6.0 REMOVAL ACTION ALTERNATIVES

The primary purpose of the EE/CA is to estimate the feasibility and cost-effectiveness of removal action alternatives. This section of the report assembles technologies into a range of actions that we believe represent a reasonable range of removal actions and costs.

Technologies that are screened forward in Section 4 (Table 4-1) are assembled into several removal action alternatives. Alternatives are evaluated against the criteria of protectiveness, effectiveness, reliability, implementability, and cost. The most cost effective removal action that meets the RAOs is recommended in Section 8. Table 6-1 summarizes the alternatives.

6.1 General Response Actions

General response actions are broad categories of actions that may satisfy the RAOs. Likely general response actions for the Site include the following:

Response Action	Example at Blue Ledge
• No action	Monitoring only
• Institutional controls	Land-use restrictions at repositories
• Engineering controls	Passive treatment of run-off
• Excavation and treatment	Excavate waste rock and place in repository
• In situ treatment	Phytoremediation of residual waste rock

6.2 No Action

The only actions under the “no action” alternative are long-term performance monitoring and reporting. The roads would be maintained to allow access for sampling and monitoring. This would result in no improvement to the ongoing and potential future risks previously identified for this site.

6.3 Alternative 1 Description

Alternative 1 consists of the following:

- Construct access roads as needed to complete the removal action. Generally, an access road will be needed to some portion of each of the four waste rock areas. Some improvements to existing roads to the mine may also be required.
- Excavate waste rock with dozers, excavators, and draglines. The specific method may vary depending on the slopes and characteristics of the waste rock area.
- Construct the unlined upland repository and prepare it for waste rock placement.
- Place the excavated waste rock in an upland repository at either the north or south repository site.
- Install a composite GCL and soil cover over the waste rock, including native revegetation, run-on diversion, grading and drainage on the repository to isolate the waste rock from the environment and inhibit leaching of acidity and metals.

- Install sedimentation basins and bioswales to control transport of contaminants from run-off, seeps, and erosion. Generally, each waste pile will have one or more sedimentation basin to collect eroded sediments. These basins may require annual maintenance until the site stabilizes.
- Place and stabilize reclamation fill and plant selected native vegetation on portions of the former waste rock areas. The reclamation fill and plantings will stabilize residual waste rock that remains after the removal is complete and minimize erosion and AMD from the residual waste rock.[3]
- Close adits with bat gates to allow access by wildlife, prevent human access, and minimize physical hazards from the mine.
- Conduct performance monitoring and reporting to assess water quality and long-term restoration of the Joe Creek and Elliott Creek watersheds.

6.4 Alternative 2 Description

Alternative 2 consists of the following primary components, many of which were described more fully under the Alternative 1 Description:

- Construct access roads as needed to complete the removal action.
- Excavate waste rock with dozers, excavators, and draglines. The specific method may vary depending on the slopes and characteristics of the waste rock area.
- Construct lined and capped repository with collection and treatment at local site. This differs from Alternative 1 in that a GCL bottom and sideslope liner is added. This creates the need to treat AMD that might leach from the waste, although AMD volumes would likely be small.
- Install sedimentation basins and bioswales to control transport of contaminants from run-off, seeps, and erosion. Generally, each waste pile will have one or more sedimentation basin to collect eroded sediments. These basins may require annual maintenance until the site stabilizes.
- Place and stabilize reclamation fill and plant selected native vegetation on portions of the former waste rock areas.
- Close adits with bat gates.
- Conduct performance monitoring and reporting.

The primary differences between Alternatives 1 and 2 include a lined and capped repository, and constructed wetlands to treat AMD and run-off from the waste rock areas.

6.5 Alternative 3 Description

Alternative 3 consists of the following, many of the components of which are described in the previous two alternatives:

[3] The amount of residual waste rock is difficult to quantify with certainty. We expect that up to 99 percent of the waste rock will be removed by conventional excavation and grading. The design will develop criteria.

- Construct access roads as needed to complete the removal action.
- Excavate waste rock with dozers, excavators, and draglines. The specific method may vary depending on the slopes and characteristics of the waste rock area.
- Haul waste rock to a landfill disposal. If neither the north nor south repository sites are suitable or otherwise permissible, then offsite disposal will be required. There appear to be suitable open areas near the Applegate Reservoir, although no particular area has been identified and investigated. If no local repository sites are suitable, commercial landfilling would be considered. The nearest commercial landfill is Dry Creek Landfill located northeast of Medford.
- Install sedimentation basins and bioswales to control transport of contaminants from run-off, seeps, and erosion. Generally, each waste pile will have one or more sedimentation basin to collect eroded sediments. These basins may require annual maintenance until the site stabilizes.
- Place and stabilize reclamation fill and plant selected native vegetation on portions of the former waste rock areas.
- Close adits with bat gates.
- Conduct performance monitoring and reporting.

The primary difference between Alternatives 2 and 3 is that a local repository is not viable and a landfill disposal would be required..

6.6 Cost Estimates

Cost estimates were developed using standard methods for conducting EE/CAs and feasibility studies. Methods were in general accordance with EPA guidance (EPA, 2000b). Costs include capital costs, recurring and future costs, and contingencies. Future costs are presented as net present value.

Table 6-2 summarizes the costs. Appendix E includes costing assumptions and cost details. Costs estimate accuracies are considered representative of typical feasibility studies. Additional details of costs estimates are provided below.

6.6.1 Capital Costs

Following are examples of capital costs:

- Design-level testing and technology development (e.g., pilot treatment tests test removals)
- Removal action implementation
- Construction management
- Contingencies
- Project Management

Capital costs are 2010 dollars and are not discounted. Costs implement the removal action were assumed to be in 2010 dollars, even if the removal may occur over a two year period.

6.6.2 Recurring and Future Costs

Following are examples of recurring and future costs:

- Road maintenance.
- Erosion repair and regrading.
- Supplemental planting of phytoremediation remedy, repository cover, or reclamation cover.
- Maintenance of repository AMD collection and treatment, if used.
- Sediment removal from sedimentation basins.
- Maintenance of passive treatment systems.
- Restoring limestone channels and ponds.

This EE/CA includes an estimate for only three years operation and maintenance costs (although operation and maintenance will likely occur over a longer period). Accordingly, future costs assume 2010 dollars and are not discounted.

6.6.3 Uncertainty and Contingencies

This report estimates costs on the basis of a feasibility-level review of technologies and alternatives. Feasibility study screening-level costs are generally assumed to vary by -50 percent to +100 percent from the estimated costs (i.e., 50 percent high to 100 percent low) (EPA, 2000b). The range in costs reflects the uncertainties in technologies and alternatives that are inherent in the conceptual stage of the EE/CA.

For the Blue Ledge Mine and this report, the following are examples of the significant uncertainties and the implications for cost estimates:

- **Methods and feasibility of waste rock removal**. This report assumes that removing waste rock from the very steep and rocky slopes can be successful using the removal methods described in this report. If assumed removal alternatives prove to be infeasible or effort is greater than expected, then removal costs could be higher.

- **Hydrogeologic conceptual model**. The processes that control fate and transport of metals from the Site are complex. Accordingly, the need for and response to actions to control surface run-off and AMD are uncertain. More or less control and treatment than assumed may be necessary.

- **Repository design.** Geotechnical review indicates that nearby repository locations are suitable and of adequate size. The RWQCB only recently provided formal comments on the repository design. The RWQCB comments are incorporated into the design concepts and the cost estimates. The feasibility and costs assume minimal additional regulatory restriction. This assumption reflects that the waste is not a listed or characteristic waste and the lack of RCRA regulation.

- **Needed level of AMD and run-off treatment**. This report assumes minimal levels of passive treatment of AMD and run-off. For example, bioswales and perhaps addition of passive treatment media are presumed to be adequate to treat run-off and AMD. If more aggressive treatment were necessary, then costs would be higher.

- **Regulatory requirements.** This report assumes that the removal actions can be implemented on private land with few regulatory restrictions. If substantial regulatory intervention occurs, or certain actions are not allowed (e.g., if California law or stakeholder interests prevent the repository in the preferred location), then costs could be higher.

In this report, contingencies applied to the capital and operations costs are intended to offset uncertainties. Contingencies include scope contingencies, which reflect technical uncertainties in the removal action approach, and bid contingencies, which reflect unforeseen conditions that impact implementation of the selected removal action. An assumed contingency of 20 percent was used (see Table 6-2).