Executive Summary

The Red Devil Mine Site (RDM) is abandoned mercury mine and ore processing facility located on public lands managed by the Bureau of Land Management (BLM). Tailings generated by historical mining and ore processing operations dominate the central area of the site and have been identified as the primary source of mercury, arsenic, and antimony being released to the environment (BLM 2013). Sediment sampling results indicate that mine tailings are migrating into the Kuskokwim River via Red Devil Creek. The BLM is planning an action for 2014 that is intended to prevent tailings from continuing to erode into Red Devil Creek and migrate to the Kuskokwim River.

The BLM initiated a Remedial Investigation and Feasibility Study (RI/FS) at Red Devil Mine in 2009 under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The project is being performed in coordination with multiple federal and state agencies. The action planned for 2014 (early action) will halt the spread of tailings during the interim period between the RI/FS and the sitewide remedial action. The early action is being performed on a non-time-critical basis, which is consistent with CERCLA guidance, including sections of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) applicable to removal actions (40 Code of Federal Regulations [CFR] Section 300.415). This Engineering Evaluation/Cost Analysis (EE/CA) presents the RI data that demonstrate the need for the early action, the regulatory framework for early action, and four alternatives considered for the project, including a feasibility analysis that yielded a preferred alternative.

Previous Investigations and Removal Actions

The RDM site is in a remote location with no road or rail connection to any community. The site can be accessed via an all-terrain vehicle (ATV) track from the village of Red Devil, which includes an airstrip. Direct site access is also by boat or barge on the Kuskokwim River. Because of its remote location, site work has proceeded in phases over the course of a number of years.

The first investigations and cleanup actions at RDM were performed in the 1970s. Removal/cleanup actions involving selective waste removal, building demolition, debris segregation and on-site burial, and contaminated soil stockpiling were conducted between 1998 and 2002. These actions included off-site disposal of hazardous waste and materials and on-site consolidation of mine structural debris. Site investigation was initiated in 1988, and groundwater monitoring was the

primary focus of site activity between 2003 and 2009. To date, the mine structures have been demolished, and three debris burial areas (monofills) have been constructed. A more complete history of environmental sampling and monitoring at the RDM site is described in the draft final RI report (BLM 2013).

Basis for Early Action

This early action EE/CA presents four alternative approaches to preventing active erosion and movement of tailings in the section of Red Devil Creek that runs through the central portion of the mine, called the Main Processing Area. The segment of Red Devil Creek that has been identified for the non-time-critical removal action has been observed to actively erode tailings, and sediment sampling results for the Kuskokwim River indicate that material is being transported to the Kuskokwim River.

A baseline risk assessment that was prepared as part of the RI concluded that tailings/waste rock, soil, and Red Devil Creek sediment pose potential risks to human and ecological receptors. Based on the site conditions, BLM, in consultation with the Alaska Department of Environmental Conservation (ADEC) and U.S. Environmental Protection Agency (EPA), determined that an early action is warranted to control or eliminate ongoing erosion of eroded material into the Kuskokwim River.

Objectives of the Early Action

The primary objective of the early action is to minimize those tailings within Red Devil Creek identified as containing the highest concentrations of antimony, arsenic, and mercury, and to reduce their potential to migrate into the Kuskokwim River. Secondary objectives were also considered when developing the removal alternatives for the site and include the following:

- Provide adequate hydraulic conveyance of Red Devil Creek;
- Provide measures, as needed, to cover exposed waste excavated from Red Devil Creek and stored on site; and
- Provide measures to stabilize slopes of the stream banks of Red Devil Creek to reduce further erosion.

Risk-based cleanup levels (i.e., remedial goals) for the site based on sitewide remedial action objectives (RAOs) were not developed as part of the design criteria for the early action due to the nature of these activities.

Early Action Alternatives

Three different alternative engineering approaches were developed and evaluated in order to identify a preferred method of reducing migration of contaminated sediments into the Kuskokwim River. The following alternatives were evaluated:

1. Alternative 1 – No Action

2. Alternative 2 – Channelization and Line Creek with Solidifying Concrete Cloth
3. Alternative 3 – Line Creek with Culvert
4. Alternative 4 – Excavate Red Devil Creek Sediment

A number of design assumptions must be made to fully develop and evaluate each alternative. The basis of the design assumptions was provided in the engineering analysis presented in the Hydraulic Analysis Report prepared by the U.S. Army Corps of Engineers (see Appendix C).

Alternative 1, the No Action Alternative, was prepared and evaluated to provide a baseline with which other alternatives can be compared. Under this alternative, no action would be taken to reduce contaminant concentrations in affected site media.

Alternative 2 involves the channelization and installation of a concrete cloth liner along the existing stream bed, and Alternative 3 involves installing a culvert liner. Both alternatives would be constructed in the portion of Red Devil Creek that flows through the Main Processing Area.

Alternative 4 involves the excavation of sediment within the portion of Red Devil Creek that extends through the Main Processing Area, which has been identified as actively eroding and containing contaminated sediments. It also involves regrading tailings on the south side of the creek in the Main Process Area to prevent future erosion.

Evaluation Process

Three broad criteria—effectiveness, implementability, and cost—were used to evaluate each alternative against the scope of the early action. The alternatives were initially evaluated individually using the three broad criteria, and then compared against one another. Tables E-1 through E-3 provide a summary of the comparative analysis.

Table E-1 Summary of Alternatives Comparative Analysis for Effectiveness

	Effectiveness			
Ranking*	Overall Protection of Human Health and the Environment	Long-Term Effectiveness	Reduction of Toxicity, Mobility or Volume Through Treatment	Short-Term Effectiveness
1	Alternative 3	Alternative 4	Alternative 4	Alternative 1
2	Alternative 2	Alternative 2	Alternative 2	Alternative 3
3	Alternative 4	Alternative 3	Alternative 3	Alternative 2
4	Alternative 1	Alternative 1	Alternative 1	Alternative 4

*Note: Rankings are from most favorable (1) to least favorable (4).

It should be noted that each of the four alternatives can be implemented such that it will be in compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and will allow for the ARARs to be met in full once a full-scale remedy is selected and implemented. Therefore, compliance with ARARs was not included in the comparative alternatives analysis.

Table E-2 Summary of Alternatives Comparative Analysis for Implementability

	Implementability		
Ranking*	Technical Feasibility	Administrative Feasibility	Availability of Service and Materials
1	Alternative 4	Alternative 3	Alternative 1
2	Alternative 3	Alternative 2	Alternative 4
3	Alternative 2	Alternative 4	Alternative 3
4	Alternative 1	Alternative 1	Alternative 2

* Note: Rankings are from most favorable (1) to least favorable (4)

Table E-3 Summary of Alternatives Comparative Analysis for Cost

		Operations and Maintenance		Total Present Worth Cost
Alternative	Capital	Yearly	Present Worth*	
1	$0	$0	$0	$0
2	$1,900,000	$23,000	$190,000	$2,090,000
3	$1,920,000	$23,000	$190,000	$2,110,000
4	$1,950,000	$23,000	$190,000	$2,140,000

* Present worth costs were calculated using an inflation factor of 3.5%, and 5 years' worth of operations and maintenance.

Recommended Early Action Alternative

Based upon the alternatives evaluations, Alternative 4, Excavation of Actively Eroding Contaminated Sediment, is the recommended early action alternative.

Based on individual and comparative analysis, Alternative 4 is considered the most effective and constructable (implementable) approach. The final configuration of the tailings piles defined for Alternative 4 is also the most consistent with the sitewide remedial action alternatives being developed as part of the Feasibility Study. Although Alternative 4 is not the least expensive to implement, the additional costs would be offset in part by avoiding potential cost increases due to administrative and technical feasibility concerns such as coordination of materials shipments to the site. Additionally, Alternative 4 is likely the most adaptable to evolving site-specific conditions that would emerge during cleanup activities under the future full-scale remedy.