

TABLES

TABLE 3-1a

**Chemical-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements
Engineering Evaluation and Cost Analysis
Blue Ledge Mine**

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
FEDERAL			
Clean Water Act 33 USC §§ 1251 - 1387			
National Ambient Water Quality Criteria	40 CFR Part 131	Establishes non-enforceable ambient water quality criteria (AWQC) based on toxicity to aquatic organisms and human health. Criteria developed by the EPA and used by the state to establish water quality standards.	To the extent that the AWQC are more stringent than the State of California surface water quality standards they will be considered ARARs.
California Toxics Rule	40 CFR Part 131.38 (a)	Establishes California water quality standards for priority toxic pollutants under the authority of the CWA.	ARAR. Requirement is applicable to the surface water bodies in California.
Effluent Limitations	40 CFR Part 440.100-440.105	Effluent limitations for active copper mines.	Not an ARAR. No point sources are anticipated to result from this removal action.
Safe Drinking Water Act 40 USC § 300			
National Primary Drinking Water Regulations and Maximum Contamination Goals	40 CFR Part 141	Establishes health-based standards, maximum contaminant levels (MCLs), for public water systems and sets goals for contaminants.	ARAR. To the extent that the National Primary Drinking Water Regulations have been adopted by the State of California they will be considered ARARs for surface water. Addressing groundwater is outside the scope of this removal action, but the removal action cannot adversely impact groundwater quality.
National Secondary Drinking Water Regulations	40 CFR Part 143	Establishes non-enforceable aesthetic standards (secondary MCLs) for public water systems.	ARAR. To the extent that the State of California has adopted the Secondary Drinking Water Regulations they will be considered ARARs for surface water. Addressing groundwater is outside the scope of this removal action, but the removal action cannot adversely impact groundwater quality.
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, sets standards for air emissions.	Not an ARAR. Only “major” sources are subject to requirements related to NAAQS, will defer to state regulation of fugitive dust emissions.

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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, and waste-rock TCLP results less than limits for characteristic waste. Mine waste exempt under RCRA Subpart C, (40 CFR 261.4(b)(7)). Parts of RCRA may be relevant and appropriate, however, and are discussed under location and action-specific requirements.
Preliminary Remediation Goals (PRGs) for soil and water	US Environmental Protection Agency (EPA) Region 9	Preliminary Remediation Goals (PRGs) are a risk-based screening concentrations used to assess cleanup goals. PRGs are generic and do not reflect site-specific information. PRGs are guidelines and not legally enforceable standards.	TBC. The PRGs will be considered in the development of project cleanup goals.
STATE OF CALIFORNIA			
California Hazardous Waste Control Law	Title 22 CCR Division 4.5	Establishes regulation of hazardous waste control including management and control of hazardous waste facilities, transportation and classification.	Not an ARAR. Mining waste is exempt from California's Hazardous Waste Control statutes and regulations under Bevill exclusion.
	Title 22 CCR Section 66261 et seq	Identifies waste subject to regulation as hazardous wastes and which are subject to the notification requirements of HSC 25153.6. Defines criteria for hazardous waste determination using Soluble Threshold Limit Concentrations (STLCs) and Total Threshold Limit Concentrations (TTLCs).	Applicable requirement for off-site disposal.
	Title 22 CCR Section 66268 et seq	Identifies hazardous wastes restricted from land disposal and defines circumstances under which an otherwise prohibited waste may continue to be land disposed.	Applicable requirement for off-site disposal.
Carpenter-Presley-Tanner Hazardous Substances Account Act	HSC Section 25300 et seq.	Establishes program for state response to cleanup releases of hazardous substances including compensation to persons for injuries caused by exposure to hazardous substances and establish adequate funds to assure payment.	Not an ARAR. State administrative requirements not applicable to CERCLA response actions.

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California Safe Drinking Water Act	Title 22 CCR Sections 64431 and 64449 (a)	Primary and secondary MCLs for public drinking water.	ARAR. To the extent that the primary and secondary MCLs that are more stringent than the Federal MCLs they will be considered ARARs for surface water. Addressing groundwater is outside the scope of this removal action, but the removal action cannot adversely impact groundwater quality.
Porter-Cologne Water Quality Control Act	California Water Code, Division 7: Water Quality Water Code Section 13000 et seq.	Establishes the policy to protect the quality of all waters of the state for the enjoyment of the people.	Applicable requirement
	Sections 13397 through 13398	Establishes the policy to reduce the threat to water quality caused by abandoned mine lands.	Applicable requirement
Basin Plan	Water Quality Control Plan for the North Coast Region		
State Anti-degradation Policy	SWRCB Resolution 68-16	Establishes the requirements for continued maintenance of high-quality water of the state.	ARAR. Requirements set forth in this resolution are applicable to maintain water quality during the action.
Sources of Drinking Water Policy	SWRCB Resolution 88-63	Establishes the policy for sources of drinking water in the state. Groundwater is considered as potential drinking water if total dissolved solids levels are below 3,000 mg/L and the yield is greater than 200 gallons per day.	ARAR. Requirement is applicable; the removal action cannot adversely impact groundwater quality.
Cleanup and Containment Zone Policy	SWRCB Resolution 92-49 Section III G	Establishes the policy and procedures for regional boards related to investigation and cleanup activities for all discharges subject to California Water Code Section 13304. Requires the attainment of background water quality or the best water quality that is reasonable if background cannot be achieved.	ARAR. Applicable requirement

TABLE 3-1b

**Location-Specific Applicable or Relevant and Appropriate Requirements and To Be Considered Requirements
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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
FEDERAL			
National Historic Preservation Act	16 USC § 470; 36 CFR Part 800 40 CFR 6.30l(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.	ARAR. This is an applicable requirement. Cultural Resources Survey has been conducted and historic features identified. These features will be preserved.
Archeological and Historic Preservation Act	16 USC § 469 40 CFR 6.30l(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.	ARAR. This is an applicable requirement. Cultural Resources Survey has been conducted and historic features identified. These features and any additional archeological findings encountered during the course of the removal action will be preserved.
Native American Graves Protection and Repatriation Act (NAGPRA)	25 USC 3001-3013 43 CFR Part 10	Establishes regulations that pertain to the identification, protection, and appropriate disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony.	ARAR
American Indian Religious Freedoms Act (AIRFA)	42 USC § 1996 et seq.	Protects and preserves the traditional religious rights and cultural practices of the American Indians, Eskimos, Aleuts, and Native Hawaiians. The act requires all governmental agencies to eliminate interference with the free exercise of Native religion, based on the First Amendment, and to accommodate access to and use of religious sites to the extent that the use is practicable and is not inconsistent with an agency's essential functions.	ARAR.
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.	ARAR. This is an applicable requirement; however, no wetlands will be affected by the removal action.
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.	ARAR. This is an applicable requirement for stream crossings required to complete the removal action.

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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
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.	ARAR. This is an applicable requirement; however, the removal action will not affect any mapped floodplain.
Fish and Wildlife Coordination Act	16 USC 661 et seq.	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.	ARAR. This is an applicable requirement for stream crossings required to complete the removal action. Plans have been provided to the USFWS.
Endangered Species Act	16 USC Chapter 35	Act to protect habitat of endangered and threatened species. Activities may not jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify a critical habitat.	ARAR. This is an applicable requirement; the USFWS (2003) states that service “trust resources” are known to occur in the Elliott Creek watershed.
Bald Eagle Protection Act	16 USC §§ 668 et seq.	Requires 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.	ARAR. This is an applicable requirement; the USFWS (2003) states that bald eagles are known to occur in the Elliott Creek watershed.
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.	ARAR. This is an applicable requirement for the removal action.
Resource Conservation and Recovery Act	42 USC § 6901 40 CFR Part 264	Location standards for hazardous and solid waste facilities and municipal waste landfills.	Not applicable. Could be relevant and appropriate for the siting of the mine waste repository. For this site, however, will defer to State of California requirements for the proper siting of disposal facilities.
STATE OF CALIFORNIA			
California Preservation Laws	Administrative Code, Title 14, Section 4307	No person shall remove, injure, deface or destroy any object of paleontological, archaeological or historical interest or value.	ARAR. Applicable requirement for CERCLA actions on private lands.

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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
California Endangered Species Act (CESA)	Fish and Game Code Section 2080 Title 14 CCR Section 783 et seq	The CESA Act generally parallels the main provisions of the Federal ESA to protect habitat of rare, endangered, and threatened species. The ‘take’ of any species that the commission has determined to be an endangered or threatened species is prohibited. However, CESA allows incidental take for lawful development projects and emphasizes early consultation to avoid impacts on projects that have a potential for a ‘take’.	ARAR. This is an applicable requirement for the removal action.

TABLE 3-1c

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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
FEDERAL			
Clean Water Act	33 USC § 1342		
National Pollutant Discharge Elimination System	40 CFR Part 122	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 stormwater discharges.	No point sources are anticipated to result from this removal action so, with the exception of stormwater requirements, this is not an ARAR.
Surface Mining Control and Reclamation Act	30 USC § 1201	A program for addressing environmental and human health effects from surface coal mine operations. The EPA has expressed that it may also be relevant and appropriate to other types of mining sites. Parts 816 and 817 provide post-mining guidelines for rehabilitation and reclamation.	Not an ARAR. Pacific Northwest Regional Forest Service Best Management Practices will be used.
Hazardous Materials Transportation Act	49 USC §§ 1801-1813 49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials.	ARAR. Requirements are applicable for transport of materials off-site.
Resource Conservation and Recovery Act			
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal (TSD) Facilities	40 CFR Part 263	Regulations applicable off-site transportation and disposal of hazardous wastes.	ARAR. Requirements are applicable for the off-site disposal of wastes if the wastes exhibit toxicity characteristics.
Land Disposal Restrictions (LDRs)	40 CFR Part 268	LDRs prohibit the placement of hazardous wastes in a land disposal unit if the wastes fail to meet treatment standards promulgated for them.	Not an ARAR. Data indicate that sediments do not fail any of the relevant LDR treatment standards. Operations monitoring will confirm disposition of sediments that collect in sedimentation basins.
Closure Requirements	40 CFR Part 264 Subpart N	Provides closure criteria for such activities as capping and run-on and run-off controls for hazardous waste facilities and municipal waste landfills.	Not applicable. Could be relevant and appropriate to the design of the mine waste repository. For this site, however, will rely on State of California requirements for the proper closure of disposal facilities.

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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
Landfill Design and Construction	40 CFR 264.301	Hazardous waste landfills must meet minimum design standards.	Not applicable. Could be relevant and appropriate to the design of the mine waste repository. For this site, however, will rely on State of California requirements for the design and construction of landfills.
Groundwater Monitoring	40 CFR & 264, Subpart F 40 CFR & 264, Subpart X	Establishes standards for detection and compliance monitoring. Site wide monitoring will accommodate specific groundwater monitoring requirements.	Not applicable to this removal action. Groundwater monitoring requirements will be determined as part of the overall site remedy
Federal Noxious Weed Act	7 USC §2801 et seq	Designates certain plants as noxious weeds and establishes the requirements to control the spread of them.	ARAR. Requirements are applicable to control the spread of noxious weeds during the removal action.
Fire Protection and Suppression	USDA Pacific Northwest Region Forest Service Standard	Establishes fire protection and suppression standards	ARAR. Requirements are applicable; the removal action is taking place under the USDA Pacific Northwest Region Forest Services' jurisdiction.
STATE OF CALIFORNIA			
California Surface Mining and Reclamation Act of 1975 (SMARA)	Title 14 CCR Section 3700 et seq	Reclamation standards adopted by the California Department of Conservation Office of Mine Reclamation including protection standards for wildlife habitat and performance standards for earthwork, revegetation, drainage, erosion control, stream protection, and closure of surface openings.	Not an ARAR. Pacific Northwest Regional Forest Service Best Management Practices will be used.
Permit Requirements for Storm Water Discharges	Order 2009-0009-DWQ	Requires that storm water runoff associated with construction meet substantive requirements of the General NPDES Permit for Storm Water Discharges Associated with Construction Activity. All discharges are required to obtain coverage effective July 1, 2010.	ARAR. The substantive requirements are applicable to the construction activities associated with the removal action.
Dust Emissions	HSC Section 41700 Siskiyou County APCD Regulation 4.2	Establishes nuisance dust prohibitions.	ARAR. The requirements are applicable during the construction of the removal action.
Diesel Emissions	Title 13 CCR, Article 4.5, Chapter 1	Establishes standards for the reduction of emissions of diesel particulate matter, oxides of nitrogen and other pollutants from in-use heavy-duty diesel-fueled vehicles.	ARAR. The requirements are applicable during the removal action.

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California Hazardous Waste Control Law and Hazardous Disposal Regulations	Title 22 CCR, 66262.1 et seq	Establishes hazardous waste management requirements including handling, storage and documentation of hazardous waste.	Not an ARAR. Mining waste is exempt from California’s Hazardous Waste Control statutes and regulations under Bevill exclusion.
	HSC Division 20, Chapter 6.5, Section 25100 HSC Division 20, Chapter 6.5, Section 25143.1	Mining waste is exempt from California’s Hazardous Waste Control statutes and regulations under Bevill exclusion. However, the wastes are subject to the requirements of Article 9.5 and Chapter 6.8 if the waste would be classified as hazardous pursuant to Section 25117 and 25141.	Applicable to off-site disposal.
	HSC Division 20, Chapter 6.5, Section 25117.13, 25222.1, 25230; Chapter 6.8, Section 25355.5 Title 22 CCR, Section 67391.1	Regulations deed restriction requirements to restrict certain uses.	May be an ARAR.
Solid Waste Rules	Title 27 CCR, Division 2		
Mining Waste Management	Title 27 CCR Section 22470-22510, 20080 et seq., 21710 et seq.	Establishes SWRCB regulations for mining waste management.	ARAR. The regulations are applicable to the repository design.
	Title 27 CCR Section 22480	Establishes the groups of mining waste based on an assessment of the potential risk of the water quality degradation posed by the waste.	ARAR. The mining waste has been classified accordingly as a ‘Group B’ waste. The repository design will comply with requirements for Group B wastes.
	Title 27 CCR Section 22490 (a) & (b)	Establishes the requirements for siting of the waste repository.	ARAR. The repository design will meet the siting requirements by being located away from Holocene faults, areas of rapid geologic change, and areas. and areas within a floodplain (i.e. 100-year peak streamflow).
	Title 27 CCR Section 22490 (c)	Establishes the construction and discharge standards for mining waste units.	ARAR. The design will meet the prescriptive liner requirements for natural and artificial containment.
	Title 27 CCR Section 22490 (d)	Establishes the requirement for design and construction oversight by registered professionals.	ARAR. The design will be completed by a registered civil engineer and the construction will be supervised by a registered civil engineer a certified engineering geologist.

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Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable or Relevant and Appropriate Requirement (ARAR) or To Be Considered (TBC)?
Mining Waste Management	Title 27 CCR Section 22490 (e) and 20320	Establishes the general criteria for containment structures.	ARAR. The design will meet the appropriate general containment criteria defined in Section 20320.
	Title 27 CCR Section 22490 (f), 21410, and 20330 (a) & (d)	Establishes liner requirements.	ARAR. The liner design and construction will meet requirements for Group B mining waste management units.
	Title 27 CCR Section 22490 (g) and 20340 (b-e)	Establishes requirements for Leachate Collection and Removal Systems (LCRS) for Group A and B wastes.	ARAR. The blanket-type LCRS design will meet the requirements for strength, placement, head buildup, clogging.
	Title 27 CCR Section 22490 (h), 20365 (d) & (e), 20375	Establishes precipitation and drainage control requirements.	ARAR. The diversion and drainage facilities will be designed and constructed to accommodate the anticipated volume of precipitation and peak flows from surface runoff for one 10 year, 24 hour storm event. Precipitation and runoff not diverted by containment structures will be collected and managed through the LCRS.
	Title 27 CCR Section 22500 and 20385-20430	Establishes water quality monitoring requirements for new and existing Group A and B mining units, subject to agreements among agencies.	ARAR.
	Title 27 CCR Section 22510 and 20950 (b) & (d)	Establishes closure and post closure maintenance requirements for mining units including performance standards, plans, funding, financial assurance, vegetation, closure standards, erosion & sediment protection, subject to agreements among agencies.	ARAR.
Porter-Cologne Water Quality Act	Order 97-03	Establishes stormwater requirements for construction activities.	ARAR. Requirements are applicable to construction activities.
California Environmental Quality Act (CEQA)	Public Resource Code Div. 13 Section 2100 et seq.	Binding guidelines for the Environmental Impact Review (EIR) of development of projects. Defines responsibility of state agencies in the EIR process.	Not an ARAR. State or local governments may have to comply with CEQA if it is triggered by their own actions.
	Title 14 CCR, Div. 1, part 3 Chapter 4, Section 750 et seq.	Specifies the objectives, criteria and procedures followed by the Fish and Game Commission in implementing CEQA.	Not an ARAR. State or local governments may have to comply with CEQA if it is triggered by their own actions.
	Title 14 CCR, Div. 6, Chapter 3 Title 22 CCR, Div 4, Chapter 2 Title 23 CCR Chapter 4	Guidelines for the implementation of CEQA, including the responsibilities, authority of public agencies, lead agency, initial studies, negative declaration process and EIR process. Defines limits, contents, types, considerations, review, litigation, monitoring, exemptions, funding, public hearings and approval.	Not an ARAR. State or local governments may have to comply with CEQA if it is triggered by their own actions.

**Table 4-1
Removal Action Technology Screening
Engineering Evaluation and Cost Analysis
Blue Ledge Mine**

Technology	Description	Effectiveness ¹ Low, Medium, High	Implementability ² Easy to Difficult	Applicability ³ Low, Med, High	Retained Yes, No
Waste Rock Removal					
Hydraulicking	Waste rock removed by spraying high-pressure stream of water at the material to create slurry and transport the material downhill to a location for loading and transport.	High Hydraulicking could remove most waste rock with little residual.	Difficult Estimated that 800 million gallons of water would be required (Golder, 2007). Containing runoff and dewatering for transport would be difficult	Low Hydraulicking could be effective but is not practicable.	No
Dragline Excavation	Operate drag bucket with aerial cables. Commonly used in mining and dredging. Dragline operation would use aerial cables to drag a bucket down and waste rock down hill to a location for loading and transport	Medium Could be effective to remove large quantities of waste rock down slope. May leave significant residual material on slope. Draglines could be used to place cover fill, but would require other methods to distribute, grade, and compact. Residual waste rock on slope could be a continuing source.	Moderately Difficult Dragline would be moderately difficult to install and operate on the steep, rocky, and irregular slopes.	Medium Draglines could be effective but are moderately difficult to install and would leave residual waste rock on slopes.	Yes
Excavators	Excavate and move waste rock down hill to a location for loading and transport. Work on benches built across the waste rock. Excavation would start at the top and the work downward on successive benches while placing soil cover behind.	Medium Could be effective to move large quantities of waste rock down slope. May leave significant residual material on slope. Excavator could remove more material than dragline. Residual waste rock on slope could be a continuing source.	Moderately Difficult Steep slopes would make benching difficult. Delivery access for reclamation cover would be difficult.	Medium Excavators could be effective but are moderately difficult to operate on steep slopes. Delivery and compaction of restoration fill would be problematic.	Yes
Dozers	Push waste rock down slope to a location for loading and transport using dozers.	Medium to High Dozers could effectively push waste rock to loading locations. Dozers and loaders could be effective in placing reclamation cover. Residual waste rock on slope could be a continuing source.	Moderately Difficult Portions of the steep slopes would require use of winching techniques.	High Use of dozers could be effective and implementable.	Yes
Waste Rock Repositories					
Blue Ledge Mine Camp Site	Moderately sloped and heavily vegetated. Near former Blue Ledge Mine Camp Site. Estimated area of approximately 2 acres.	Low Area is an active landslide area and would not be stable for a repository.	Easy Area is close to waste rock areas and would be easy to construct.	Low Instability makes area unsuitable. Implications of historic structures uncertain.	No
South Site	Formerly cleared and minimally vegetated hillside and apparent former logging operations area of approximately 1.7 acres. Estimated haul of 0.8 miles. Possible former landslide area.	Medium to High Properly constructed repository above the water table on a stable slope would adequately isolate waste rock and minimize potential leaching and erosion.	Easy Area is close to waste rock areas and would be easy to construct.	High Area is nearby and south area alone may be of sufficient size to accommodate all rock.	Yes
North Site	Cleared ridge location and former logging operations area of approximately 0.5 acres. Estimated haul of 0.9 miles.	Medium to High Properly constructed repository above the water table on a stable slope would adequately isolate waste rock and minimize potential leaching and erosion.	Easy to Moderately Difficult Area is close to waste rock areas and would be easy to construct. North area would require significant expansion to accommodate all waste rock.	Medium North area alone may not be adequate without significant expansion.	Yes
Area near Applegate Reservoir	No specific areas are identified, although several reported logging operations areas may be suitable.	Medium to High Properly constructed repository above the water table on a stable slope would adequately isolate waste rock and minimize potential leaching and erosion.	Moderately Difficult No specific area identified. Minimum estimated haul distance is 10 miles. Additional road maintenance would be required.	Low to Medium Longer haul distance would result in high cost. Applicability depends on viability of other options.	No Unless other locations are deemed unviable.

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Technology	Description	Effectiveness ¹ Low, Medium, High	Implementability ² Easy to Difficult	Applicability ³ Low, Med, High	Retained Yes, No
Repository Design Elements	Potential repository design elements typical of landfills include impermeable cap, bottom liner, AMD collection and treatment.	High Landfill design elements are well understood and reliable. However, these conservative design elements may not be necessary.	Easy to Moderately Difficult Landfill design elements are well understood and easy to construct. AMD collection and treatment would be moderately difficult due to additional operation requirements.	Medium Landfill design elements should be installed to isolate waste rock and minimize AMD generation in the repository.	Yes
Chemical Stabilization of Waste Rock in Repository	Various commercial products, lime, and industrial process byproducts have been used to neutralize pH and stabilize metals in acid forming mine wastes. Such amendments may be used to stabilize waste rock placed in repository.	High Placement of treated waste rock in a properly designed repository would effectively stabilize waste rock.	Moderately Difficult Waste rock would have to be processed and mixed with additives.	Low to Medium A properly designed repository would effectively isolate waste rock. Chemical treatment in addition does not appear necessary.	No
Nearest Landfill	Nearest commercial landfill appears to be Dry Creek Landfill located northeast of Medford.	High Lined landfill would effectively contain deleterious materials.	Easy No construction necessary. Estimated haul distance is 40 miles.	Low Long haul distance would result in high cost. Applicability depends on viability of other options.	No Unless north and south repositories become unviable.
In Situ Stabilization and Treatment of Waste Rock					
In Situ Stabilization	Waste rock stabilized in situ without additional treatment. Waste rock piles regraded in a series of benches. Runoff diversions installed to direct surface water. Cover material placed and replanted.	Low to Medium Physical stabilization would minimize runoff and erosion. Redirecting runoff would reduce infiltration and AMD formation, but source waste rock would remain.	Difficult Construction on steep hillsides difficult. Ability to achieve effective stabilization in situ uncertain.	Low Existing waste rock piles are eroding and unstable. Ability to stabilize waste rock long term and minimize AMD is uncertain.	No
In Situ Chemical Treatment	Various commercial products, lime, and industrial process byproducts have been used to neutralize pH and stabilize metals in acid forming mine wastes. Waste rock would be blended in situ to neutralize pH and sequester metals. Treatment would minimize AMD.	Medium The principals of stabilization and sequestration are well understood. Metals can be effectively immobilized and pH neutralized.	Difficult Treatment depends on adequate mixing of treatment materials and waste rock. Volume of waste rock and steep slopes make in situ treatment impractical. Slope stability is substantial concern.	Low Treatment techniques are well understood, but implementation is not feasible.	No
In Situ Stabilization and Phytoremediation	Use of plants to reduce, remove, degrade, or immobilize metals. Waste rock would be redistributed, regraded, and planted with metals and pH tolerant species. Plant community would transform to native species over time. Could be used in combination with partial removal.	Medium Physical stabilization would minimize runoff and erosion. Redirecting runoff would reduce infiltration and AMD formation. Designed phytoremediation would enhance effectiveness. Underflow of groundwater beneath root zone might generate AMD.	Difficult Construction on steep hillsides difficult. Effective stabilization in situ uncertain but unlikely. Effective development of successional vegetation is uncertain.	Low Ability to stabilize waste rock long term is uncertain. Reconsolidation on lower slopes and design phytoremediation may be effective. Uncertainty minimizes applicability.	No
Runoff Collection and Treatment					
Sedimentation Basins	Runoff would be direct through sedimentation basins to collect sediments eroded from the slopes above.	Low to High Principles of sedimentation are well understood. Effectiveness depends on design capacity and maintenance. Capacity and maintenance provisions should be added to improve performance over existing sedimentation basin in Area 1.	Easy to Moderately Difficult Construction in low-lying areas of site has been demonstrated. Construction on higher slopes would be more difficult.	High Sedimentation basins should be installed to minimize sediment transport in runoff.	Yes
Interceptor Drains	Interceptor drains consisting of porous rock would be installed at intervals along lower slopes to intercept AMD runoff. Collected AMD would be directed to passive treatment.	Medium Interceptor drains may effective in directing subsurface flow within waste rock to passive treatment. If so, AMD might not discharge through seeps to Joe Creek.	Moderately Difficult to Difficult Construction on steep hillsides moderately difficult. Configuring drains to effectively AMD may be difficult.	Medium AMD discharge to Joe Creek could be a continuing source of metals and acidity. Metals content of AMD under removal alternatives probably low.	Yes

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Technology	Description	Effectiveness ¹ Low, Medium, High	Implementability ² Easy to Difficult	Applicability ³ Low, Med, High	Retained Yes, No
Open Limestone Trenches and Ponds	Limestone boulders or fragments would be added directly to channels, basins, or ponds. Limestone dissolved to produce alkalinity to buffer pH and precipitate metals.	Low to Medium Slow dissolution rates, burial by sediments, and transport of limestone from the channel during high flow are problems. Coating with iron precipitates may reduce contact and effectiveness. Rapid coating of limestone in existing channels at the site demonstrates the problems.	Easy Open ponds and trenches are easy to construct in low-lying areas, such as the location of the current log dam and limestone basin.	Medium Data indicate that the existing limestone ponds are not effective in reducing metals and acidity. Monitoring indicates minimal impact of the existing open limestone trenches and ponds on water quality (Elliot, 2007)	Yes
Anoxic Limestone Drains or Upflow Limestone Ponds	Burial of limestone in trenches or placement in submerged ponds could limit drawbacks of open channels and ponds. Buried or submerged limestone contacts AMD. Higher carbon dioxide and lower oxygen enhances limestone dissolution and minimizes iron oxidation and fouling. Ponds would be constructed to direct collected AMD upward through the bottom of the pond and through the limestone.	Low to Medium Design capacity and maintenance are significant issues. It may be difficult to maintain anoxic conditions in ponds during low water times of the year.	Moderately difficult Maintenance and sufficient summertime water to maintain submerged conditions are potential problems. Visual observation and access are advantages over buried systems.	Medium Ponds or drains could be targeted at specific sources such as underflow AMD or a particular seep.	Yes
Bioswales and Constructed Wetlands	Biological treatment consists of a series of shallow ponds planted with emergent wetland plants. Microbe-plant associations remove dissolved metals. Treatment is passive, requiring minimal continuing maintenance.	Medium Constructed wetlands are demonstrated effective at buffering pH and removing metals. Greatest utility appears for small flows. Very high flows common during rain-on-snow events or summer storms and cold winter temperatures may limit treatment efficiency. Treatment processes are complex and variable. Maintenance may be required.	Easy to Moderately Difficult Initial design and construction costs may be significant. May not be sufficient area to construct wetland of adequate capacity.	Medium to High May be the most effective AMD and runoff treatment technology for runoff and AMD.	Yes
Soil cover and Revegetation	Soil cover would isolate and minimize erosion of residual waste rock. Vegetation would control soil erosion, encourage soil development, and create aesthetically pleasing landscape.	Medium Effectiveness depends on proper placement of suitable cover and selection and placement vegetation species that are compatible with the conditions. Ability to place and maintain effective cover and vegetation uncertain.	Easy to Moderately Difficult Placement of soil on steep hillsides moderately difficult.	High Soil cover and revegetation provides utility and aesthetics.	Yes
Active AMD and runoff treatment	AMD and runoff would be collected and treated using conventional technologies to the extent practical. Conventional technologies include pH adjustment, metals precipitation, and solids management.	Low to High Effectiveness depends on design capacity. A system could not be reasonably designed with capacity for high flows resulting from rain-on-snow or summer storms.	Difficult Siting, design, construction, and operation would be difficult and extremely expensive in this remote location.	Low Active conventional treatment is not a viable alternative.	No
Reclamation Cover					
Reclamation Fill and Planting	Clean fill from a local source would be placed on slopes where waste rock was removed. Reclamation fill would be placed and graded into a series of benches. Runoff diversions would be installed to direct surface water. Cover material would be planted with native species.	High A well-established and stable reclamation cover would minimize erosion and leaching and would be aesthetic.	Moderately Difficult to Difficult Moderately difficult construction on steep hillsides at the site.	High URS assumes that reclamation cover is likely if the waste rock removal is the selected technology.	Yes

**Table 4-1
Removal Action Technology Screening
Engineering Evaluation and Cost Analysis
Blue Ledge Mine**

Technology	Description	Effectiveness ¹ Low, Medium, High	Implementability ² Easy to Difficult	Applicability ³ Low, Med, High	Retained Yes, No
No Action	No reclamation cover.	Low Absence of cover would allow continued erosion and transport of residual waste rock down slope to Joe Creek. Effectiveness depends on completeness of waste rock removal and susceptibility of underlying rock and surrounding areas to erode.	Easy No action necessary.	Medium Effectiveness assumes that residual waste rock would be a continuing source.	No Unless employed in as part of a stepwise evaluation.
Adit Closure					
Sealing	Adits can be sealed with plugs, walls, or dams or backfilled with native or imported materials.	Medium Sealing prevents access by people but also prevents access by wildlife. Sealing may result in accumulation of AMD in mine workings that could cause AMD formation and discharge elsewhere.	Easy A variety of methods are routinely implemented at abandoned mines.	Low The long term benefits of sealing have not been investigated.	No
Gates	Gates can be fixed or movable.	High Gates prevent access by people but allow access by wildlife.	Easy A variety of gates are routinely implemented at abandoned mines.	High Gates are a good option to allow wildlife use, limit access by people, and minimize physical hazards to people.	Yes
Fences	Fences installed to block access to mines by people.	Low to Medium Fences are minimally effective in preventing access by people and tend to be damaged over time.	Easy Fences are easy to construct.	Low Fences require ongoing maintenance, have low likelihood of preventing access by humans, and restrict wildlife mobility.	No

NOTES:

- ¹ Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet RAOs.
- ² Implementability rating of easy, moderately difficult, and difficult reflects estimated relative complexity and cost of implementing the technology.
- ³ Applicability reflects the relative overall relevance of the technology to the site. Low applicability indicates low effectiveness or severe constraints to implementation. Uncertainty rating reflects additional data needs or technology development needed to demonstrate applicability.

**Table 6-1
Summary of Removal Action Alternatives
Engineering Evaluation and Cost Analysis
Blue Ledge Mine**

Alternative	Actions	Comparison Summary (elements in addition to alternative above)	Cost	Comments on advantages and limitations regarding protectiveness, effectiveness, implementability and reliability
No Action	<ul style="list-style-type: none"> • Monitoring, reporting and road maintenance 	<ul style="list-style-type: none"> • Performance monitoring and reporting • Road maintenance for access 	\$0.14 M	Resource not protected. Ongoing ecological and human health risk not mitigated.
Alternative 1 Waste rock removal. Unlined repository with GCL and soil cover at local site.	<ul style="list-style-type: none"> • Design, specifications, contracting • Waste rock removal with dozers, excavators, and drag lines • Unlined repository with GCL and soil cover at local site • Sedimentation basins, bioswales • Reclamation fill and planting • Adit closure with bat gates • No groundwater treatment • Performance monitoring and reporting 	<ul style="list-style-type: none"> • Includes elements of No Action alternative. • Primary design elements are waste rock removal, repository, reclamation fill and planting, and passive leachate and runoff treatment. 	\$15.99 M	<p>Removing the waste rock would eliminate most of the primary sources of contamination, presumably resulting in a protective and effective remedy. Reliability of unlined and uncapped repository is medium to high.</p> <p>Residual waste rock could continue to erode and leach metals. Alternative provides minimal leachate treatment.</p>
Alternative 2 Waste rock removal. Lined and capped repository with leachate treatment at local site.	<ul style="list-style-type: none"> • Design, specifications, contracting • Waste rock removal with dozers, excavators, and drag lines • Lined and capped repository with leachate treatment at local site • Sedimentation basins, bioswales and constructed wetlands • Reclamation fill and planting • Adit closure with bat gates • Performance monitoring and reporting 	<ul style="list-style-type: none"> • Includes elements of No Action alternative. • Lined and capped repository is more complex. • Constructed wetland added to leachate and runoff treatment. • More intensive O&M due to added passive treatment. 	\$17.65 M	<p>Removing the waste rock would eliminate most of the primary sources of contamination, presumably resulting in a protective and effective remedy. Reliability of lined and capped repository is high.</p> <p>Additional passive treatment of leachate and runoff, as compared to Alternative 2 increases protectiveness and reliability. Implementability of constructed wetlands for leachate treatment is uncertain due to space constraints and possible capacity constraints during high flows.</p>
Alternative 3 Waste rock removal. More distant repository or landfill disposal.	<ul style="list-style-type: none"> • Design, specifications, contracting • Waste rock removal with dozers, excavators, and drag lines • More distant repository or landfill disposal • Sedimentation basins, passive treatment, bioswales and constructed wetlands. • Reclamation fill and planting • Adit closure with bat gates • Performance monitoring and reporting 	<ul style="list-style-type: none"> • Includes elements of No Action alternative. • More distant repository or landfill disposal increases disposal costs. 	\$19.65 M	<p>Removing the waste rock would eliminate most of the primary sources of contamination, presumably resulting in a protective and effective remedy. Reliability of lined and capped off-site repository or landfill is high. Need for off-site repository or landfill depends on availability and suitability of local repository site.</p>

**Table 6-2
Summary of Alternative Costs
Preliminary Removal Action Costs
Blue Ledge Mine**

line	Item	No Action	Alt 1	Alt 2	Alt 3
Capital Costs					
1	Waste Rock Removal (incl. roads, mobe, demobe)	\$0	\$5,672,000	\$5,765,000	\$5,765,000
2	Repository and Disposal	\$0	\$1,377,000	\$1,555,000	\$3,825,000
3	Leachate and Runoff Collection and Treatment (passive)	\$0	\$300,000	\$350,000	\$350,000
4	Reclamation Cover	\$0	\$1,551,000	\$1,551,000	\$1,551,000
5	Adit Closure	\$0	\$160,000	\$160,000	\$160,000
6	Construction Mgmt, Engineering, Consulting, Construction Completion report	\$0	\$1,669,000	\$1,963,000	\$1,669,000
7	Construction Management	\$0	\$365,000	\$487,000	\$365,000
8	IQAT	\$0	\$428,000	\$571,000	\$428,000
9	Operation and Maintenance	\$18,000	\$360,000	\$585,000	\$423,000
10	Monitoring and Reporting	\$105,000	\$150,000	\$300,000	\$255,000
11	Subtotal	\$123,000	\$12,032,000	\$13,287,000	\$14,791,000
12	Contingency (%)	0%	20%	20%	20%
13	Contingency (\$)	\$0	\$2,406,400	\$2,657,400	\$2,958,200
14	Prime Fee on Subs (5.45%)	\$6,704	\$786,893	\$868,970	\$967,331
15	Forest Service Oversight (5% on capital costs)	\$6,000	\$761,000	\$841,000	\$936,000
16	Subtotal	\$13,000	\$3,954,000	\$4,367,000	\$4,862,000
17	Total Alternative Cost	\$0.14 M	\$15.99 M	\$17.65 M	\$19.65 M

Notes:

Alternatives assembled to demonstrate a range in costs.

No Action: Long term monitoring and performance evaluation.

Alternative 1: Waste rock removed with dozers and excavators. Unlined repository. Partial revegetation and leachate treatment by sedimentation basins.

Alternative 2: Waste rock removed with dozers and excavators. Lined and capped repository. Revegetation and leachate treatment by sedimentation basins and constructed wetland.

Alternative 3: Waste rock removed with dozers and excavators. Landfill disposal. Revegetation and leachate treatment by sedimentation basins and constructed wetlands.

TABLE 6-3

**Summary of NCP Removal Action Factors
40 CFR 300.415(b) (2)
Engineering Evaluation and Cost Analysis
Blue Ledge Mine**

Factor	Site Condition	Justification¹
1) Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants	<ul style="list-style-type: none"> • Groundwater is used for drinking water but impacts are uncertain. • Surface water is used for gardening and as a water supply for domestic animals. • Metals concentrations in soil, surface water, and groundwater exceed risk-based concentrations protective of ecological receptors. • Groundwater discharges from seeps and adits are present at high concentrations that result in an unacceptable risk to human and ecological receptors. • Survey results indicate that metals from the Site are impacting the macroinvertebrate community of Joe Creek. 	Yes
2) Actual or potential contamination of drinking water supplies or sensitive ecosystems	<ul style="list-style-type: none"> • Groundwater is used for drinking water, but impacts are uncertain. • Groundwater discharges from seeps and adits are present at high concentrations that result in an unacceptable risk to human and ecological receptors. • Humans routinely contact surface water in Joe Creek and Elliott Creek. • Ecological receptors within Joe Creek exposed to contamination. • Within a sensitive ecosystem (Northern Goshawk, Northern Spotted Owl, Siskiyou Mountain Salamander) 	Yes
3) Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers, that may pose a threat of release.	<ul style="list-style-type: none"> • No drums or barrels located at site. 	No
4) High levels of hazardous substances or pollutants or contaminants in soils largely at or near the surface, that may migrate	<ul style="list-style-type: none"> • Waste rock is rich in arsenic, copper, cadmium, lead and zinc. • Erosion and leaching transport metals from waste rock piles resulting in unacceptable metals concentrations in surface water, groundwater, soil, and sediment. 	Yes

TABLE 6-3

Summary of NCP Removal Action Factors
40 CFR 300.415(b) (2)
Engineering Evaluation and Cost Analysis
Blue Ledge Mine

Factor	Site Condition	Justification¹
5) Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released	<ul style="list-style-type: none">• Heavy rains and spring runoff cause erosion and leaching of pollutants resulting in unacceptable metals concentrations in surface water, groundwater, soil, and sediment.	Yes
6) Threat of fire or other explosion	<ul style="list-style-type: none">• The site contaminants do not cause threat of fire or explosion.	No
7) The availability of other appropriate federal or state response mechanisms to respond to the release	<ul style="list-style-type: none">• N/A	No
8) Other situations or factors that may pose threats to public health or welfare of the United States or the environment	<ul style="list-style-type: none">• Steep waste rock piles cause physical hazard.• Mine adits cause physical hazard.	No

Notes:

¹ Yes justification means factor provides compelling rationale for the removal action.