SUMMARY

This Engineering Evaluation and Cost Analysis (EE/CA) describes technologies and alternatives to mitigate the primary source of environmental damage and potential human health risk at the abandoned Blue Ledge Mine site (the Site) and recommends a removal action. URS Corporation (URS) prepared this document for the US Forest Service, Department of Agriculture (USFS) under the terms of the USFS request for proposal (RFP) RFP-27-06-113 (USFS, 2006).

BACKGROUND

The Site is located on patented and National Forest System (NFS) land in northern California, within the Rogue River-Siskiyou National Forest, approximately 3 miles south of the Oregon border. The mine site lies at the upper headwaters of the Joe Creek watershed on a steep hillslope. Joe Creek flows north to Elliott Creek, which in turn is a tributary to the Middle Fork of the Applegate River. The Applegate River feeds the Applegate Reservoir. The small community of Joe Bar is located downstream of the Site just downstream of the confluence of Joe Creek with Elliott Creek.

Mines that exploit mineralized sulfide deposits are common sources of acid mine drainage (AMD). Acid mine drainage refers to acidic water that discharge from mine adits or leaches from waste rock or tailings. An estimated 70,000 tons of sulfide-rich waste rock was discarded on the hillsides below the adits. The waste rock is located in four primary areas downslope of historically productive adits. Over time, the waste rock has eroded and leached acidity and metals to Joe Creek and Elliott Creek. Both the acidity and the dissolved metals in AMD are harmful to aquatic and terrestrial natural resources and potentially harmful to humans.

Discharges from one or more mine adits, contaminated sediments in Joe Creek, and contaminated groundwater are also significant adverse impacts at the Site. Subsequent remedial action will be required to control these sources and mitigate the impacts. The specific remedial actions that may be needed are beyond the scope of this EE/CA.

PREVIOUS INVESTIGATIONS

Various investigations since 1992 have documented the conditions at the Blue Ledge Mine and show that AMD from the Site has impacted surface water, stream sediments, and groundwater near the Site. The 2009 Site Investigation (SI) report documents previous investigations and the current site conditions (URS). The site investigations indicate that the mine site is a source of arsenic, cadmium, copper, iron, lead, and zinc to soil, groundwater, surface water, and sediments.

RISK EVALUATION

The 2008 quantitative ecological risk evaluation and biological stream surveys reflect the obvious visual impacts:

- Joe Creek is severely impacted, with virtually no visual signs of aquatic life.
- The ecological damage to Joe Creek is confirmed by past macroinvertebrate surveys and a 2008 macroinvertebrate survey by URS.
- The macroinvertebrate surveys show poor ecological health of Joe Creek, as compared to Elliott Creek.

- The lack of native fish and amphibians in a creek that should support aquatic life is notable and in stark contrast to the abundant aquatic life observed just upstream of the mine site.

The quantitative risk evaluation performed by URS in 2008 concluded that metals sourced at the mine pose significant ecological risk in surface water at the Site and in Joe Creek and in riparian soil and sediments of Joe Creek. Metals concentrations in water, sediment, and riparian soil of Elliott Creek were lower than in Joe Creek but still exceeded the minimum threshold for unacceptable ecological risk.

Potentially complete exposure pathways for humans include consumption of fish, direct contact with sediments and riparian soils, and ingestion of groundwater. Arsenic in surface water exceeded human health screening criteria. The Blue Ledge mine is a source of arsenic, but regional sources may also exist. Residents of Joe Bar use groundwater from four wells and one groundwater seep for drinking water. Groundwater samples collected in 2008 were used to support the human health risk assessment. Human health risks in the Applegate Reservoir appear to be low, but that system may not be in equilibrium with contaminants being transported from the mine, and the risk to humans may increase in the future.

RATIONALE FOR REMOVAL ACTION

Site data clearly demonstrate that a removal action is justified. The Site is a historic and ongoing source of AMD from adits and waste rock. Site contamination has eliminated fish and significantly reduced macroinvertebrate populations in Joe Creek and poses an unacceptable ecological risk. Site contamination results in an unacceptable human health risk within the immediate site area and may also impact drinking water.

The Site meets the criteria for a natural resource damage assessment claim. The National Contingency Plan (NCP) grants authority to lead agencies to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or the threat of release of hazardous substances. Absent a removal action, fish are unlikely to return to Joe Creek for the foreseeable future.

The removal action objectives (RAOs) considered in the EE/CA reflect the NCP objectives to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or the threat of releases from the waste rock that pose environmental risk (NCP 40CFR 300.415). This EE/CA assesses treatment technologies and alternatives to mitigate the contamination sourced at the mine. The most significant source of contamination is the waste rock. Removal or stabilization of the waste rock would eliminate the primary source of acid mine drainage. AMD discharge from mine adits and sediments that are already present in Joe Creek may also be significant sources of environmental impacts, but treating AMD discharging from adits and sediments in Joe Creek is not within the scope of this EE/CA.

SCREENING OF TECHNOLOGIES AND ALTERNATIVES

The EE/CA considered the effectiveness, implementability, and costs of technologies and alternatives. Technologies considered included removal and off-site disposal and in situ stabilization of the waste rock. In situ stabilization was considered to be impractical and was not retained in removal alternatives. Removal by dozers, excavators, and draglines was considered to be feasible. Once removed, the waste rock would be deposited in an engineered repository

located near the mine site. Two potential repository sites, referred to as the north and south repository sites, are located within one mile of the mine site, and appear to be feasible, but the EE/CA also considered more distant repositories and landfilling. It is likely that one or the other of the repository sites would have adequate capacity to accommodate the entire volume of waste rock. Based primarily on its size, ease of construction, and absence of critical habitat, the south repository site is the preferred site to construct the repository. The north site is retained as a storage and lay-down area.

Alternatives considered in the EE/CA also include technologies for the following:

- AMD and run-off control and treatment;
- Reclamation cover after removal of waste rock; and
- Adit closure.

This EE/CA focuses on removal of the waste rock, which is believed to be a significant source of the contamination in Joe Creek. This EE/CA does not consider other potentially significant environmental concerns at the site because they are outside the scope of a removal action. Additional study and possible remediation may include the following:

- AMD discharge from adits;
- Waste rock sediments in Joe Creek; and
- Groundwater.

The major elements and costs of the alternatives that were considered include the following:

No Action Performance monitoring and reporting and road maintenance for access. $0.14M.

Alternative 1 Waste rock removal, unlined repository with impervious cover at local site. $15.99M.

Alternative 2 Waste rock removal, lined repository with impervious cover and AMD treatment at local site. $17.65M.

Alternative 3 Waste rock removal. More distant repository or landfill disposal. $19.65M.

RECOMMENDED REMOVAL ACTON

Alternative 2 is the recommended removal action. It consists of the following primary elements:

- 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 be required.
- Excavate waste rock with dozers, excavators, and draglines. The selected contractor will select the methods depending on the slopes and characteristics of the waste rock area.
- Construct the upland repository at the south repository site and prepare it for waste rock placement. The repository will be lined with a geosynthetic clay liner (GCL) and have AMD collection and treatment.

- Place the excavated waste rock in the repository.
- Install a composite GCL and soil cover over the waste rock, including native revegetation, run-on diversion, grading and drainage to isolate the waste rock from the environment and inhibit leaching of acidity and metals.
- Place and stabilize reclamation fill, where practical, and plant selected native vegetation on portions of the former waste rock areas. The reclamation fill and plantings will stabilize waste rock that remains after the removal is complete and minimize erosion and AMD from the residual waste rock.
- 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 reclaimed site stabilizes.
- Close adits with bat gates to allow access by wildlife, prevent human access, and minimize physical hazards from the mine shafts.
- Conduct performance monitoring and reporting to assess water quality and long-term restoration of the Joe Creek and Elliott Creek watersheds.

Treatment of mine adit water, sediments in Joe Creek, and groundwater are not components of this alternative. Additional investigation and feasibility study are necessary to assess remedial alternatives for these issues.

It will take an estimated two construction seasons (June through October) to construct the remedy. A removal action should be implemented as soon as possible to mitigate continued degradation of the environment and potential risks to human health.