Engineering Evaluation/Cost Analysis
Red Devil Mine
Red Devil, Alaska

Prepared for

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HLA Project 47411

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DISTRIBUTION

1.0 INTRODUCTION

The Bureau of Land Management (BLM), Alaska State Office, retained Harding Lawson Associates/Wilder Construction Company Joint Venture (HLA/Wilder) to prepare an Engineering Evaluation/Cost Analysis (EE/CA) for the former Red Devil Mine retort and two former battery storage areas near Red Devil, Alaska (Figure 1). The BLM assigned the scope of work (SOW) to HLA/Wilder under Delivery Order 0014 and Modification 1 of Contract 1422-N660-C97-3025.

Before implementation of any alternatives presented in this EE/CA, additional site characterization is necessary. The appropriateness and estimated rough-order-magnitude (ROM) costs for each alternative should be re-evaluated after the additional site characterization. Available data is summarized in Section 2; however, the extent of contamination in soils adjacent to the retort building and former battery storage areas have not been identified. The alternatives and estimated ROM costs presented in this EE/CA are intended to assist the BLM with site scoping and planning purposes only.

2.0 SITE CHARACTERIZATION

2.1 Site Description and Background

The Red Devil Mine is in a remote part of western Alaska, on the south side of the Kuskokwim River (Figure 1). The mine occupies approximately 10 acres of BLM-managed land (Roy F. Weston, Inc. [Weston], 1989). An airstrip at the village of Red Devil provides access to the area. From the airstrip, the mine site can be accessed by boat on the Kuskokwim River or along an unimproved road.

The mine site consists of the following areas (Figure 2):

- A housing area with six individual units
- Equipment storage buildings
- Laboratory
- Engine shop
- Mine portal
- Chemical storage sheds
- Steam plant
- Ball mill and crusher
- Retort building
- Settling ponds
- Five aboveground storage tanks (ASTs)

Currently, the buildings are dilapidated and structurally unsound. Mining material and debris is spread across much of the site. Red Devil Creek runs through the mine site, separating the retort building, crusher, ASTs, steam plant, and chemical storage sheds from the access road.

The Red Devil Mine started producing mercury in 1933. The mine was owned and operated by New Idria-Alaska Quicksilver Mining Company from 1933 to 1946. DeCoursey Mountain Mining Company, also known as DeCoursey Brewis Company and Alaska Mines and Minerals, Inc., resumed mining operations in 1952, discontinuously producing mercury until 1971. At times, the mine was one of the largest producers of mercury in the United States and produced 35,000 flasks of mercury according to a site investigation by Weston (Weston, 1989).

A 1988 site investigation included collecting surface water, creek sediment, and mine tailings samples and analyzing them for mercury, arsenic, and antimony. Select samples were analyzed for additional metals. One residential well was sampled. Thirty-one transformers were inventoried and analyzed for polychlorinated biphenyls (PCBs). Chemicals stored at the site were characterized and their quantities estimated. Drums at the site were inspected. Results from the site investigation show mercury, antimony, and arsenic in the sediment and tailings. The surface water results were similar to background samples (Weston, 1989).

Two of the transformers had PCB concentrations over 50 parts per million and were removed from the site (Weston, 1989). The chemicals stored at the site were identified as copper sulfate, sodium hydroxide, and potassium carbonate.

The mine site has been inspected by the U.S. Environmental Protection Agency (EPA) (1971, 1979, and 1987), the Alaska Department of Environmental Conservation (ADEC) (1985 and

1987), and the BLM (1988) (Weston, 1989). According to an ADEC Oil and Hazardous Materials Spill Report dated June 30, 1997, the site was given a "no further action" flag by the EPA Superfund Program in 1990 (BLM, 1999).

2.2 Previous Removal Actions

In June 1999, HLA/Wilder conducted a limited waste removal action and sampling project at the Red Devil Mine site (HLA/Wilder, 1999). The SOW for the removal action was developed on the basis of results from a site visit conducted by HLA/Wilder in 1998, results from the site investigation performed by Weston (Weston, 1989) and input from ADEC and EPA. The removal action activities included characterizing selected waste streams, removing limited quantities of waste, and sampling background and suspected contaminated areas after waste removal. The removal activities focused on five areas of concern: battery storage, transformer areas, drum areas, chemical storage, and the retort building. The following quantities of waste were removed:

- 5 EP-2 boxes/batteries
- 18 Fifty-five-gallon drums/used oil
- 3 Fifty-five-gallon drums/suspected PCB-contaminated transformer oil
- 3 Fifty-five-gallon drums/Stoddard solvent
- 3 Fifty-five-gallon drums/grease
- 2 Fifty-five-gallon drums/mercury-contaminated ash
- 2 Fifty-five-gallon drums/mercury-contaminated concrete
- 3 Supersacks™/mercury-contaminated ash
- 2 Supersacks™/mercury-contaminated PPE and debris
- 2 Fifty-five-gallon drums/sodium dichromate dihydrate
- 7 Supersacks™/potassium carbonate
- 5 Supersacks™/chemical-contaminated soil and debris
- 2 Supersacks™/sodium hydroxide
- 2 Fifty-five-gallon drums/copper sulfate

Surface soil, sediment, and surface water samples were collected to obtain quantitative contaminant concentration data for the site. For the purpose of this EE/CA, the discussion of sample results for the limited removal action is focused on mercury contamination in surface soil at the retort building area. A complete discussion of the limited removal action results is presented in HLA/Wilder's report titled *Limited Waste Removal Action, Red Devil Mine, Red Devil, Alaska* (HLA/Wilder, 1999).

The background mercury concentration in surface soil for the Red Devil site was 3.49 milligrams per kilogram (mg/kg), which exceeds the 1.4 mg/kg ADEC cleanup level from Title 18, Alaska Administrative Code, Chapter 75 (18 AAC 75), Method 2, Table B1, under 40-inch zone, most conservative pathway. Mercury concentrations for soil samples collected from the retort building area (including adjacent chemical storage sheds) ranged from 185 to 35,300 mg/kg.

The background sediment sample from the Kuskokwim River had a mercury concentration of 0.138 mg/kg. Mercury concentrations in the sediment samples from the Kuskokwim River downstream of the retort area ranged from 0.185 to 55.5 mg/kg. Mercury was not detected at or above the detection limit of 0.0002 (ND[0.0002]) milligrams per liter (mg/L) in the surface water of the Kuskokwim River at the background location or downstream from the retort area.

The background sediment sample from Red Devil Creek had a mercury concentration of 0.309 mg/kg. Mercury concentrations in the sediment samples from Red Devil Creek downstream from the Retort area ranged from 48.4 to 399 mg/kg. Mercury was not detected (ND[0.0002] mg/L) in the surface water of Red Devil Creek at the background location. Water samples below the settling ponds and at the mouth of Red Devil Creek contained 0.000262 and 0.00143 mg/L mercury, respectively.

Seven near-surface soil samples were collected from the area around the retort building (including adjacent chemical storage sheds). Mercury was visible at one of the sample locations and in the surrounding tailings. Mercury results for the samples ranged from 185 to 35,300 mg/kg, which

exceeds the background concentration. Two samples with mercury concentrations of 23,800 and 11,200 mg/kg were analyzed for mercury using the toxicity characteristic leaching procedure (TCLP). These results did not exceed the 0.2 mg/L maximum contaminant concentration for the toxicity characteristic under the Resource Conservation and Recovery Act (RCRA).

Lead concentrations for three soil samples collected from the two former battery storage areas ranged from 1,080 to 13,500 mg/kg. These results exceed the ADEC 18 AAC 75 cleanup level (1,000 mg/kg for a commercial/industrial land-use scenario).

2.3 Source, Nature and Extent of Contamination

The source for the mercury contamination at the retort building is retorting activities conducted discontinuously from 1933 to 1971. The source for the lead contamination is battery storage activities at the two identified locations.

The extent of mercury-contaminated soils surrounding the retort building or lead-contamination in soils at the former battery storage areas has not been identified. However, based on surface sample results and field observations during the 1999 limited removal action, the lateral extent of mercury contamination likely extends to limits of the pad of graded tailings the retort building sits on. The extent of lead contamination is likely limited to near-surface soils at the former battery storage areas.

2.4 Analytical Data

Available characterization data is discussed in Section 2.2.

2.5 Streamlined Risk Evaluation

This streamlined risk evaluation is limited to a discussion of source areas, secondary release mechanisms, pathways, and routes of exposure. This evaluation is based on a conceptual model of the site and available data from surface- and near-surface soil, and surface water/sediments. A groundwater investigation at the site has not been conducted.

The primary source areas at the site include soil in the vicinity of the retort building (mercury) and former battery storage areas (lead) (Figure 2). For mercury, secondary release mechanisms include volatilization, dust, and infiltration/percolation. For lead, secondary release mechanisms include dust and infiltration/percolation.

Potential exposure pathways (and exposure routes) include air (inhalation), wind (inhalation or ingestion), soil (ingestion or dermal contact), groundwater (ingestion or dermal contact), and surface water/sediments (ingestion or dermal contact).

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

3.1 Statutory Limits on Removal Actions

The final disposition of the soil around the retort building will be determined to a great degree by their status as either hazardous or nonhazardous (solid) wastes under federal and state regulations. As a processing waste, the materials will be subject to the waste characterization requirements under RCRA. Under RCRA, these materials will be classified as solid waste if TCLP analytical results for mercury are less than 0.2 mg/L. The State of Alaska regulates solid waste disposal under 18 AAC 60. If TCLP analyses for mercury are greater than 0.2 mg/L, the waste will be considered a RCRA hazardous waste. The Land Disposal Restrictions (LDRs) under RCRA require hazardous mercuric wastes to be further subdivided on the basis of their total mercury content. Hazardous wastes containing up to 260 mg/kg of total mercury are classified as "low level" wastes and must be stabilized before disposal by landfilling. Hazardous waste having total mercury concentration in excess of 260 mg/kg are "high level" waste and must be retorted before disposal by landfilling.

The regulatory requirements and disposal costs for the waste will be dependent on its status as either a solid or hazardous waste. During the 1999 interim removal action, two soil samples (total mercury concentrations of 11,200 and 23,800 mg/kg) from near the retort building were analyzed for TCLP mercury. Results for both samples did not exceed the 0.2 mg/L toxicity characteristic for mercury.

3.2 Determination of Removal Scope

The goal of the EE/CA is to reduce the environmental risk associated with the mercury-contaminated retort structure and the surrounding surface soils. To meet this goal the following objectives will need to be completed.

- Decontaminate and demolish the retort building to eliminate the chemical and physical hazards.
- Reduce the environmental risk posed by decontaminating the retort demolition debris.
- Dispose of the demolition debris.
- Remove mercury-contaminated surface soil in the immediate vicinity of the retort building to reduce environmental risk.
- Treat/contain and/or dispose of the mercury-contaminated soil.
- Remove lead-contaminated surface soil in the vicinity of the former battery storage areas to reduce environmental risk.
- Treat/contain and/or dispose of the lead-contaminated soil.

3.3 Determination of Removal Schedule

A removal schedule has not been established.

3.4 Planned Remedial Activities

Planned remedial activities have not been established.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

HLA/Wilder evaluated and prepared a cost analysis for the following alternatives. The alternatives discussion is limited to the mercury-contaminated soil. The volume of lead-contaminated soils is likely small, and depending on additional site characterization, could likely be handled under the selected alternative(s).

Alternative 1 – Stabilize Surface Soil and Leave In Situ

Mercury-contaminated soil may be stabilized in situ with the addition of a chemical agent and mechanical mixing with a backhoe or suitable equipment which converts leachable metals to nonleachable minerals. HLA/Wilder has experience using Maectite chemical treatment to stabilize soil with metals contamination. To stabilize the soils, liquid Maectite is mixed with the contaminated soils. Our assumptions for this alternative are listed below.

- The soil is a solid waste rather than a hazardous waste.
- The quantity of Maectite required to stabilize the soil would be established by performing a small-scale bench test before field application. We have assumed 5 percent Maectite by weight will be required to stabilize the mercury.

Alternative 2 – Excavate and Dispose in Onsite Solid Waste Landfill (SWLF)

This alternative involves soil excavation and the design, permitting, construction, and monitoring of a landfill at the mine site. Our assumptions for this alternative are as follows:

- The wastes are solid rather than hazardous wastes.
- A suitable location for a landfill exists at the mine site and is managed by the BLM. The BLM will implement deed restrictions for future land use at the landfill site.

- A Class I solid waste landfill will be constructed. Landfill permitting and design will be performed in accordance with 18 AAC 60.

- The State will waive the leachate collection system requirements for the Class I landfill and require a 5-year post-closure monitoring period.

- Equipment is not available locally and will have to be mobilized from Anchorage.

Alternative 3 – Excavate and Dispose in Offsite Landfill

This alternative involves soil excavation and offsite transport and disposal at a permitted landfill. Our assumptions for this alternative are listed below.

- The soil is a solid waste rather than a hazardous waste.

Alternative 4 – Excavate, Stabilize, and Dispose in Onsite SWLF

This alternative combines soil stabilization (Alternative 1) and onsite construction of a SWLF. Our assumptions for this alternative are listed below.

- The wastes are solid rather than hazardous wastes.

- A suitable location for a landfill exists at the mine site and is managed by the BLM. The BLM will implement deed restrictions for future land use at the landfill site.

- A Class I SWLF will be constructed. Landfill permitting and design will be performed in accordance with 18 AAC 60.

- The State will waive the leachate collection system requirements for the Class I landfill and require a 5-year post-closure monitoring period.

- Equipment is not available locally and will have to be mobilized from Anchorage.

- By stabilizing the wastes the long term risk associated with the soil is reduced and could, if approved by the ADEC, eliminate the requirement for post-closure monitoring.

Alternative 5 – Excavate, Retort, and Dispose in Onsite SWLF

This alternative is similar to Alternative 4 (Excavate, Stabilize, and Dispose in Onsite SWLF) except the soil would be retorted before being placed in the onsite landfill.

Alternative 6 – Excavate and Transport Hazardous Waste to Treatment, Storage, Disposal Facility (TSDF)

Under this alternative additional characterization results indicate the soil fails mercury TCLP and is a RCRA hazardous waste. Under the alternative the mercury-contaminated soil surrounding the Retort Building will be hauled offsite for treatment/disposal at an approved TSDF.

4.1 Effectiveness, Implementability, and Cost

The effectiveness, implementability, and estimated ROM costs for each alternative are discussed below. The discussions below assume the volume of contaminated soil is approximately 7,000 cubic yards. This assumption allowed development of the ROM costs to assist the BLM with site scoping and planning purposes, and are not cost estimates for HLA/Wilder to conduct the work. However, the effectiveness, implementability, and ROM costs for each alternative should be re-evaluated after the additional site characterization activities are completed. Appendix A presents the estimated ROM costs for each alternative.

Alternative 1 – Stabilize Surface Soil and Leave In Situ

Effectiveness

The effectiveness of Alternative 1 to protect human health and the environment depends on the additional site characterization results; including contaminant concentrations, vertical and lateral

extent of contamination, depth to groundwater, groundwater sample results, and negotiations with regulators.

Implementability

The implementability of this alternative depends on the additional site characterization results. If implemented, institutional controls and a groundwater monitoring program would likely be required.

Cost

Appendix A presents estimated ROM costs for this alternative.

Alternative 2 – Excavate and Dispose in Onsite Solid Waste Landfill (SWLF)

Effectiveness

This alternative is protective of human health and the environment through excavation of the contaminated soil and containment in an onsite SWLF.

Implementability

The implementability of this alternative depends on the additional site characterization results. Implementation will require siting a SWLF onsite, establishing institutional controls, and developing a groundwater monitoring compliance program.

Cost

Appendix A presents estimated ROM costs for this alternative.

Alternative 3 – Excavate and Dispose in Offsite Landfill

Effectiveness

This alternative is protective of human health and the environment because soil will be excavated and disposed offsite. Since the soil will be disposed offsite, this alternative has the advantage of minimizing the BLM's long-term liability.

Implementability

The implementability of this alternative depends on results from additional characterization.

Cost

Appendix A presents estimated ROM costs for this alternative.

Alternative 4 – Excavate, Stabilize, and Dispose in Onsite SWLF

Effectiveness

The effectiveness of this alternative is similar to Alternative 2 (Excavate and Dispose in Onsite SWLF) except the soil is stabilized before placement in the SWLF.

Implementability

The implementability of this alternative is the same as Alternative 2 (Excavate and Dispose in Onsite SWLF) except stabilization may allow a decrease of the duration of the groundwater monitoring program depending on negotiations with regulatory agencies.

Cost

Appendix A presents estimated ROM costs for this alternative.

Alternative 5 – Excavate, Retort, and Dispose in Onsite SWLF

Effectiveness

The effectiveness of this alternative is the same as Alternative 4.

Implementability

The implementability of this alternative is the same as Alternative 4 (Excavate, Stabilize, and Dispose in Onsite SWLF).

Cost

Appendix A presents estimated ROM costs for this alternative.

Alternative 6 – Excavate and Transport Hazardous Waste to Treatment, Storage, Disposal Facility (TSDF).

Effectiveness

The effectiveness of the this alternative is the same as Alternative 3 (Excavate and Dispose in Offsite Landfill).

Implementability

The implementability of this alternative is the same as Alternative 3 (Excavate and Dispose in Offsite Landfill).

Cost

Appendix A presents estimated ROM costs for this alternative.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

A comparative analysis of the removal action alternatives is not meaningful until completion of the additional site characterization. Depending on the results of the additional characterization work and negotiations with regulatory agencies, the appropriate action may be a combination of the alternatives presented in this EE/CA.

6.0 RECOMMENDED REMOVAL ACTION ALTERNATIVES

Selection of the appropriate removal action alternative(s) depends on the additional site characterization results and establishing the regulatory status of the soils.

Once the additional site characterization work is complete, the alternatives presented in this EE/CA should be re-evaluated for effectiveness, implementability, and cost. The final removal action may consist of more than one alternative based on the additional site characterization results.

7.0 BIBLIOGRAPHY

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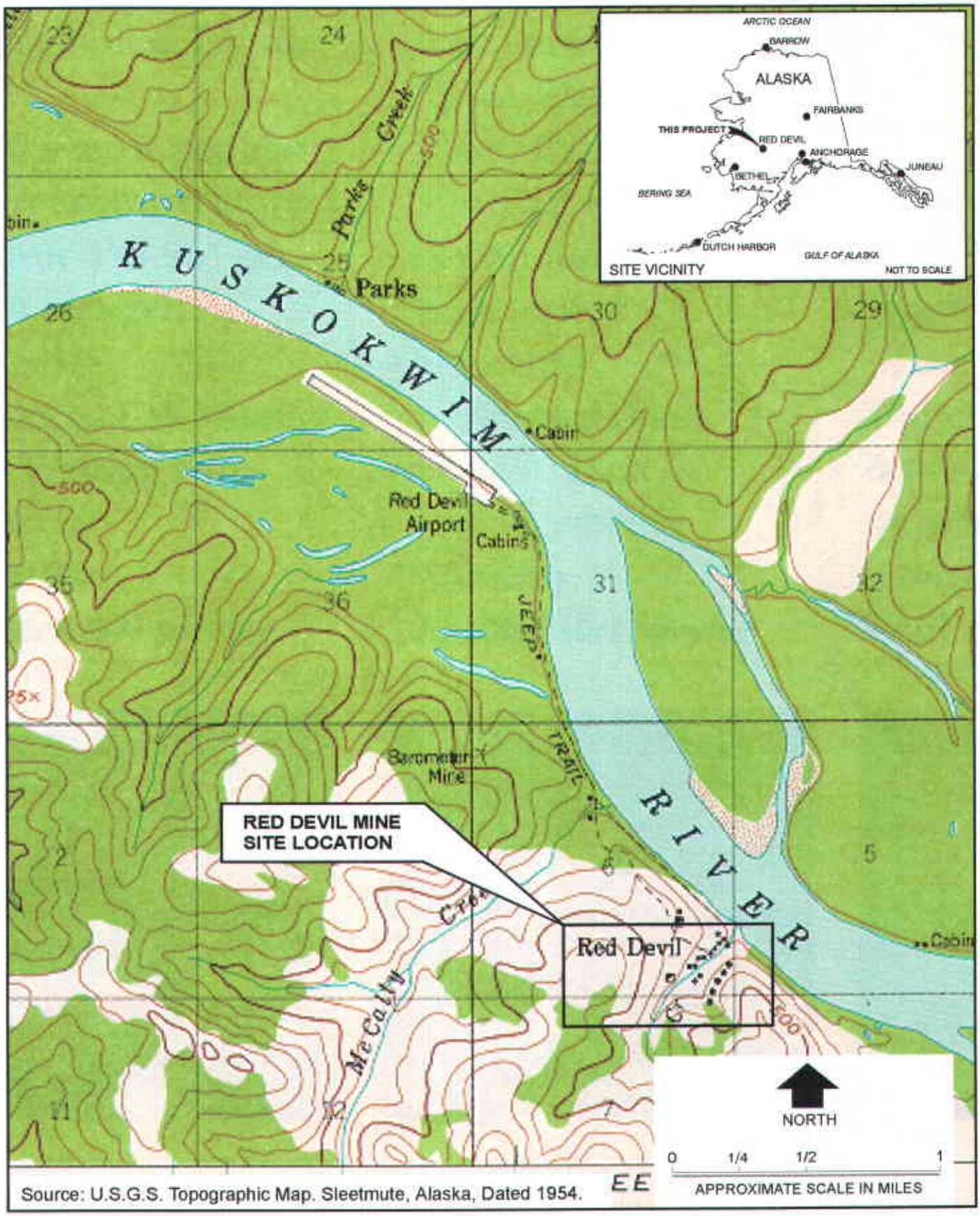
FIGURES

FIGURES



Source: U.S.G.S. Topographic Map. Sleetmute, Alaska, Dated 1954.

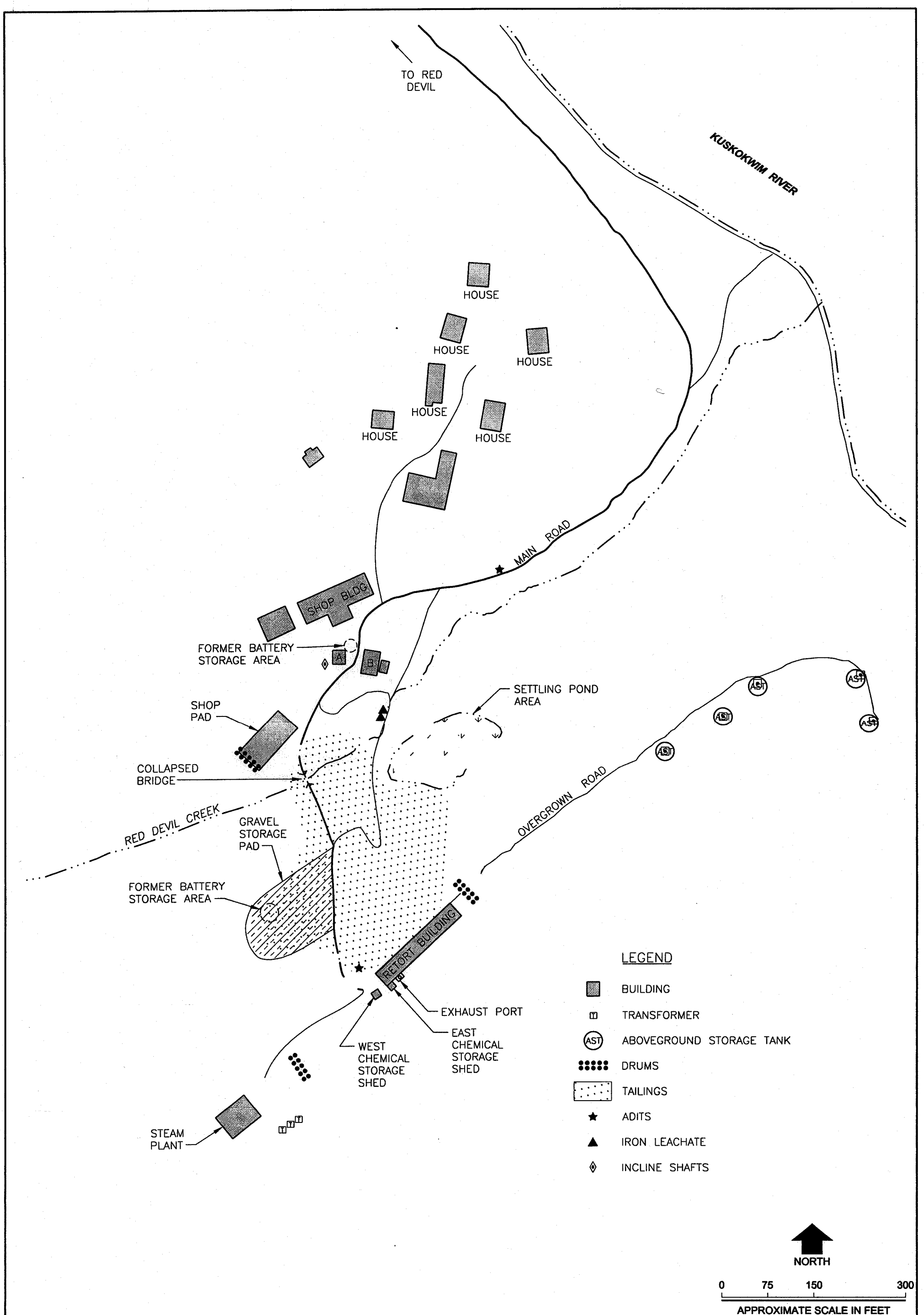
Harding Lawson Associates/
Wilder Construction Company
Joint Venture

Site Location and Vicinity Map

Red Devil Mine Site
Red Devil, Alaska

FIGURE
1

DRAWN	PROJECT NUMBER	APPROVED	DATE	FILE NAME
CEH	47411		3/00	47411a3.cdr



Harding Lawson Associates/
Wilder Construction Company
Joint Venture

WILDER

Site Plan

Red Devil Mine Site
Red Devil, Alaska

FIGURE
2

DRAWN	PROJECT NUMBER	APPROVED	DATE	FILE NAME
CEH	47411	ISD	3/00	47411a3.dwg

APPENDIX A

APPENDIX A

COST ANALYSIS SPREADSHEETS

Red Devil Mine - Retort Building Area Only

EE/CA ROM Cost Estimates

Option	Task	Cost
1	Retort Building Demolition and C&D Monofill	$393,000
2	Retort Building Demolition, Temporary Storage and C&D Monofill	$592,000
3	Construct Onsite Solid Waste Landfill	$1,020,000

Alternative	Task		Cost
1	Stabilize Surface Soil and Leave In Situ	*with Option 1*	$790,000
		with Option 2	$989,000
2	Excavate and Dispose in Onsite SWLF	*with Option 1*	$1,633,000
		with Option 2	$1,832,000
3	Excavate and Dispose in Offsite Landfill	*with Option 1*	$13,393,000
		with Option 2	$13,592,000
4	Excavate, Stabilize and Dispose in Onsite SWLF	*with Option 1*	$3,463,000
		with Option 2	$3,662,000
5	Excavate, Retort and Dispose in Onsite SWLF	*with Option 1*	$2,933,000
		with Option 2	$3,132,000
6	Excavate and Transport Hazardous Waste to TSDF	*with Option 1*	$43,853,000
		with Option 2	$44,052,000

Recommendation	Cost
Perform Site Characterization at the Retort Building Area	$186,600

Overall Assumptions

1 These costs are only rough order magnitude (ROM) estimates and are not intended to be used as actual estimates to complete the work.
2 The volume of contaminated soil used for the ROM estimates is 7,000 cubic yards.
3 Costs for assessing regulatory status of contaminated soil is not included in the ROM estimates.
4 Disposal and or resale of recovered mercury in alternative 6 is not included.
5 For Alternatives 1 through 5, the soil is presumed to pass the Toxicity Characteristic Leachate Procedure (TCLP) for mercury.
6 For Alternative 6, the soil is presumed to fail the TCLP for mercury.
7 Option 2 includes two separate mobilizations to the field (one in the first field season and one in the second season).
8 All estimates assume the site is barge/Herc accessible for mobilization/demobilization.
9 The ROM estimates only address the Retort Building Area.
10 The ROM estimates assume that lodging will be available in Red Devil.
11 The ROM estimate for the site characterization recommendation is separate from the all of the Options and Alternaitves.

Red Devil Mine
EE/CA ROM Cost Estimates
Option 1
Retort Building Demolition and C&D Monofill

	Task	ROM Cost
1	Planning Documents	$26,062
2	Asbestos Survey and Abatement	$34,794
3	Mobilization/Demobilization	$140,866
4	Retort Building Decontamination	$29,139
5	Retort Building Demolition	$30,515
6	C&D Landfill Design and Permitting	$62,442
7	Landfill	$69,366
	Total	**$393,000**

Assumptions

1 Planning documents include a WP, SSHP, SAP, and Asbestos Abatement Plan.
2 For the asbestos survey and abatement, assume 2 days onsite for survey and 3 days for the abatement crew. Also assume 2 separate mobilizations.
3 Mobilization/demobilization includes travel for 6 people, preparation time and shipping costs.
4 Retort Building decontamination will take approximately 4 days. Assumed a lump sum disposal cost for recovered mercury.
5 Building demolition will take approximately 4 days.
6 Mono fill design and permitting will take place during the planning phase and will take approximately 8 weeks.
7 The monofill will take approximately 10 days to construct.

Red Devil Mine
EE/CA ROM Cost Estimates
Option 2
Retort Building Demolition, Temporary Storage and C&D Monofill

	Task	ROM Cost
1	Planning Documents	$26,062
2	Asbestos Survey and Abatement	$34,794
3	Mobilization/Demobilization	$277,233
4	Retort Building Decontamination	$29,139
5	Retort Building Demolition	$30,515
6	Temporary Onsite Storage of Debris	$44,877
7	C&D Landfill Design and Permitting	$62,442
8	Landfill	$86,851
	Total	**$592,000**

Assumptions

1 Planning documents include a WP, SSHP, SAP, and Asbestos Abatement Plan.
2 For asbestos survey and abatement, assume 2 days onsite for the survey and 3 days for abatement crew. Also assume 2 separate mobilizations.
3 Mobilization/demobilization includes travel for 6 people, preparation time and shipping costs.
4 Retort Building decontamination will take approximately 4 days. Assumed a lump sum disposal cost for recovered mercury.
5 Building demolition will take approximately 4 days.
6 Onsite storage preparation will take approximately 4 days, assumed unlined and uncovered storage for C&D debris.
7 Monofill design and permitting will take place during the planning phase and will take approximately 8 weeks.
8 The monofill will take approximately 10 days to construct.

Red Devil Mine
EE/CA ROM Cost Estimates
Option 3
Construct Onsite Solid Waste Landfill

	Task	ROM Cost
1	Preliminary ADEC Coordination	$10,251
2	Pre-design Site Visit	$30,640
3	Class 1 Landfill Design	$88,098
4	Permit Application Preparation	$28,287
5	Permit Processing	$50,129
	Subtotal Design and Permitting Cost	***$207,406***
	Construct Modified Class 1 SWLF	
6	Mobilization/Demobilization	$310,105
7	Clear and Grub Site	$13,353
8	Construct Drainage Control Improvements	$13,299
9	Excavate Landfill	$28,624
10	Liner Purchase and Placement	$52,837
11	Place Soil in Landfill	$33,533
12	Place Top Liner and Cover	$52,837
13	Revegetate Cover	$40,464
14	Contsruct Groundwater Monitorig System	$53,761
15	Construct Site Control Measures	$34,095
	Subtotal Construction Costs	***$632,910***
16	Perform Asbuilt Survey	$22,260
17	Prepare Record Drawings	$33,551
18	Post Use Confirmation Sampling and Analyses	$20,759
19	Record SWLF	$15,129
20	Monitor and Documentation for 5 Years	$90,967
	Subtotal Post Construction Cost	***$182,666***
	Total	**$1,020,000**

Assumptions

1 The preliminary ADEC coordination task includes time to evaluate and agree on landfill requirements.
2 The pre-design site visit includes a topographic survey, control establishment and a hydrologic survey.
3 Rule of thumb - Design is 10% of the total cost. For class 1 landfill design, assume approximately 8 weeks.
4 Permit application preparation will take approximately 4 weeks.

Red Devil Mine
EE/CA ROM Cost Estimates
Option 3
Construct Onsite Solid Waste Landfill

5 Permit processing includes monitoring the progress of the permit application, comunicating with ADEC and surrounding communities, answering questions, and making design and permit changes. Assume a total of approximately 6 weeks.
6 Mobilization/demobilization is for 6 people and equipment for the landfill option only. Mobilization/demobilization for Options 1 and 2, and the Alternatives are covered elsewhere.
7 Clearing and grubbing will take approximately 2 days.
8 Excavating the new landfill will take approximately 4 days.
9 Constructing drainage control will take approximately 2 days.
10 Placement of bottom Liner will take approximately 5 days.
11 Placing soil in the new landfill will take approximately 4 days.
12 Placing the top liner and cover will take approximately 5 days.
13 Cover revegetation is estimated.
14 Groundwater monitoring well construction includes:
* Assume 4 wells within landfill perimeter and 3 wells on downgradient edge (7 wells total)
* Assume wells are 20 feet deep with locking steel casings.
* Assume drilling and well installation will take approximately 4 days and other miscelaneous construction will take 3 days. Need to mobilize drill rig and drill crew.
15 Not certain what site control measures will be until ADEC agreement, so estimate this task at $35,000 for now. Includes a trip for the project managers to visit site.
16 The as-built survey will take approximately 2 days. Include mobilization/demobilization and a final aerial photograph.
17 Record drawings will take approximately 3 weeks.
18 Sampling will be performed at the soil staging areas and along the soil transport routes. Assume 40 samples.
19 Recording the SWLF is estimated to cost $15,000.
20 Monitoring and documentation includes sampling 7 wells once per year, recording field observations, and providing a report each year. Assume 3 days in the field, and about 2 weeks to prepare the report.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 1
Stabilize Surface Soil and Leave In Situ

	Task	ROM Cost
1	Subcontract Management	$3,926
2	Maectite LaboratoryTreatability Study	$14,366
3	Amendments to Planning Documents	$9,112
4	Procure Maectite	$59,046
5	Ship Maectite	$84,515
6	Mobilization/Demobilization	$132,299
7	Apply Maectite	$40,064
8	Maectite Drum Disposal	$16,803
9	Remedial Action Report Preparation	$36,822
	Total	**$397,000**

Assumptions

1 Subcontract management is for the Maectite subcontractor.
2 The Maectite treatability study task is estimated.
3 Work plan amendments - prepare addendums to plans prepared under Option 1 or 2.
4 Maectite cost based on 750 cubic yards to treat, 1.75 tons/yard, and 5% (by wt.) application rate. The density of Maectite is 13.5 lb/gal and the cost is $6/gal.
5 Maectite shiping will most likely require a HAZMAT specialist to monitor shipping progress (i.e., safety specialist), however we are assuming the Maectite is NOT HAZMAT. Assume barge rates are $25/100 lb from Seattle to Bethel and another $13/100 lb from Bethel to Red Devil. Assume rates from Indiana to Seattle are $25/100 lb (Seattle transfer cost included). Total weight of Maectite needed is 131,250 lbs. Exclude shipping container weight.
6 Mobilization/demobilization supplements Options 1 or 2.
7 Assume we can clean Maectite drums onsite and reuse them for miscellaneous HAZMAT disposal. Assume the drums will be steam cleaned and the decontamination water will be treated onsite. Assume 5 gallons wastewater generated per drum.
8 Applying Maectite will require miscellaneous equipment (loader, dozer, cement mixer, etc.).
9 Draft Remedial Action Report will take approximately 3 weeks. Final version will take approximately 1 more week.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 2
Excavate and Dispose in Onsite SWLF

	Task	ROM Cost
1	Amendments to Planning Documents	$25,076
2	Mobilization/Demobilization	$31,098
3	Excavate and Haul Soil to Staging Area	$74,852
4	Prepare Soil Staging Area	$28,368
5	Onsite SWLF (see Option 3)	$1,022,982
6	Remedial Action Report Preparation	$53,750
	Total	**$1,240,000**

Assumptions

1 Amendments to the planning documents will take approximately 3 weeks. A SWPPP will also be prepared.

2 Mobilization/demobilization will supplement Option 1 or 2, and Option 3. Most of the mobilzation/demobilization is covered under Option 3.

3 Assume we can excavate and haul 100 cubic yards per hour leading to 70 hours for 7,000 cubic yards. This will require 2 excavators, 4 end dumps and 6 operators.

4 The soil staging area will include a layer of 30-mil liner (about 150 ft x 150 ft), use 100 x 100 ft (1,100 square yards) of 60-mil liner to approximate the 30-mil cost (i.e., 2/3 cost).

5 The landfill cost comes from Option 3.

6 Draft Remedial Action Report will take approximately 5 weeks. Add one more week for the final version.

Red Devil Mine
EE/CA ROM Estimates
Alternative 3
Excavate and Dispose in Offsite Landfill

	Task	ROM Cost
1	Amendments to Planning Documents	$17,057
2	Mobilization/Demobilization	$233,362
3	Prepare Soil Staging Area	$29,478
4	Excavate and Haul Soil to Staging Area	$74,852
5	Load Soil for Transport to Offsite Landfill	$43,807
6	Transport to Offsite Landfill for Disposal	$12,557,441
7	Transport and Disposal Tracking	$23,821
8	Remedial Action Report Preparation	$42,235
	Total	**$13,000,000**

Assumptions

1 Amendments to the planning documents will take approximately 2 weeks.
2 Mobilization/demobilization supplements Option 1 or 2.
3 Assume the soil staging area will include a layer of 30-mil liner (about 150 ft x 150 ft), use 100 x 100 ft (1,100 square yards) of 60-mil liner to approximate the cost (i.e. 2/3 cost). Also construct some sort of soil loading area to load soil shiping containers
4 Assume we can excavate and haul 100 cubic yards per hour leading to 70 hours for 7,000 cubic yards. This includes 2 excavators, 4 end dumps and 6 operators.
5 Loading soil for transport will take about 2 weeks and will require logistical support.
6 Soil transport is estimated by using a shipping rate of $0.38 per pound for 7,000 yards (12,250 tons) from Red Devil to Anchorage. The cost also includes packaging and manifesting time, 175 shipping containers, barge coordination time, and assumes a disposal cost of $200 per ton for non-RCRA waste.
7 Transport and disposal tracking will take about 8 weeks. Check manifests, monitor shiping progress, and track disposal progress.
8 The Draft Remedial Action Report will take approximately 4 weeks. Another week will be needed for the final version.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 4
Excavate, Stabilize and Dispose in Onsite SWLF

	Task	ROM Cost
1	Amendments to Planning Documents	$27,958
2	Subcontract Management	$23,854
3	Maectite LaboratoryTreatability Study	$22,366
4	Procure Maectite	$551,355
5	Ship Maectite	$942,379
6	Mobilization/Demobilization	$109,571
7	Prepare Soil Staging/Mixing Area	$52,219
8	Excavate and Haul Soil to Staging/Mixing Area	$74,852
9	Apply Maectite	$109,797
10	Maectite Shipping Container Cleaning and Disposal	$76,770
11	Onsite SWLF (see Option 3)	$1,020,000
12	Remedial Action Report Preparation	$61,564
	Total	**$2,050,000**

Assumptions

1 Amendments to the planning documents will take approximately 3 weeks. An SWPPP will also be prepared.
2 Subcontract management covers coordination with the Maectite supplier and the HAZMAT specialists.
3 The Maectite treatability study cost is estimated.
4 Maectite cost based on treating 7,000 cubic yards, at 1.75 tons/yard, and 5% (by wt.) application rate. The density of Maectite is 13.5 lb/gal and the cost is $6/gal.
5 Maectite shiping will most likely require a HAZMAT specialist to monitor shipping progress (i.e., safety professional), however we are assuming that the maectite is NOT HAZMAT. Assume barge rates are $25/100 lb from Seattle to Bethel and another $13/100lb from Bethel to Red Devil. Assume rates from Indiana to Seattle are $25/100 lb (icluding transfer fee in Seattle). Assume we will ship 1,225,000 lbs of Maectite and the total shipping container weight will 60,000 lbs. The shippingcontainers will be purchased for $2000 each.
6 Mobilization/demobilization supplements Option 1 or 2, and Option 3. Most of the mobilization/demobilization is covered in Option 3, however this taks includes the costs for shipping equipment to mix the maectite.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 4
Excavate, Stabilize and Dispose in Onsite SWLF

7 Assume soil staging area will include 4,000 square yards of 30-mil liner. Approximate with 3,000 square yards of 60-mil liner. Preparation of soil staging area and mixing stations will require 5 days.
8 Assume we can excavate and haul 100 cubic yards per hour leading to 70 hours for 7,000 cubic yards. This task includes 2 excavators, 4 end dumps, and 6 operators.
9 Applying the Maectite will require miscellaneous equipment (loader, dozer, cement mixer, etc.).
10 Assume 61 containers about the size of a 1,500 gallon rectangular fuel tank. Assume the tanks are rented and will be cleaned and returned. Cleaning will produce 50 gallons wastewater per tank (i.e., 6,100 gallons).
11 See Option 3 for landfill assumptions.
12 The Draft Remedial Action Report will take approximately 6 weeks to complete. Another week will be required for the final version.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 5
Excavate, Retort and Dispose in Onsite SWLF

	Task	ROM Cost
1	Amendments to Planning Documents	$27,958
2	Subcontract Management	$31,258
3	Mobilization/Demobilization	$149,029
4	Prepare Soil Staging/Retorting Area	$48,219
5	Excavate and Haul Soil to Staging/Retorting Area	$74,852
6	Onsite Retorting	$1,124,581
7	Onsite SWLF (see Option 3)	$1,020,000
8	Remedial Action Report Preparation	$61,564
	Total	**$1,520,000**

Assumptions

1 Amendments to the planning documents will take approximately 3 weeks. An SWPPP will also be prepared.
2 Subcontract management covers coordination with the retort contractor and the HAZMAT specialists. The mercury retort will take approximately 8 weeks.
3 Mobilization/demobilization supplements Option 1 or 2, and Option 3. Most of the mobilization/demobilization is covered in Option 3, however this task does include the cost for shipping retort equipment to the site.
4 Preparation of the soil staging/retort area will take approximately 5 days. This task includes retort equipment setup. Assume the soil transport staging area will include 4,000 square yards of 30-mil liner.
5 Assume we can excavate and haul 100 cubic yards per hour leading to 70 hours for 7,000 cubic yards. This will require 2 excavators, 4 end dumps, and 6 operators.
6 Onsite retorting is estimated to cost $1,000,000 (this does not inlcude labor for oversite or additional equipment costs).
7 See Option 3 for landfill assumptions.
8 The Draft Remedial Action Report will take approximately 6 weeks. Another week will be required for the final version.

Red Devil Mine
EE/CA ROM Cost Estimates
Alternative 6
Excavate and Transport Hazardous Waste to TSDF

	Task	ROM Cost
1	Amendments to Planning Documents	$17,057
2	Mobilization/Demobilization	$873,362
3	Prepare Soil Staging Area	$35,178
4	Excavate and Haul Soil to Staging Area	$74,852
5	Load Soil for Transport to Offsite Landfill	$48,899
6	Transport to Offsite Landfill for Disposal	$42,314,441
7	Transport and Disposal Tracking	$50,260
8	Remedial Action Report Preparation	$42,235
	Total	**$43,460,000**

Assumptions

1 Amendments to planning documents will take approximately 2 weeks.
2 Mobilization/demobilization supplements Options 1 or 2.
3 Assume soil transport staging area will include 4,000 square yards of 30-mil liner. Approximate with 3,000 square yards of 60-mil liner. Also construct some sort of soil loading area to load soil shiping containers.
4 Assume we can excavate and haul 100 cubic yards per hour leading to 70 hours for 7,000 cubic yards. This will require 2 excavators, 4 end dumps and 6 operators.
5 Loading soil (i.e., RCRA-waste) for transport will take about 2 weeks and will require logistical support and extensive manifesting.
6 Estimate by using a shipping rate of $0.63 per pound from Red Devil to Wisconsin for 7,000 cubic yards (12,250 tons or 24,500,000 lbs). Include 350 shipping containers at 4,000 lbs each. Includes packaging and manifesting time and barge coordination. Assume disposal costs are $2000 per ton for RCRA waste.
7 Transport and disposal tracking will take about 8 weeks. Check manifests, monitor shiping progress, and track disposal progress
8 The Draft Remedial Action Report will take approximately 4 weeks. Another week will be required for the final version.

Red Devil Mine
EE/CA ROM Cost Estimates

Site Characterization

	Task	ROM Cost
1	Perform Site Characterization at the Retort Building Area	$186,590
	Total	**$186,600**

Assumptions

1 Perform field screening at 60 locations using XRF technology. Screening will be performed on a 20-foot triangular sampling grid.
2 Collect surface soil samples at 40 locations based on the XRF field screening results
3 Drill 24 soil borings and install 6 monitoring wells. Soil borings in the retort area will be located based on XRF screening results.
4 Soil samples will be collected at 5-foot intervals from the retort area soil borings (20 total retort area borings). Approximately 100 soil samples will be collected and submitted to the laboratory for total mercury analysis. Approximately 50 samples will be analyzed for mercury using TCLP.
5 XRF instrument rental, operator labor, transportation and per diem are not included in this estimate.
6 The site characterization event will require two Herc flights for mobilization and two Herc flights for demobilization.
7 The planning documents are supplemental to the Bureau of Land Management Quality Assurance Program Plan.
8 Draft and final Site Characterization Reports will be prepared.

DISTRIBUTION

Engineering Evaluation/Cost Analysis
Red Devil Mine
Red Devil, Alaska

April 10, 2000

1 Copy:	Mr. Wayne Svejnoha U.S Department of the Interior Bureau of Land Management Alaska State Office 222 West Seventh Avenue, #13 Anchorage, Alaska 99513-7599
12 Copies:	Mr. Mike Alcorn U.S. Department of the Interior Bureau of Land Management P.O. Box 147 Glennallen, Alaska 99588-0147
1 Copy:	Project File
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Quality Control Reviewer

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