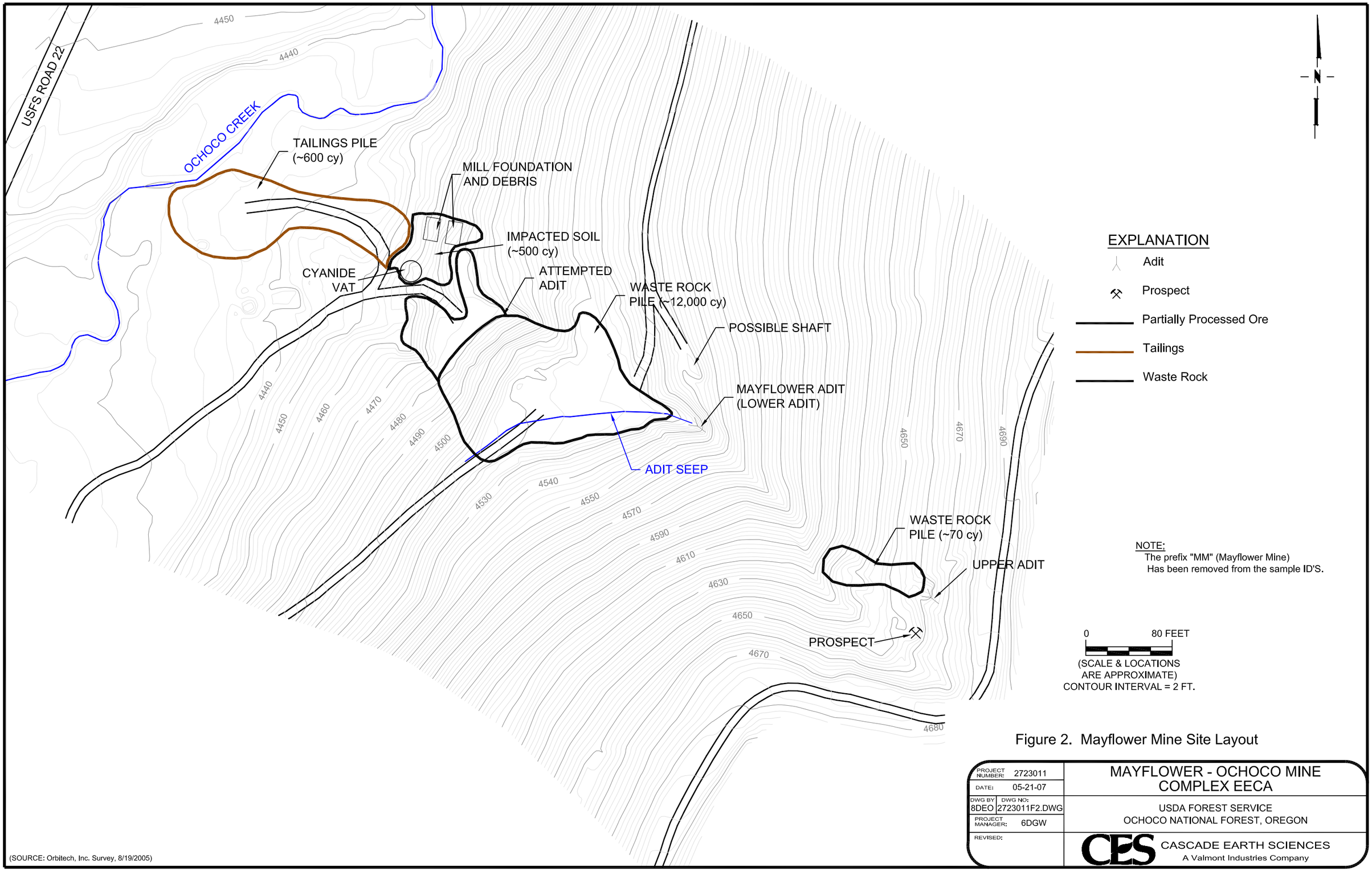
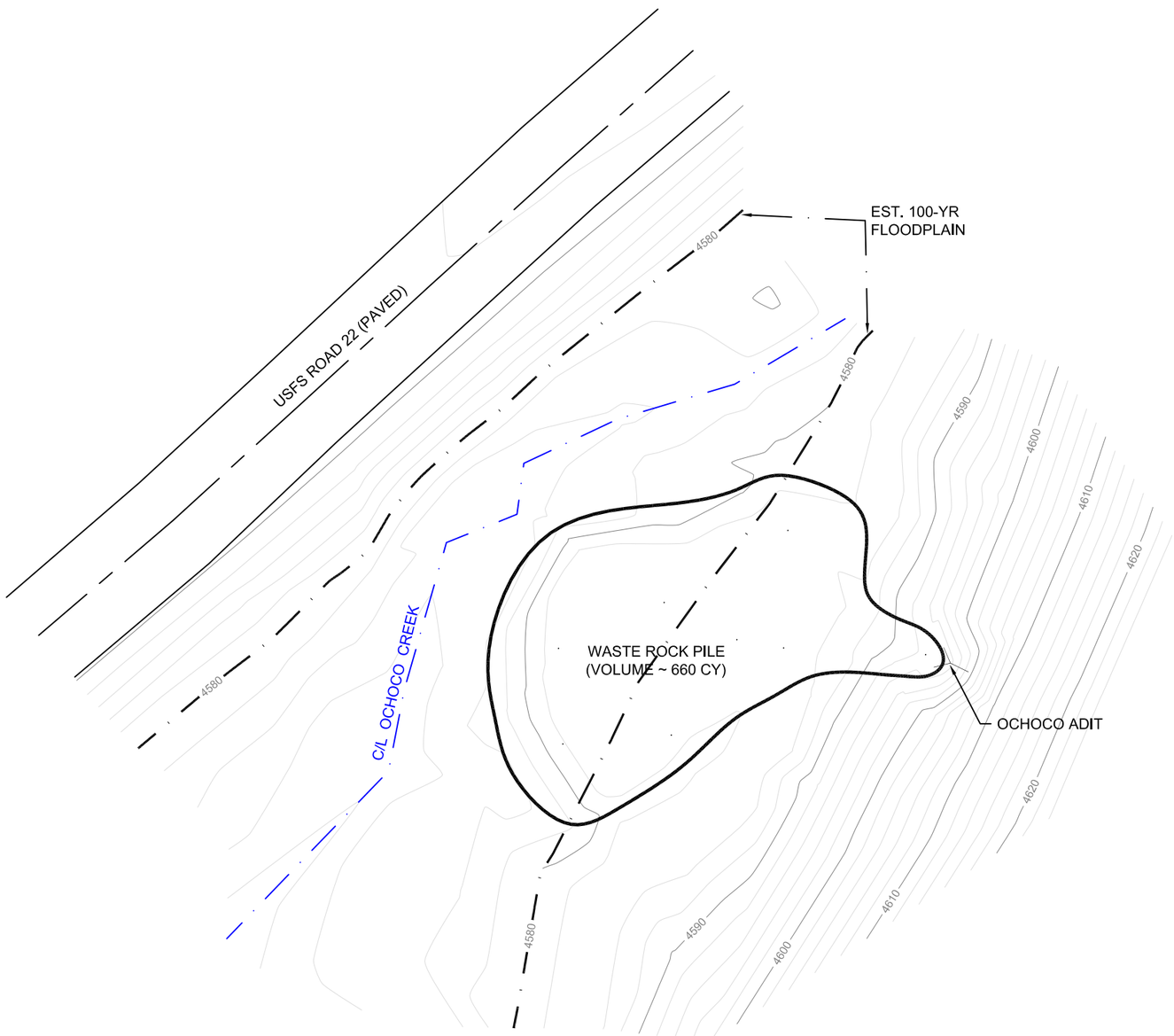


Figure 2. Mayflower Mine Site Layout



EXPLANATION

Adit

Waste Rock Boundary

NOTE:
The prefix "OM" (Ochoco Mine) has been removed from the sample ID'S.

Figure 3. Ochoco Mine Site Layout

0 30 FEET

(SCALE & LOCATIONS ARE APPROXIMATE)
CONTOUR INTERVAL = 2 FT.

(SOURCE: Orbitech, Inc. Survey, 8/29/2005)

PROJECT NUMBER: 2723011	MAYFLOWER - OCHOCO MINE COMPLEX EECA
DATE: 05-21-07	
DWG BY 8DEO / DWG NO: 2723011F3.DWG	USDA FOREST SERVICE OCHOCO NATIONAL FOREST, OREGON
PROJECT MANAGER: 6DGW	
REVISED:	CASCADE EARTH SCIENCES A Valmont Industries Company

APPENDICES

Appendix A. **Applicable and Relevant and Appropriate Requirements**
Appendix B. **Cost Estimates**

Appendix A.

Applicable or Relevant and Appropriate Requirements

Table 1. Chemical-Specific Applicable or Relevant and Appropriate Requirements
Mayflower – Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
Safe Drinking Water Act	40 USC § 300		
National Primary Drinking Water Regulations	40 CFR Part 141	Establishes health-based standards, maximum contaminant levels (MCLs), for public water systems.	Not an ARAR, since surface water and groundwater are not used as drinking water in the area surrounding the Site.
National Secondary Drinking Water Regulations	40 CFR Part 143	Establishes aesthetic standards (secondary MCLs) for public water systems.	Not an ARAR; these are not enforceable standards and are outside scope of removal action.
Clean Water Act	33 USC §§ 1251-1387		
National Ambient Water Quality Criteria	40 CFR Part 131	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	Not an ARAR since the State of Oregon has been delegated this program (see Page 2 – State ARARs).
Clean Air Act	40 USC § 7409		
National Primary and Secondary Ambient Air Quality Standards	40 CFR Part 50	Establishes air quality levels that protect public health.	Not an ARAR; only "major" sources are subject to requirements related to NAAQS, defer to State.
Preliminary Remediation Goals (PRGs) for soil and water	US Environmental Protection Agency (EPA) Region 9	PRGs are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations that are intended to assist risk assessors and others in initial screening-level evaluations of environmental measurements. The PRGs contained in the Region 9 PRG Table are generic; they are calculated without site specific information. However, they may be re-calculated using site specific data. PRGs should be viewed as Agency guidelines, not legally enforceable standards. They are used for site "screening" and as initial cleanup goals if applicable.	Relevant and Appropriate Requirement
Resource Conservation and Recovery Act	40 USC § 7601		
Lists of Hazardous Wastes	40 CFR Part 261, Subpart D and C	Defines those solids wastes which are subject to regulation as hazardous wastes under 40 CFR Parts 262-265 and Parts 124, 270, and 271.	Not an ARAR; mine waste is not a listed hazardous waste, Bevill exempt. Even if TCLP testing confirmed a characteristic waste (Subpart C), it is still exempt. Parts of the RCRA regulations may be relevant and appropriate; however, and are discussed under action-specific requirements.

Table 1. Chemical-Specific Applicable or Relevant and Appropriate Requirements
Mayflower – Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF OREGON			
Hazardous Substance Remedial Action Rules	OAR 340-122-0040, 0084, and 0115	Establishes Oregon Department of Environmental Quality (ODEQ) Guidelines for assessing human and ecological risk assessments from contamination according to ODEQ risk guidelines and levels. Also specifics the use of risk-based cleanup concentrations and the use of background concentrations.	Applicable Requirement
Hazardous Substance Occupational Exposure	OAR 437	Establishes Oregon-Occupational Safety and Health Administration (OR-OSHA) Permissible Exposure Limits (PELs). OR-OSHA exposure limits mirror the federal chemical specific limits (refer to NIOSH Pocket Guide to Chemical Hazards for details on individual chemicals)	Applicable Requirement
Numeric Soil Cleanup Levels for Motor Fuel and Heating Oil	OAR 340-122-305 through 360	Establishes cleanup standards for contamination of soil by motor fuel and heating oil.	To Be Considered
Oregon Soil Cleanup Rules for Simple Sites	OAR 340-122-045 and 046	Establishes ODEQ rules for streamlined cleanup processes and cleanup standards at simple sites.	To Be Considered
Oregon Water Pollution Control Statutes	ORS 468B.005-ORS 468B.190	Address effluent standards, permit requirements for discharges to US waters and minimum Federal water quality criteria. Applicable to the protection of surface water during removal activities.	Relevant and Appropriate Requirement
Groundwater Quality Protection Program	OAR Chapter 340 Division 40	Establishes the mandatory minimum groundwater quality protection requirements for federal and state agencies, cities, industries, and citizens.	Relevant and Appropriate Requirement
State of Oregon is authorized by the USEPA to implement the Clean Water Act in Oregon	ORS 468B.050 OAR Chapter 340 Division 41, Table 20	Establishes acceptable contaminant levels for ingestion of aquatic organisms and for intake by aquatic organisms in surface water.	Applicable Requirement
Oregon Air Pollution Laws	ORS 468A.005-ORS 468A.085	Provides a state program with laws governing air pollution control, abatement and prevention.	Relevant and Appropriate Requirement, during removal action.
Ambient Air Quality Standards and PSD Increments	OAR Chapter 340 Division 202	Establish concentrations, exposure time, and frequency of occurrence of an air contaminant in the ambient air that must not be exceeded.	Relevant and Appropriate Requirement, during removal action.
Asbestos Removal	OAR 340-32-5620 through 5650	Establishes ODEQ requirements for licensing and certification for asbestos workers. All workers who handle asbestos-containing materials must meet certain training and certification requirements.	To Be Considered

Table 2. Location-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
Resource Conservation and Recovery Act	40 USC § 7601		
Hazardous and Solid Waste Regulations	40 CFR Part 264.18	Location standards and restrictions for hazardous waste treatment, storage, and disposal (TSD) facilities.	Relevant and Appropriate Requirement
	40 CFR §§ 257.3-1 through 257.3-4	Location standards and restrictions for municipal solid waste (MSW) facilities.	Relevant and Appropriate Requirement
National Historic Preservation Act	16 USC § 470; 36 CFR Part 800 40 CFR 6.301(b)	Requires Federal Agencies to take into account the effect of any Federally assisted undertaking or licensing on any property with historic, architectural, archeological, or cultural value that is included in or eligible for inclusion in the National Register of Historic Places.	Applicable Requirement
Archeological and Historic Preservation Act	16 USC § 469 40 CFR 6.301(c)	Establishes procedures to provide for preservation of significant scientific, prehistoric, historic, and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a Federally licensed activity or program.	Relevant and Appropriate Requirement
The Archaeological Resources Protection Act of 1979	43 CFR 7	Regulates requirements for authorized removal of archaeological resources from public or tribal lands.	Relevant and Appropriate Requirement
Executive Order 11593	16 USC § 469 40 CFR § 6.301(c)	Provides for the inventory and nomination of historical and archeological sites.	Relevant and Appropriate Requirement
Federal Land Policy and Management Act of 1976	43 USC 1701	Provides for multiple use and inventory, protection, and planning for cultural resources on public lands.	Relevant and Appropriate Requirement
Native American Graves Protection and Repatriation Act	25 USC 3001-3013 43 CFR Part 10	Regulations that pertain to the identification, protection, and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony.	Relevant and Appropriate Requirement

Table 2. Location-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
Protection of Wetlands Executive Order No. 11990	40 CFR Part 6; Appendix A, 40 CFR 6.302(a)	Avoid adverse impacts associated with the destruction or loss of wetlands and avoid support of new construction in wetlands if a practicable alternative exists.	Relevant and Appropriate Requirement
Dredge and Fill Regulations	33 USC § 1344, 33 CFR 323.1 et. seq.	Prohibits discharge of dredged or fill material into waters of the United States without a permit	Relevant and Appropriate Requirement
Fish and Wildlife Coordination Act	16 USC Chapter 49, §§ 2901-2912; 40 CFR 6.302(g)	Requires consultation when Federal department or agency proposes or authorizes any modification of any stream or other water body to assure adequate protection of fish and wildlife resources.	Relevant and Appropriate Requirement
Floodplain Management Executive Order No. 11988	40 CFR Part 6, Appendix A 40 CFR 6.302(b)	Requires Federal agencies to evaluate the potential effects of actions they may take in a floodplain to avoid the adverse impacts associated with direct and indirect development of a floodplain to the extent possible.	Applicable Requirement
Endangered Species Act	16 USC §§ 1531-1543; 40 CFR 6.302 (h); 50 CFR Part 402	Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.	Applicable Requirement
Migratory Bird Treaty Act	16 USC §§ 703 et seq.	Establishes federal responsibility for the protection of the international migratory bird resource and requires continued consultation with the USFWS during remedial design and remedial construction to ensure that the cleanup of the site does not unnecessarily impact migratory birds.	Applicable Requirement
Bald Eagle Protection Act	16 USC §§ 668 et seq.	Requires continued consultation with the USFWS during remedial design and remedial construction to ensure that any cleanup of the site does not unnecessarily adversely affect the bald or golden eagle.	Applicable Requirement

Table 2. Location-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF OREGON			
Plants: Wildflowers and Endangered, Threatened and Candidate Species	OAR 635 Div 100	Provides for protection of certain plants, wildflowers, and shrubs; guidelines on the listing, reclassification, and delisting of plant species as threatened or endangered.	Applicable Requirement
Wildlife Diversity Program	OAR 635 Div 100	Provides rules for maintaining Oregon's wildlife diversity by protecting and enhancing populations and habitats of native wildlife at self-sustaining levels throughout geographic ranges.	Relevant and Appropriate Requirement

Table 3. Action-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL			
Clean Water Act	33 USC § 1342		
National Pollutant Discharge Elimination System	40 CFR Part 122.26	In general, Part 122 provides permit requirements for the discharge of pollutants from any point source into waters of the United States. Part 122.26 requires permits for storm-water discharges.	Relevant and Appropriate Requirement.
Surface Mining Control and Reclamation Act	30 USC §§ 1201-1328	Performance standards for surface mining activities.	Relevant and Appropriate Requirement
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 49 CFR Parts 10, 171-177	Regulates transportation of hazardous materials.	Applicable Requirement, if any hazardous materials are transported offsite.
Resource Conservation and Recovery Act	46 USC § 7601		
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	40 CFR Part 264.13.14	Requirements for proper handling, treatment, storage, and disposal of hazardous wastes.	Relevant and Appropriate Requirement
Land Disposal Restrictions (LDRs)	40 CFR Part 268	LDRs place specific restrictions (conc. or trmt) on RCRA hazardous wastes prior to their placement in a land disposal unit. Relevant and appropriate LDR requirements will be met if any material accumulations are treated *ex situ*.	Relevant and Appropriate Requirement
Disposal of Solid Waste	RCRA 42 U.S.C. § 6901 *et seq*; 40 CFR 257	Facility or practices in floodplains will not restrict flow of basic flood, reduce the temporary water storage capacity of the floodplain or otherwise result in a wash-out of solid waste.	Relevant and Appropriate Requirement
Closure Requirements	RCRA/HWMA 40 CFR 264, Subpart G	Closure of hazardous waste repositories must meet protective standards. Regulations to minimize contaminant migration, provide leachate collection and prevent contaminant exposure will be met.	Relevant and Appropriate Requirement

Table 3. Action-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
FEDERAL (continued)			
Landfill Design and Construction	RCRA/HWMA 40 CFR 264, Subpart N	Hazardous waste landfills must meet minimum design standards. Protectiveness will be achieved through capping and institutional controls.	Relevant and Appropriate Requirement
Ground Water Monitoring	RCRA/HWMA 40 CFR & 264, Subpart F 40 CFR & 264, Subpart X	Establishes standards for detection and compliance monitoring. Site wide monitoring will accommodate specific ground water monitoring requirements.	Relevant and Appropriate Requirement
Criteria for Classification of Solid Waste Disposal Facilities and Practices	40 CFR Part 257	Establishes criteria for determining which solid waste disposal practices pose threats to human health and the environment.	Relevant and Appropriate Requirement
Occupational Exposure to Asbestos	29 CFR Parts 1910 and 1926.	Establishes OSHA requirements for asbestos-related work in the construction and demolition industry. Requirements on exposure limits, work practices and engineering controls to provide worker safety in handling, removal, disposal, or other workplace exposure to asbestos.	To Be Considered
Fugitive Dust Emissions	40 CFR Section 50.6	Establishes standards for PM-10.	Relevant and Appropriate Requirement

Table 3. Action-Specific Applicable or Relevant and Appropriate Requirements
Mayflower- Ochoco Mine Complex, Ochoco National Forest

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/Relevant and Appropriate?
STATE OF OREGON			
Regulations pertaining to NPDES and WPCF Permits	OAR 340 Div 45	Prescribes limitations on discharge of wastes and the requirements and procedures for obtaining NPDES and WPCF permits from the ODEQ	Relevant and Appropriate Requirement
Groundwater Quality Protection Program	OAR 340 Div 40	Establishes the mandatory minimum groundwater quality protection requirements for federal and state agencies, cities, counties, industries, and citizens.	Relevant and Appropriate Requirement
Solid Waste: Land Disposal Sites other than Municipal Solid Waste Landfills	OAR 340 Div 95	Regulates the siting, operation and maintenance of any non-municipal land disposal site.	Relevant and Appropriate Requirement
Storage, Treatment and Disposal of Hazardous Waste	ORS Chapter 466	Regulates the transportation and disposal of hazardous waste.	Relevant and Appropriate Requirement
Reduction of use of Toxic Substances and Hazardous Waste Generation	ORS 465.200 - .455 and 465.900	Establishes ODEQ removal and remedial action program	Relevant and Appropriate Requirement
Asbestos Removal	OAR 340-32-5620 through 5650	Establish ODEQ requirements for licensing and certification for asbestos workers. All workers who handle asbestos-containing materials must meet certain training, licensing and certification requirements.	To Be Considered
	OAR 340-33-010 through 100	Establish ODEQ requirements for handling asbestos-containing materials. Handling, removing, transporting and disposing of asbestos material in a manner that prevents it from becoming friable and releasing asbestos fibers.	To Be Considered

Appendix B.

Cost Estimates

COST ESTIMATE FOR
ALTERNATIVE 2 - EXCAVATION AND ONSITE CONTAINMENT IN TWO REPOSITORIES

TASK	QUANTITY	UNITS	UNIT $	COST $
MOBILIZATION, BONDING & INSURANCE	1	LS	10,000	10,000
LOGISTICS				
Access Road Improvements	1	LS	5,000	5,000
Site Clearing/Preparation	1	LS	5,000	5,000
Erosion Control - Silt Fences	1	LS	3,000	3,000
EXCAVATION, TRANSPORT, AND PLACEMENT - MAYFLOWER MINE				
Excavation of Mayflower Mine Waste Material	13,200	B.C.Y.	10	132,000
Transport, Placement, and Grading of Mayflower Mine Waste Material in Repository #1	15,840	L.C.Y	6	95,040
EXCAVATION, TRANSPORT, AND PLACEMENT - BRIAN O'LYNN ADIT				
Bridge Rental, Transport, and Placement	1	LS	10,000	10,000
Excavation of Brian O'Lynn Waste Material	450	B.C.Y.	50	22,500
Transport, Placement, and Grading of Brian O'Lynn Waste Material in Repository #2	540	L.C.Y	6	3,240
EXCAVATION, TRANSPORT, AND PLACEMENT - STREET ADIT				
Excavation of Street Adit Waste Material	1,000	B.C.Y.	10	10,000
Transport, Placement, and Grading of Street Adit Waste Material in Repository #2	1,200	L.C.Y	6	7,200
EXCAVATION, PLACEMENT, AND GRADING - MAYFLOWER UPPER ADIT AREA				
Excavation, Placement, and Grading of Upper Adit wasterock	70	B.C.Y.	50	3,500
EXCAVATION, PLACEMENT, AND GRADING - OCHOCO MINE				
Excavation, Placment, and Grading of Ochoco Mine Wasterock	300	B.C.Y.	20	6,000
EXCAVATED AREA GRADING AND CONTOURING				
Mayflower Mine	1	LS	4,000	4,000
Street Adit	1	LS	2,000	2,000
Brian O'Lynn Adit	1	LS	2,000	2,000
STREAM RECONSTRUCTION AND STABILIZATION				
Ochoco Mine Area	1	LS	5,000	5,000
REPOSITORY COVER CONSTRUCTION				
Repository #1 - Cover Soil Stockpile, Placement, and Grade	2,200	L.C.Y	5	11,000
Repository #2- Cover Soil Stockpile, Placement, and Grade	500	L.C.Y	5	2,500
REVEGETATION AND ROAD OBLITERATION				
Road Decommissioning, water bars and ripping	1	LS	5,000	5,000
Seed/Fertilization	8	Acre	2,000	16,000
Mulch	8	Acre	2,000	16,000
DEMOLITION AND DISPOSAL OF BUILDINGS, EQUIPMENT, AND DEBRIS				
Demolition and Consolidation of Debris	10	L.C.Y	50	500
Load Building Materials and Process Equipment	10	L.C.Y	100	1,000
Transportation and Disposal	10	L.C.Y	50	500
ADIT/SEEP INFILTRATION BASIN	1	LS	3,000	3,000
HEALTH AND SAFETY, DECON, CONFIRMATION SAMPLES, AND NITON	1	LS	20,000	20,000
DEMOBILIZATION	1	LS	5,000	5,000
Subtotal Capital Costs				**405,980**
Data Gaps				23,000
Design Expenses (5%)				20,299
Construction Oversight (15%)				60,897
Post Construction Monitoring (3 years)				75,000
Subtotal Indirect Capital Costs				585,176
Contingency (10%)				58,518
TOTAL CAPITAL AND INDIRECT CAPITAL COSTS				**643,694**
POST CLOSURE MONITORING AND MAINTENANCE COSTS				
Inspections	1	per year	250	250
Maintenance	1	LS	1,000	1,000
TOTAL ANNUAL O&M COSTS				**1,250**
TOTAL CAPITAL AND INDIRECT CAPITAL COSTS				643,694
PRESENT WORTH O&M COST				
20 YRS. (10%)				10,642
TOTAL PRESENT WORTH COST				**654,000**

NOTES:
L.C.Y = Loose Cubic Yards
B.C.Y = Bank Cubic Yards
LS = Lump Sum

PRELIMINARY COST ESTIMATE FOR
ALTERNATIVE 3 - EXCAVATION AND OFFSITE DISPOSAL

TASK	QUANTITY	UNITS	UNIT $	COST $
MOBILIZATION, BONDING & INSURANCE	1	LS	20,000	20,000
LOGISTICS				
Access Road Improvements	1	LS	5,000	5,000
Site Clearing/Preparation	1	LS	5,000	5,000
Erosion Control - Silt Fences	1	LS	3,000	3,000
EXCAVATION, TRANSPORT, AND DISPOSAL - MAYFLOWER WASTE MATERIAL				
Excavation of Waste Material	13,200	B.C.Y.	10	132,000
Transportation to Disposal Facility	15,840	L.C.Y	20	316,800
Disposal and Tax Charge	15,840	L.C.Y	75	1,188,000
EXCAVATION, TRANSPORT, AND DISPOSAL - BRIAN O'LYNN WASTE MATERIAL				
Bridge Rental, Transport, and Placement	1	LS	10,000	10,000
Excavation of Waste Material	450	B.C.Y.	50	22,500
Transportation to Disposal Facility	540	L.C.Y	20	10,800
Disposal and Tax Charge	540	L.C.Y	75	40,500
EXCAVATION, TRANSPORT, AND DISPOSAL - STREET WASTE MATERIAL				
Excavation of Waste Material	1,000	B.C.Y.	10	10,000
Transportation to Disposal Facility	1,200	L.C.Y	20	24,000
Disposal and Tax Charge	1,200	L.C.Y	75	90,000
EXCAVATION, PLACEMENT, AND GRADING - MAYFLOWER UPPER ADIT AREA				
Excavation, Placement, and Grading of Upper Adit wasterock	70	B.C.Y.	50	3,500
EXCAVATION, PLACEMENT, AND GRADING - OCHOCO MINE				
Excavation, Placment, and Grading of Ochoco Mine Wasterock	300	B.C.Y.	20	6,000
EXCAVATED AREA GRADING AND CONTOURING				
Mayflower Mine	1	LS	4,000	4,000
Street Adit	1	LS	2,000	2,000
Brian O'Lynn Adit	1	LS	2,000	2,000
STREAM RECONSTRUCTION AND STABILIZATION				
Ochoco Mine Area	1	LS	5,000	5,000
REVEGETATION				
Road Decommissioning, water bars and ripping	1	LS	5,000	5,000
Seed/Fertilization	6	Acre	2,000	12,000
Mulch	6	Acre	2,000	12,000
DEMOLITION AND DISPOSAL OF BUILDINGS, EQUIPMENT, AND DEBRIS				
Demolition and Consolidation of Debris	10	L.C.Y	50	500
Load Building Materials and Process Equipment	10	L.C.Y	100	1,000
Transportation and Disposal	10	L.C.Y	50	500
ADIT/SEEP INFILTRATION BASIN	1	LS	3,000	3,000
HEALTH AND SAFETY, DECON, CONFIRMATION SAMPLES, AND NITON	1	LS	20,000	20,000
DEMOBILIZATION	1	LS	10,000	10,000
Subtotal Capital Costs				**1,964,100**
Data Gaps				23,000
Design Expenses				25,000
Construction Oversight (5%)				98,205
Post Construction Monitoring (3 years)				75,000
Subtotal Indirect Capital Costs				2,185,305
Contingency (10%)				218,531
TOTAL CAPITAL AND INDIRECT CAPITAL COSTS				**2,403,836**
POST CLOSURE MONITORING AND MAINTENANCE COSTS				
Inspections	1	per year	250	250
Maintenance	1	LS	500	500
TOTAL ANNUAL O&M COSTS				**750**
TOTAL CAPITAL AND INDIRECT CAPITAL COSTS				2,403,836
PRESENT WORTH O&M COST				
20 YRS. (10%)				6,385
TOTAL PRESENT WORTH COST				**2,410,000**

NOTES:
L.C.Y = Loose Cubic Yards
B.C.Y = Bank Cubic Yards
LS = Lump Sum