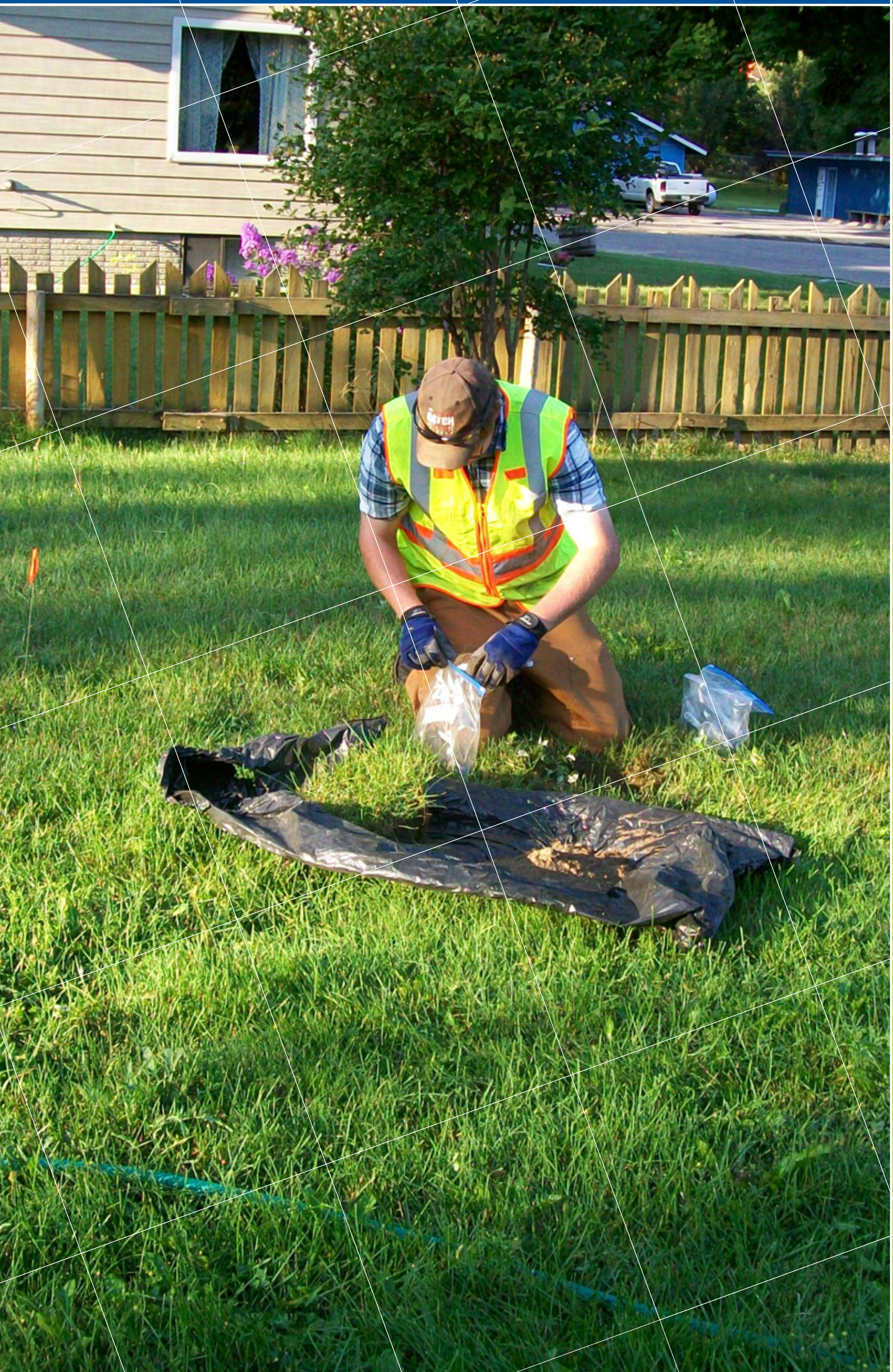
Feasibility Study Report



Flat Creek / IMM Superfund Site

MINERAL COUNTY, MT

Operable Unit 1

September 9, 2011

Prepared for USEPA by CDM

RESPONSE ACTION CONTRACT
FOR REMEDIAL, ENFORCEMENT OVERSIGHT, AND NON-TIME CRITICAL REMOVAL ACTIVITIES AT SITES OF RELEASE OR THREATENED RELEASE OF HAZARDOUS SUBSTANCES IN EPA REGION VIII

U. S. EPA CONTRACT NO. EP-W-05-049

FINAL FEASIBILITY STUDY REPORT
OPERABLE UNIT 1

FLAT CREEK/IMM SUPERFUND SITE
MINERAL COUNTY, MONTANA

Work Assignment No.:
3383-327

September 9, 2011

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Contents

Section 6 Definition of Criteria Used in the Detailed Analysis of Retained Alternatives

Section 7 Detailed Analysis of Retained Alternatives

Exhibits

Tables

Figures

Acronyms

ALM	Adult Lead Methodology
ARARs	applicable or relevant and appropriate requirements
ASARCO	American Smelting and Refining Company
ATSDR	Agency for Toxic Substances Disease Registry
bgs	below ground surface
$CaCO_3$	agricultural lime
$Ca(OH)_2$	hydrated lime
C&D	construction and demolition
CCPs	coal combustion products
CDM	CDM Federal Programs Corporation
CEIC	Census and Economic Information Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COPC	contaminants of potential concern
CTE	Central Tendency Exposure
cy	cubic yards
DEQ	Montana Department of Environmental Quality
DNRC	State of Montana – Department of Natural Resources and Conservation
DOT	U.S. Department of Transportation
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FRTR	Federal Remediation Technologies Roundtable
FS	feasibility study
GCL	geosynthetic clay liner
GIS	geographic information system
GPS	global positioning system
gpm	gallons per minute
GRAs	general response actions
HHRA	human health risk assessment
I-90	U.S. Interstate 90
IEUBK	Integrated Exposure Uptake Biokinetic
IMM	Iron Mountain Mine
ITRC	Interstate Technology Regulatory Council
MCL	maximum contaminant level
MDSL	Montana Department of State Lands
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MSL	mean sea level

NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OUs	operable unit
OU1	residential and commercial properties and roadways in the Town of Superior
OU2	the rest of the site which includes the IMM property with the mill site and the stream corridor between the IMM and OU1
OU3	waste repository
PA	preliminary assessment
PP	proposed plan
PPE	personal protective equipment
ppm	parts per million
PRAOs	preliminary remedial action objectives
PRGs	preliminary remediation goals
PRPs	potentially responsible parties
PWS	public water supply
QA/QC	quality assurance/quality control
RAC	Remedial Action Contract
RAOs	remedial action objectives
RBGs	risk-based goals
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RME	Reasonable Maximum Exposure
ROD	record of decision
SAPs	sampling and analysis plans
SCM	site conceptual model
SI	site inspection
SITE	Superfund Innovative Technology Evaluation
TAL	Target Analyte List
TBC	to be considered
TCLP	toxicity characteristic leaching procedure
TCRA	Time Critical Removal Action
TSP	triple super phosphate
the site	Flat Creek/IMM Site
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
UOS	URS Operating Systems
U.S.C.	United States Code
USFS	U.S. Forest Service
WRCC	Western Regional Climate Center
XRF	x-ray fluorescence

Executive Summary

This feasibility study (FS) report for Operable Unit 1 (OU1) of the Flat Creek/Iron Mountain Mine (IMM) Site (the site) was prepared for the U. S. Environmental Protection Agency (EPA) Region 10 by CDM under EPA Remedial Action Contract (RAC) No. EP-W-05-049. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the site is MT0010106206.

This report presents the results of the development, screening, and detailed evaluation of remedial alternatives to address the contaminated medium for OU1 (soils). The work performed during the FS was in accordance with guidance developed by EPA for conducting remedial investigation (RI)/FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (EPA 1988). In addition, the cost estimates for each alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000a).

The site is located in and around the community of Superior, in western Montana, approximately 47 miles east of the Idaho border at latitude 47.192 and longitude -114.892. It includes the Clark Fork River and Flat Creek within its boundaries. The next nearest community is St. Regis, Montana, which is 14 miles to the west. The nearest city is Missoula, Montana, which is 58 miles to the southeast. Superior is located at exit 47 of U.S. Interstate 90 (I-90) and has an area of 1.18 square miles. Most of Superior lies north and west of I-90 and south and east of the Clark Fork River.

The site contains three operable units (OUs). OU1, which is the focus of this FS, is the residential and commercial properties and roadways in the Town of Superior.

The OU1 RI investigated the upper 12 inches of soils at 588 properties in the Town of Superior. The local alleys were also investigated. The human health risk assessment (HHRA) summarized in the RI identified antimony, arsenic, and lead as the contaminants of potential concern (COPC) at OU1. Arsenic and lead are the primary source of contamination that contributes to human health risks. Risks to ecological receptors were not assessed for OU1. An environmental risk assessment will be conducted on a site-wide basis as part of the RI for OU2. All remedial alternatives in this FS address human health risks.

During the FS, preliminary remedial action objectives (PRAOs) were identified and remedial technologies and process options were developed and screened for the contaminated soils. Five remedial alternatives were assembled from the retained technologies to address contaminated soils. These alternatives were screened based on effectiveness, implementability, and cost to reduce the number of alternatives for detailed analysis.

All five alternatives were retained after screening. These alternatives were evaluated in detail and compared based on first seven of the nine National Oil and Hazardous Substances Pollution Contingency Plan (NCP) remedy selection criteria. The NCP remedy selection criteria comprise two threshold criteria (overall protection of human health and the environment and compliance with applicable or relevant and appropriate requirements [ARARs]), five balancing criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost), and two modifying criteria (support agency acceptance and community acceptance). Evaluation of support agency and community acceptance will be conducted after comments are received on the proposed plan (PP) and are not evaluated at this stage of the FS process.

Preliminary Remedial Action Objectives: The PRAOs presented are initially based on anticipated future use of OU1 by people for primarily residential and commercial purposes:

1. Mitigate the potential for inhalation and ingestion exposures by human receptors to lead in soil resulting in risks exceeding a 5 percent probability of blood lead in children above 10 micrograms per deciliter (μg/dL).

2. Mitigate the potential for inhalation and ingestion exposures by human receptors to arsenic in soil resulting in cancer risks that exceed 1E-04.

3. Mitigate the potential for inhalation and ingestion exposures by human receptors to antimony in soil resulting in cancer risks that exceed 1E-04.

4. Control erosion of lead, arsenic, and antimony in soil by wind and water to prevent the spread of contamination to unimpacted locations and media.

General Response Actions (GRAs): GRAs considered for remediation of the contaminant medium (i.e., contaminated soil) include the following:

- No action
- Monitoring
- Land Use Controls
- Reuse, Reclamation, Recovery
- Containment
- Removal/Transport/Disposal
- Treatment

Only those remedial technologies and process options identified as feasible, with respect to overall technical implementability and suitability of the technology for treatment of soil contaminated with lead and arsenic, were evaluated or screened within each GRA. These remedial technologies and process options were further evaluated for effectiveness, implementability, and cost.

Development and Screening of Alternatives: Remedial action alternatives are assembled by combining the retained remedial technologies and process options.

Following are the remedial alternatives that were assembled by combining the retained remedial technologies and process options:

Alternative 1: No Further Action

Alternative 2: In-Place Capping of Contaminated Soils

Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities

Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository

Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

These remedial action alternatives were screened and evaluated for effectiveness, implementability, and cost to reduce the number of alternatives retained for detailed analysis.

Detailed Analysis of Retained Alternatives: Remedial alternatives retained after the initial screening and evaluation undergo detailed analysis. During detailed analysis, each alternative is assessed using the seven NCP evaluation criteria previously mentioned. The following alternatives were retained for detailed analysis:

Alternative 1: No Further Action

Alternative 2: In-Place Capping of Contaminated Soils

Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities

Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository

Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

Comparative Analysis: Each remedial alterative undergoing detailed analysis was then compared using the seven NCP evaluation criteria as presented in Exhibit ES-1.

When the FS is finalized, a preferred alternative for OU1 is presented to the public in the PP. The PP briefly summarizes the RI and FS, alternatives studied in the detailed analysis phase of the FS, and highlights the key factors that led to identifying the preferred alternative. The PP allows the State of Montana (represented on this project by the Montana Department of Environmental Quality [DEQ]) and the community to comment on the preferred alternative.

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Section 1 Introduction

1.1 Purpose

In 2009, the U.S. Environmental Protection Agency (EPA) directed CDM Federal Programs Corporation (CDM) to perform a remedial investigation (RI) of Operable Unit 1 (OU1) of the Flat Creek/Iron Mountain Mine (IMM) Site (the site). The scope was subsequently expanded to include a feasibility study (FS) and post-RI/FS support. This FS report was prepared for EPA by CDM under EPA Remedial Action Contract (RAC) No. EP-W-05-049. The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the site is MT0010106206.

The FS is the mechanism for the identification, development, screening, and detailed evaluation of remedial alternatives that are capable of addressing risks to human health and the environment from contaminated media. The RI report for OU1 (CDM 2011) details the information used to characterize conditions at the operable unit (OU), determines the nature and extent of contamination, and summarizes risks to human health and the environment. The RI and FS were conducted concurrently, and data collected and summarized in the RI report influenced the development of remedial alternatives in the FS.

When the FS is finalized, a preferred alternative for OU1 is presented to the public in the proposed plan (PP). The PP briefly summarizes the RI and FS, alternatives studied in the detailed analysis phase of the FS, and highlights the key factors that led to identifying the preferred alternative. The PP allows the State of Montana (represented on this project by the Montana Department of Environmental Quality [DEQ]) and the community to comment on the preferred alternative.

The final phase of the RI/FS process is to prepare a record of decision (ROD). Following the receipt of public comments and any final comments from DEQ, EPA selects and documents the remedy selection decision for the OU in the ROD.

This FS report presents the results of the development, screening, and detailed evaluation of remedial alternatives to address contaminated media for OU1. The work performed during the FS was in accordance with guidance developed by EPA for *Conducting RI/FS under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA*) (EPA 1988). In addition, the cost estimates for each alternative were developed in accordance with *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000).

1.2 Organization

The progress between major process steps of the FS is graphically illustrated at the beginning of each section. This report is organized as follows:

- The Executive Summary provides a brief summary of the key information and conclusions included in the FS.
- Section 1 discusses the purpose of the FS report, the report organization, and site background information.
- Section 2 describes the characteristics of the site, including the site conceptual model (SCM), features and physical characteristics, a summary of the nature and extent of contamination, and a summary of human health risks posed by contamination.
- Section 3 describes the process for identifying preliminary remedial action objectives (PRAOs) and preliminary remediation goals (PRGs). This section also identifies potential applicable or relevant and appropriate requirements (ARARs) and "to be considered" (TBC) information for the OU.
- Section 4 describes the options for general response actions (GRAs) and the screening and evaluation of different remedial technologies and process options used to develop remedial alternatives for the OU.
- Section 5 identifies and describes the remedial alternatives and the screening process followed to reduce the remedial alternatives to those considered to be most suitable for further analysis.
- Section 6 describes the criteria used to evaluate the alternatives retained for further analysis in Section 7.
- Section 7 presents a detailed analysis of the remedial alternatives and summarizes the comparative analysis conducted to compare and contrast the remedial alternatives.
- Section 8 lists the references and documents referred to in this FS.
- Appendix A provides a summary of federal and state ARARs and TBCs.
- Appendix B provides quantity calculations for the screening and detailed analysis of remedial alternatives.
- Appendix C documents the alternative screening evaluation.
- Appendix D documents the alternative screening cost information. Screening cost estimates have an expected accuracy range between +100 percent and -50 percent of the actual costs.

- Appendix E provides the detailed analysis of alternatives.

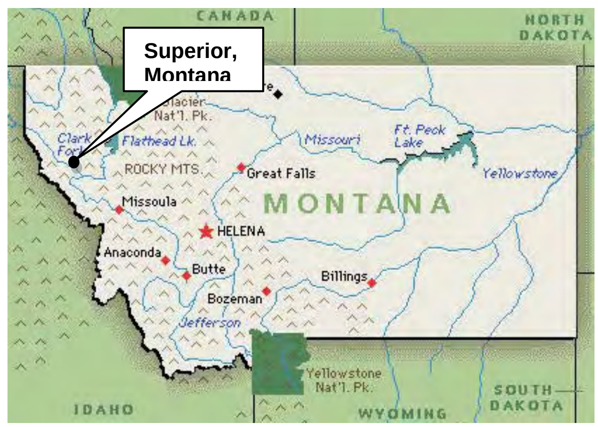
- Appendix F provides the detailed alternative analysis cost information. Detailed analysis cost estimates have an expected accuracy range between +50 percent and -30 percent of the actual costs.

1.3 Site Location and Layout

The site is located in and around the community of Superior, in western Montana, approximately 47 miles east of the Idaho border (Exhibit 1-1) at latitude 47.192 and longitude -114.892. It includes the Clark Fork River and Flat Creek within its boundaries. The next nearest community is St. Regis, Montana, which is 14 miles to the west. The nearest city is Missoula, Montana, which is 58 miles to the southeast. Superior is located at Exit 47 of U.S. Interstate 90 (I-90) and has an area of 1.18 square miles. Most of Superior lies north and west of I-90 and south and east of the Clark Fork River.

The site contains three OUs. OU1 is the residential and commercial properties and roadways in the Town of Superior (Figure 1-1). OU2 is the rest of the site which includes the IMM property with the mill site and the stream corridor between the IMM and OU1. OU3 is the waste repository that is being built by EPA and the U.S. Forest Service (USFS). Prior to being listed on EPA's National Priorities List (NPL), the site was known as the Superior Waste Rock site.

Exhibit 1-1. Site Location Map



1.3.1 Site Background

The IMM is the primary source for contamination at the site. It operated from 1909 to 1930 and again from 1947 to 1953, producing silver, gold, lead, copper, and zinc ores. The now abandoned property includes tunnels, tailings, and the remnants of a mill and other mine buildings. The tailings from the mine contain elevated concentrations of metals. While the mine was in operation, tailings were disposed of along Flat Creek using gravity drainage. Those tailings have been distributed along Flat Creek as far as its confluence with the Clark Fork River.

The IMM covers approximately three acres of property and consisted of a 200-ton mill and approximately 500 feet of tunnel. Tunnels were developed at the 200-foot, 400-foot, 700-foot, and 1,600-foot levels, with the main haulage level at 1,600 feet. The mill also accepted ore from the Dillon Mill and the Belle of the Hills, which were located up gradient of the IMM in Hall Gulch. The IMM reportedly used flotation methods to separate the metals.

Although a waste rock and tailings piles still exist on site, most of the tailings were washed down onto the Flat Creek floodplain (EPA 2009a). Tailings have also been imported into Superior by the local government and various individuals for use as fill material in yards, roadways, and other locations (e.g., the school track).

1.3.2 Regulatory and Government Involvement

Regulatory and government activities at the site began with the State of Montana in the early 1990s. A forest fire caused significant deforestation which resulted in a large runoff event that caused the release of significant volumes of contaminated tailings and other mine wastes to Flat Creek. This, along with reports that mine wastes had been used for fill at various properties in Superior, raised the threat profile of the site and resulted in EPA involvement.

The following briefly lists the regulatory and other associated activities that have occurred at the site:

- **1993 – Abandoned Mines Investigation.** The Montana Department of State Lands (MDSL) conducted an abandoned mine investigation to determine the potential health risks associated with the IMM site. Concentrations of many metals were found at elevations significantly above background.

- **1998 – Initial Reclamation Activities.** The IMM's owner removed some tailings from Flat Creek and placed them in an impoundment that was then covered and revegetated. Additional tailings along the creek were revegetated in place.

- **1998 – Drinking Water Testing.** The town government became concerned about the potential public health effects from the IMM after a water sample from the town's well two miles downstream of the mine tested above EPA's maximum contaminant level (MCL) for antimony

- **September 2000 – Documented Release and Request from Montana DEQ.** A lightning storm ignited wildfires that burned more than 9,000 acres in the drainage (EPA 2009a). Shortly thereafter, a high rainfall event resulted in a debris flow (including tailings) that swept into and down Flat Creek. Due to concern that tailings would be mobilized, DEQ requested that EPA conduct a Preliminary Assessment (PA), and Site Inspection (SI) at IMM, Flat Creek, and Superior.

- **July 2001 – PA/SI.** EPA conducted a Focused SI at the mine and in portions of Superior where importation of tailings was suspected. Elevated concentrations were detected for lead, arsenic, antimony, cadmium, and manganese (URS Operating Systems [UOS] 2001). Soil samples were collected from the high school track and residential properties in Superior. Samples from the track were elevated for various metals, including lead and arsenic, as were samples from a residential property and a right-of-way in a residential neighborhood.

- **February 2002 – Blood and Urine Testing.** Mineral County collected blood lead and urine samples from individuals living in Superior to evaluate exposure to arsenic. No effects of exposure were found.

- **June 2002 – Additional Sampling.** As a result of elevated concentrations of target analytes, additional sampling was conducted in 2002 by EPA's Removal Branch. Soil samples were collected from 64 residential properties, 20 right-of-ways, and 10 city/county and open space properties within and around Superior (UOS 2002).

- **August 2002 – General Notice Letter and Action Memorandum.** EPA issued a general notice letter to the potentially responsible parties (PRPs) on August 21. EPA also drafted an Action Memorandum to support the removal action of tailings used as fill in Superior because of possible health and environmental problems (EPA 2009a). EPA established health-based risk benchmarks of 3,000 parts per million (ppm) for lead and 400 ppm for arsenic for a removal action.

- **August through November 2002 – Time Critical Removal Action (TCRA).** Based on the 2001 and 2002 sampling events, EPA's Removal Branch conducted a TCRA to remove soils exceeding risk benchmarks. An estimate of 6,500 cubic yards (cy) of both mine tailings (4,000 cy) and contaminated soils (2,500 cy) were excavated. Treatment (via solidification with Portland cement) of the tailings was conducted, followed by disposal at the repository at the Mineral County Airport.

- **2004 DEQ – Montana State Superfund List.** DEQ added the IMM site to its State Superfund List.

- **May 2007 – PA.** An additional PA was prepared to update the 2001 PA using the data generated in the TCRA and observations made during a 2-day site reconnaissance in April 2007 to determine if there were still "targets associated with soil exposure."

- **December 24, 2008 – NPL Request Letter.** The Mineral County Board of Commissioners requested in a letter that Montana Governor Schweitzer support the addition of the site to EPA's NPL.

- **January 6, 2009 – NPL Request Letter.** Montana Governor Schweitzer relayed in a letter to EPA that he supported a NPL listing of the site.

- **January 22, 2009 – NPL Confirmation Letter.** In a letter to Governor Schweitzer, EPA indicated that they would proceed with the proposed listing.

- **April 2009 – NPL Proposal.** The site was proposed for addition to the Superfund NPL in April 2009, and a 60-day comment period ended in June 2009.

- **June 2009 – RI.** EPA began an RI in June 2009. This entailed an environmental screening of shallow soils in residential and commercial properties in OU1.

- **September 23, 2009 – NPL Listing.** The site was officially added to the NPL.

- **December 2009 – American Smelting and Refining Company** (**ASARCO) Bankruptcy.** The bankruptcy settlement of the ASARCO IMM site was completed.

- **January 2010 – Public Health Assessment Completed.** The Agency for Toxic Substances Disease Registry (ATSDR) finalized its report entitled *Public Health Assessment for Flat Creek IMM (aka Superior Waste Rock), Superior, Mineral County, Montana* (ATSDR 2010).

- **July and August 2010** – **RI**. EPA completed a second field season of the RI. This included sampling of the majority of the remaining residential and non-residential properties in town, as well as alleys.

- **July and August 2010 – Second TCRA**. Based on the 2009 and 2010 sampling results, EPA's Removal Branch conducted a second TCRA to remove soils exceeding 3,000 ppm of lead or 400 ppm of arsenic. A total of 7,903 cy of contaminated soil were removed from 29 properties. This volume also includes material generated by Mineral County's water line installation (650 cy) and the material excavated by the USFS at their property (600 cy). The wastes were treated with 2 percent triple super phosphate (TSP) whenever materials exhibited a TCLP of more than 5 milligrams per liter (mg/L) for lead.

- **April 2011 – Human Health Risk Assessment (HHRA).** EPA completed a HHRA for OU1 in support of the RI.

- **August 2011 –HHRA Revision.** EPA completed a HHRA Addendum for OU1 in support of the RI, focusing on human health risks from antimony.

- **September 2011 – RI Report.** EPA completed a RI report characterizing the nature and extent of shallow soil contamination in OU1.

- **September 2011 – OU1 FS Report.** EPA completed the FS report that identifies, develops, screens, and evaluates remedial alternatives that are capable of addressing risks to human health and the environment from contaminated media at OU1.

Upcoming activities include issuance of a PP for cleanup and a ROD for OU1. After the cleanup parameters are set in the ROD, EPA will begin a remedial design of the properties to be cleaned up under OU1 and will undertake a remedial action to implement the clean up.

Section 2
Site Characteristics

This section summarizes site characteristics and the nature and extent of contamination discussed in the OU1 RI. It also provides information on the importance of remediating or managing lead and arsenic at OU1 to mitigate human health risks. OU1 is the residential and commercial properties and roadways in the Town of Superior. OU2 is the rest of the site, which includes the IMM property with the mill site and the stream corridor between the IMM and OU1. OU3 is the waste repository that is being built by EPA and the USFS. OU2 and OU3 will be addressed separately from OU1. Complete details of the site characteristics and the nature and extent of contamination are presented in the OU1 RI report (CDM 2011).

The OU1 RI investigated the upper 12 inches of soils at 588 properties in the Town of Superior. The local alleys were also investigated. The HHRA summarized in the RI identified lead, arsenic, and antimony as the contaminants of potential concern (COPC) at OU1. Lead and arsenic are the primary source of contamination that contributes to human health risks. Environmental risk was not assessed for OU1. An environmental risk assessment will be conducted on a site-wide basis as part of the RI at OU2.

2.1 Conceptual Model

The SCM incorporates the primary mechanisms that lead to release of contaminants from source materials, migration routes of contaminants in the environment, exposure pathways, and human/ecological receptors.

2.1.1 Sources of Arsenic and Lead

The original source of the mining-related contamination in OU1 is the tailings from the IMM mine. Those tailings currently exist in piles at the mine site, along and in the Flat Creek streambed, and as imported fill in various properties throughout Superior.

It was a common practice in the 1950s and 1960s for tailings from the IMM site to be hauled into town for use as roadbed, driveways, and fill material for low-lying areas. The tailings were also reportedly sometimes used along the edges of properties to suppress weed growth. These tailings were readily available near and below the mill, as well as along Flat Creek. The tailings were sought after because they were well sorted and they compacted and drained well. Local residents reported that they saw the tailings being used by town government for road projects and for the high school track, and that they felt that there were no problems associated with their use.

2.1.2 Migration Routes

There are four primary mechanisms for migration of COPCs in OU1:

- Migration in soil
- Wind erosion
- Migration in surface water
- Migration in ground water

2.1.3 Migration Potential in Soil

Elements and compounds added to soil will normally be retained near the soil surface. Movement of elements into other media (i.e., groundwater, surface water, or the atmosphere) should be limited, as long as the moisture retention capacity of the soil is not exceeded. The extent of movement of an element in the soil system is related to the physical and chemical properties of the soil as well as the elements and compounds in the waste materials. Based on experience at other mining-related sites, it is unlikely that the COPCs are migrating through the soil profile and accumulating at depth.

2.1.4 Migration Potential by Wind Erosion

The potential for release of COPCs to the air is limited to wind erosion of source materials and suspension of particulates in the form of fugitive dust. The potential for wind erosion increases as the particle size decreases. Wind is expected to be a transport mechanism when waste material is dry and exposed. The ground in this area is frozen, wet, or covered with snow during at least 6 months of the year. Therefore, windborne dust is not generated, and airborne transport is a mechanism of concern for only part of the year, and only for areas that are not vegetated.

Most of the major concentrations of mine waste that were imported into OU1 were used as backfill for streets or sidewalks, and they are covered with asphalt or cement. Areas of exposed, scattered mine waste that was a remnant of that road building process are present in vacant lots or bare areas near those roads. Some of this material is currently exposed, and could be impacted by wind erosion. In other cases, overlying vegetation protects the mine waste from erosion. For the locations where mine waste was brought in as fill for driveways, the material is exposed to the wind, but appears to be well-packed and large enough in particle size so that wind erosion is not evident.

2.1.5 Migration Potential in Surface Water

Releases of contaminants to surface water can occur when waste material or contaminated soil is exposed. If uncontrolled, solid waste material can erode into the storm water system, perennial tributaries, and potentially the Clark Fork River. Investigation of surface water was outside the scope of the RI for OU1. No visual evidence of runoff was noted in the field.

2.1.6 Migration Potential in Groundwater

Investigation of groundwater was not included in the RI for OU1 and the migration potential for contaminants to groundwater has not been characterized. However, the mine waste materials were primarily imported for shallow use, other than those used for road base. The road base materials are essentially capped by the overlying asphalt which would limit infiltration of precipitation through the contaminated material. The driveways are uncapped and infiltration is possible. However, the individual driveways that are constructed of mine waste are scattered and do not present a concentrated source area for contamination of groundwater.

2.1.7 Exposure Pathways and Potential Receptors

Figure 2-1 presents a conceptual model summarizing how area residents may be exposed to site-related contaminants in soils in their yards or driveways. Each of the exposure pathways are described below. Quantification of hypothetical future exposure to subsurface soil is very difficult because neither the amount of soil brought to the surface nor the degree to which the subsurface soil becomes mixed with surface soil is known. For this reason, the HHRA focused only on exposures to current surface soils.

- **Incidental Ingestion of Outdoor Soil**. Area residents (especially children) may ingest small amounts of soil that adhere to their hands during outdoor work or play activities. Contact is primarily with surface soil (0 to 2 inches), and exposure to subsurface soil generally does not occur unless some sort of excavation activity occurs that brings the subsurface soil to the surface. Thus, only exposures to current surface soils were evaluated for this pathway in the HHRA.

- **Dermal Contact with Soil**. Residents may have dermal exposure to contaminated soil while working or playing outdoors. This pathway is likely to be minor in comparison to the amount of exposure that occurs by the oral route. Most metals bind to soils, reducing the likelihood that they would dissociate from the soil and cross the skin, and ionic species such as metals have a relatively low tendency to cross the skin even when contact does occur. Neither EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model or Adult Lead Methodology (ALM) include a dermal exposure pathway. Thus, dermal contact with soil was not evaluated in the HHRA.

- **Ingestion of Indoor Dust**. Outdoor soil may be tracked into homes by people or pets, or may enter by deposition of dust. Once inside, humans may ingest the dust by hand-to-mouth contact. Most people spend a majority of time indoors, so this pathway can be significant, and was evaluated in the HHRA.

- **Inhalation of Airborne Soil Particulates**. Whenever contaminated soil is exposed at the surface, particles may become suspended in air by wind or mechanical disturbance, and humans in the area could inhale those particles. Although the amount of airborne dust inhaled is usually minor compared to ingestion, some metals are carcinogenic when inhaled. Thus, this pathway was evaluated in the HHRA.

- **Ingestion of Homegrown Produce.** Vegetables grown in contaminated soil may take up contaminants from soil into their edible portion and may be ingested. There are no site-specific data on this uptake, and studies at other sites suggest this pathway is usually quite minor, especially if the vegetables are washed before eating. Thus, this pathway was not evaluated in the HHRA.

2.2 Site Setting and General Site Features

2.2.1 Site Setting

The Town of Superior, Montana (OU1) is located adjacent to Exit 47 on U.S. Interstate 90 (I-90) (Figure 2-2). The elevation of Superior is 2,762 feet above mean sea level (MSL). There are over 88 mountain summits and peaks in Mineral County, and Superior is surrounded by the mountains of the Bitterroot Range. Within a mile of town, there are mountains with elevations of over 4,400 feet above MSL. Within 4 miles, elevations are as high as 6,400 feet MSL. The Clark Fork River runs through the community in a northwesterly direction. The Clark Fork is part of the Columbia River Basin watershed and ultimately drains to Lake Pend Oreille in northern Idaho. Flat Creek, a tributary to the Clark Fork River, drains the watershed north of Superior. Its confluence with the Clark Fork River is near River Street in Superior.

The IMM (in OU2) is the source for the tailings and waste rock found in Superior, but was not included in the RI. The IMM is located approximately 3.5 miles north of Superior at the confluence of Hall Gulch and Flat Creek at latitude 47^{o} 14’25” North and longitude 114^{o} 51’ 10” West. It covers an area of approximately 3 acres, and is at approximately 3,400 feet above MSL. The mine is surrounded by the Lolo National Forest. Vegetation generally consists of cedar, spruce, fir, and willow trees (MDSL 1993).

2.2.2 General Site Features

OU1 is essentially the residential and non-residential properties in Superior, Montana. The majority (500) of the 588 properties sampled as part of the RI are individual residences, typically containing a yard, driveway, primary dwelling, and sometimes secondary structures (e.g., a garage or shed). The yard is typically divided into a front and back yard and there may also be side yards in larger properties. Most yards are relatively well vegetated, although there are some bare areas. Most driveways are either concrete or gravel. Properties are generally relatively small (less than 10,000 square feet).

Non-residential properties include municipal properties such as local schools, the library, the fairgrounds, courthouse, etc. Privately-owned non-residential properties include: banks, stores, offices, storage units, gas stations, restaurants, and other small businesses. Roads in the community are generally paved and alleys are unpaved.

2.3 Summary of Physical Characteristics

2.3.1 Climate

Climate data from the Western Regional Climate Center (WRCC 2010) for the Superior, Montana station indicate the weather at the site is typical of the climate in western Montana. The area has a relatively cool and dry continental climate. Due to its lower elevation, temperatures in Superior are warmer year round than in many parts of western Montana. The lowest average minimum temperature is in January (17.7 degrees Fahrenheit [°F]) and the highest average maximum temperature is in July (87°F). The regional temperature is marked by wide seasonal and diurnal variations. In winter, temperatures often drop below 0°F with extended periods of sub-freezing temperatures. In summer, highs often exceed 90°F. There is a greater than 50 percent probability of first frost by September 20 and last frost by May 19.

The average annual snowfall for the area is 36.4 inches. Local mountains are generally blanketed in snow from November through March. Average annual precipitation is 16.8 inches and is delivered relatively evenly throughout the year. Average precipitation is highest in June (1.96 inches) and lowest in July (0.87 inches). Summer thunderstorms frequently produce high winds, intense rainfall, and occasional hail.

2.3.2 Geology

The general geology of the Superior region is characterized by Proterozoic age bedrock of the Belt Supergroup, with Quaternary age alluvial sediments within the Clark Fork River basin. Quaternary age deposits are also intermittently present within area stream and drainage channels (Lonn 2007).

The Osburn fault trends from northwest to southeast across the IMM area. Bedrock to the northeast of the fault consists of the Helena Formation and the Revett Formation, which generally consist of quartzite with thin beds of siltite and argillite. An anticline runs through these formations approximately parallel to the fault strike. To the southwest of the Osburn fault are the younger rocks of the Wallace Formation. The Wallace Formation consists of dolomitic quartzite and siltite with discontinuous interbeds of argillite (Campbell 1960).

2.3.3 Hydrogeology/Hydrology

Water bearing units in the Superior area include the alluvial sediments within the Clark Fork River basin and fractured bedrock. Groundwater yields from the fractured bedrock are highly variable. Well yields for wells within the fractured bedrock average approximately 10 gallons per minute (gpm) (LaFave 2006a). Yields within the alluvial basin may yield approximately three times this amount. Wells are uncommon within the bedrock aquifer in the direct vicinity of the IMM site. Wells in the alluvial valley near Superior may number as high as 11 to 30 wells per section in some areas (Warren 2007.) The potentiometric surface of wells within both the bedrock aquifer and the alluvial aquifer typically ranges between 2,650 and 2,700 feet above MSL in the Superior area. Groundwater flow is typically toward the Clark Fork River within the alluvial basin (LaFave 2006a). Groundwater flow within bedrock is dominated by fracture networks and is variable.

Background concentrations of nitrates are typically less than 2.0 mg/L and arsenic concentrations less than 5.0 mg/L in both the bedrock and alluvial aquifers. Water quality is good with respect to total dissolved solids, with concentrations typically less than 500 mg/L throughout the region (LaFave 2006b).

2.3.4 Groundwater Use

Since the early 1900s, the majority of town residents have been connected to the public water supply (PWS). Previously, the PWS source for the Town of Superior was a spring adjacent to Flat Creek. However, the Mountain Water Company (former PWS owner) discontinued use of Flat Creek Spring in 1997 when antimony was detected at concentrations above the MCL (EPA 2001, DEQ 2004). Currently, the spring is not in use, but it is maintained as an emergency drinking water source (UOS 2001). Although named "Flat Creek Spring", the spring surfaces at a higher elevation than Flat Creek (EPA 2001). As a "gravity flow spring", it arises from discharges of area groundwater (DEQ 2004).

Ownership of the PWS was transferred from the Mountain Water Company to the Town of Superior in October 2000. The current PWS has a total of 430 connections. There are three production wells for this system (Figure 2-2). The wells are located within the city limits of Superior and are drilled into the confined aquifer at depths of 105.5 feet below ground surface (bgs) (Well 1), 118 feet bgs (Well 2), and 214 feet bgs (Well 3). Well water is treated, and the Town of Superior tests these wells for water quality in accordance with federal standards.

Most residents living in the Town of Superior receive drinking water from the PWS, but a few homes on the north side of town obtain water from private wells. In general, these private wells draw water from the deep aquifer (more than 85 feet bgs), which is believed to be confined. However, several homes do have wells that draw water from less than 85 feet bgs (DEQ 2003). It is not known whether these wells are currently used as a drinking water source.

There is also one residence located north of the town limits that is not served by the PWS. This residence draws drinking water from two distinct sources—a private groundwater-fed well and a diversion from Flat Creek, approximately 2 miles south of the IMM site (EPA 2001).

2.3.5 Demography and Land Use

Demographic data for Superior are derived from the 2010 census and are published by the Montana Department of Commerce's Census and Economic Information Center (CEIC). As of the 2010 census (CEIC, 2011), Mineral County had a population of 4,223 which is a 9 percent increase over the 2000 census. Mineral County is ranked 39th in population of 53 Montana counties.

In Superior, the 2010 census showed a population of 812, which is a 9 percent drop below the 2000 census. Detailed census data from 2010 are not yet available. Based on the 2000 census there were 410 housing units in Superior. There were 239 children over the age of 3 years enrolled in school, and 95 percent of the population over 5 years of age spoke English only.

Complete demographics from the 2010 census are not yet available, so the 2000 census statistics are provided below. In 2000, half of the adult population was married, and the medium household income in 2000 was $25,333. A total of 61 percent of workers worked for private industry, 27 percent worked for government, and 11 percent were self-employed. The most commonly cited employers in 2000 were: educational, health, and social services (25 percent); agriculture, forestry, fishing and hunting, and mining (14 percent); arts, entertainment, recreation, accommodation, and food services (11 percent); and retail trade (9 percent).

According to the Montana Cadastral Mapping Program website, there are approximately 700 properties within the area investigated as part of the RI. This area extends beyond the boundaries of the Town of Superior, as access forms were received from residents beyond the town limits.

Within OU1, land ownership is primarily comprised of privately-owned residential parcels (85 percent) versus non-residential (15 percent). These numbers are based on the results of the effort in the RI to obtain access to all residential properties. The non-residential properties include municipal, state, or federal land that is used for open space, roadways, or buildings (e.g. schools). A small percentage of properties are privately-owned for commercial purposes (e.g., gas stations, shops, etc.). Figure 2-3 shows the residential versus non-residential properties in OU1.

2.4 Summary of RI Investigation

The objective of the RI of OU1 was to determine whether or not mine waste had been imported to individual properties in Superior. Sampling was limited to the upper 12 inches of soil at any given property. Specifics of the sampling and the associated quality assurance/quality control (QA/QC) protocols were detailed in the various sampling and analysis plans (SAPs) for OU1:

- *Sampling and Analysis Plan, 2009 Remedial Investigation, Flat Creek/IMM Superfund Site, Mineral County, Montana, July 28, 2009* (CDM, 2009a).
- *Amendment to the 2009 Sampling and Analysis Plan, for the 2010 Remedial Investigation, Flat Creek/IMM Superfund Site, Mineral County, Montana, May 20, 2010* (CDM, 2010a).
- *Second Amendment to the 2009 Sampling and Analysis Plan, for the 2010 Remedial Investigation (Addition of Alley Sampling), Flat Creek/IMM Superfund Site, Mineral County, Montana, July 15, 2010* (CDM, 2010b).

Field work was fully documented in field logbooks in accordance with CDM standard operating procedures. Photographic documentation of sampling locations was conducted and the field crew recorded global positioning system (GPS) coordinates of each sample location. Sampling point locations were estimated to known points and recorded on sketches of the yards. Because it was not known which (if any) yards would require remediation, only basic sketches of the residential property features were made. All GPS coordinates of sample locations are being managed in the geographic information system (GIS) in Helena, Montana.

The RI included screening by x-ray fluorescence (XRF) of all properties for which access was granted and at which there was at least a reasonable expectation that material might have been imported. Large, open fields that appeared to be unaltered were not included in the sampling. EPA estimates that over 90 percent of all properties in town were screened as part of the RI. This is more than sufficient to characterize the nature and extent of contamination in local soils. In addition, most of the alleys in town were also screened to provide information on locations that had the potential to generate dust.

The 2009 and 2010 sampling events included over 90 percent of all properties in town. A total of 7,209 samples from 588 properties were screened by XRF. Most (500) were residential properties. The screening included 6,038 residential samples and 1,171 non-residential samples. All properties collected at a property were analyzed for lead and arsenic by XRF. Samples with concentrations greater than 250 ppm for lead by XRF were submitted for Target Analyte List (TAL) analysis by the EPA Contract Laboratory Program (CLP) laboratory. At least 5 percent of all remaining samples were also submitted for QA purposes. Samples were sent in as needed to account for special request or issues at a property.

A total of 1,012 samples from 345 properties were submitted to the laboratory. This represents 14 percent of all samples collected and 59 percent of all properties screened. Only 279 (4 percent of all samples collected or 27 percent of the samples sent to the laboratory) of those samples were submitted because of lead concentrations above the 250 ppm screening level.

2.5 Summary of Nature and Extent of Contamination

The results of the RI confirm the original understanding of the contaminant model for OU1. Mine waste tailings were transported to town on an individual basis by land owners or government entities for use as fill material. There is no recognizable, spatial pattern to the distribution of the contamination in the upper 12 inches of soils at the OU. However, clusters of contamination are seen in areas where the material was brought in for use in construction of Mullan and River Roads. There are numerous reports of significant use of mine waste as road base in those areas. However, the scope of the RI focused on individual properties and did not include confirmation of those reports.

Mine waste material from the IMM was free, relatively easy to obtain, and had physical properties that made it desirable for use in driveways, road beds, and as fill for building pads. These same characteristics made it undesirable for areas such as gardens or children's play areas (e.g., sand boxes). As a result, it was not seen in those areas during the RI field sampling events. It was also reportedly used along the sides of properties to keep down the growth of weeds, and it was seen along the edges of some properties.

The results show that most properties (88 percent) in Superior are in the low concentration category (less than 400 ppm of lead and less than 100 ppm of arsenic), either because of XRF readings or CLP results. A total of 29 properties (5 percent) (22 residential and 7 non-residential) had moderate concentrations of lead (400 to 1,200 ppm) or arsenic (100 to 400 ppm). Only 42 properties (7 percent) (30 residential and 12 non-residential) had concentrations in the high category for lead (greater than 1,200 ppm) or arsenic (greater than 400 ppm).

Contamination is scattered across town, rather than clustered in specific areas. This confirms the reports that contamination was brought in generally on a yard-by-yard bases for use as fill material in driveways or other areas of individual properties. The mine waste was also used in municipal road construction and on municipal properties such as the school track and the fairgrounds.

2.6 Summary of 2002 TCRA Emergency Removals

In 2002, EPA conducted a TCRA to remove soils exceeding 3,000 ppm of lead or 400 ppm of arsenic. An estimate of 6,500 cy of both mine tailings (4,000 cy) and contaminated soils (2,500 cy) were excavated (Figure 2-4). The materials were staged at the Mineral County Airport until final treatment and disposal. Treatment (via solidification with Portland cement) of the tailings began in late October and was completed by November 5, 2002. The waste was disposed of in a repository built on the Mineral County Airport. Capping of the repository (with membrane and cover soil) was completed shortly thereafter.

2.7 Summary of 2010 TCRA Emergency Removals

EPA conducted a second TCRA to remove soils exceeding 3,000 ppm of lead or 400 ppm of arsenic at properties that were identified as a result of the 2009 field investigation for the RI. A total of 7,903 cy of contaminated soil were removed from 29 properties. Areas removed included driveways, the high school track, and a portion of the Mineral County fairgrounds. This volume also includes material generated by Mineral County's water line installation (650 cy) and the material excavated by the USFS at their property (600 cy) (Nguyen, 2011a). The wastes were treated with 2 percent Triple Super Phosphate whenever materials exhibited more than 5 mg/L for lead by toxicity characteristic leaching procedure (TCLP). Following treatment, the wastes were disposed of at the Mineral County Airport.

The removals addressed concentrations greater than 3,000 ppm of lead or 400 ppm of arsenic. While the removals significantly reduced the overall concentrations of lead and arsenic as a whole and at individual properties, moderate to high concentrations remain. These concentrations do not present an immediate unacceptable risk, but will be addressed in the risk management decisions made for OU1.

2.8 Summary of the HHRA

The HHRA identified lead, arsenic, and antimony as the COPCs for OU1. Risk was assessed for residential properties using only the analytical data for the surface depth interval (0 to 2 inches). Exposures were based on a yard-wide average for each property.

The highlights of the HHRA results are:

- For antimony, there were no residential properties above a level of concern for people with average exposure levels. However, there were three properties (RY422, RY523, and RY600) where non-cancer risks from antimony slightly exceeded EPA's level of concern to people with reasonable maximum exposures..
- For arsenic, there were no residential properties of concern for non-cancer risks, but there were two properties (RY036 and RY523) where estimated cancer risk to people with reasonable maximum exposure slightly exceeded EPA's risk based goal of 1E-04.
- For lead, exposures at six residential properties (RY086, RY101, RY257, RY422, RY523, and RY600) exceeded EPA's risk based goal (no more than a 5 percent probability that blood lead in children would exceed 10 micrograms per deciliter [ug/dL]).
- Human health risks have been reduced significantly by the number of properties at which EPA conducted emergency removals.
- Based on the exposure assumptions used in the risk assessment, the average soil concentrations that are appropriate for use in triggering the need to soil cleanup are: antimony, 130 milligrams per kilogram (mg/kg); arsenic, 100 mg/kg; and lead, 400 mg/kg.

Seven residential properties were identified for potential remediation by the HHRA (Exhibit 2-1), as shown on Figure 2-5. One of those properties, RY086, has since been remediated by EPA's Removal Group, and is no longer in need of remediation.

Exhibit 2-1. Properties Identified by the HHRA to be Remediated

Index	Property ID	Antimony		Arsenic		Lead	
		CTE	RME	CTE	RME	GM (ug/dl)	P10 (%)
1	RY036	0.4	1	2E-05	2E-04	4.4	4.1
2	RY086	0.2	1	8E-06	8E-05	4.8	5.8
3	RY101	0.3	1	1E-05	1E-04	6.1	14.6
4	RY257	0.2	1	7E-06	6E-05	6.1	14.3
5	RY422	1	2	6E-06	5E-05	4.8	6
6	RY523	1	2	2E-05	2E-04	10.9	57.1
7	RY600	1	3	1E-05	1E-04	8.3	34.2

ug/dl = micrograms per deciliter   CTE = Central Tendency Exposure   RME = Reasonable Maximum Exposure

Shading indicates that concentrations exceed acceptable risk

2.9 Risk Management Issues

The HHRA analyzes data to describe the likelihood of harm to human health. Risk management uses the HHRA in conjunction with other information to make regulatory decisions. During the risk management process EPA takes into account input from its regulatory stakeholders and also considers precedent at sites in the same state or region to arrive at acceptable cleanup decisions. Risk-based action levels are not set in the HHRA, but are part of the risk management process. Other factors relating to cleanup are also evaluated, such as the percentage of a property to be remediated, remediation depth, and contaminants to be addressed. The following provides relevant information for the risk management process.

2.9.1 Residential Properties

To support the risk management process, the RI identified 29 additional residential properties (beyond those identified in the HHRA) (Exhibit 2-2) that may warrant remediation (Figure 2-5). The factors behind the identification of these properties are:

- **Sampling locations vs. yards.** Many properties have one or more sample locations with concentrations that exceed cleanup triggers, but where the yard-wide average is not exceeded. Thus, those yards are not identified for remediation in the HHRA. However, in recent years, DEQ and EPA have shown a preference for moving away from use of the entire yard as the exposure point and have used the smaller area represented by the individual sampling location to make cleanup decisions. Using surface sampling locations would add 12 properties.

- **Below surface depths.** The HHRA assessed only the upper 2 inches of soil, which does not account for future risk. Residents could disturb the soils from the 2 to 12 inches for which data are available with only minor home improvement activities, such as digging a flowerbed, installing a vegetable garden, or building a play area or patio. Many properties have concentrations of lead or arsenic in the subsurface that exceed cleanup triggers. Those yards are not identified for remediation in the HHRA. Addressing this deeper contamination would add 22 properties.

Of the additional residential properties that may warrant remediation, 12 properties were added based on individual sampling location rather than yard-wide averages and 22 properties were identified based on including soil samples from 2 to 12 inches rather than just surface soils at a depth of 0 to 2 inches. Seven properties were identified for both categories, making a total of 28 residential properties.

2.9.2 Non-Residential Properties

The same analysis was performed in the RI for non-residential properties (Exhibit 2-3). The HHRA looked only at current risk. However, the lack of zoning regulations in Superior allows for many of the non-residential properties to be used for residential purposes in the future, which could present a potential for unacceptable risk. Including these non-residential properties added 16 properties (Figure 2-5) to the list of potential properties to be remediated:

- **Sampling locations vs. yards.** Using individual samplings location, rather than yard-wide averages adds 11 non-residential properties.
- **Below surface depths**. Including subsurface results adds 13 non-residential properties.

Of the additional non-residential properties that may warrant remediation, 11 properties were added based on individual sampling location rather than yard-wide averages. Also, 13 properties were identified based on including soil samples from 2 to 12 inches rather than just surface soils at a depth of 0 to 2 inches. Eight properties were identified for both categories, for a total of 16 residential properties.

2.10 Conclusions of the RI

- The nature and extent of contamination in the surface and near surface soils in OU1 has been adequately characterized in the 2009 and 2010 sampling events.
- Any additional properties that were not fully characterized during the RI can be addressed during remedial design/remedial action.
- The majority of the properties (88 percent) in Superior have no unacceptable risks associated with mine waste in soils. Of the remaining 12 percent of properties, most concentrations of lead, arsenic, or antimony are not an immediate threat to human health.
- EPA's emergency removals in 2002 and 2010 addressed the majority of the most contaminated properties at the OU.
- The HHRA identified seven residential properties for potential remediation based on a yard-wide average concentration in surface soils at residential properties of 130 mg/kg of antimony, 400 ppm of lead, or 100 ppm of arsenic. No properties exceeded a yard-wide average of 130 ppm for antimony in surface soils.

The RI identified additional yards that EPA and DEQ may potentially include for remediation based on risk management decisions. These properties included those that exceed 400 ppm of lead and/or 100 ppm of arsenic for individual sampling locations, all depths, and both residential and non-residential properties. Antimony results for the subsurface soils were reviewed to identify any properties with yardwide averages of antimony exceeding 130 ppm. This list is the most conservative estimate of properties for possible remediation. It included 28 additional residential properties and 16 additional non-residential properties, in addition to the 6 non-remediated properties identified by the HHRA.

Exhibit 2-2. Potential Additional Residential Properties to be Remediated

Index	Property ID	Sampling Area > 400 ppm Lead			Sampling Area > 100 ppm Arsenic		
		Depth Interval (inches bgs)					
		0-2	2-6	6-12	0-2	2-6	6-12
1	RY007			A 439			
2	RY008				A 133		
3	RY021		E 544	D 1820			
4	RY023	A 523		A 431 B 678			
5	RY026					C 274	
6	RY043				E 144		E 111
7	RY061			E 1,030			
8	RY089	I 445					
9	RY091				E 298		
10	RY092	C 904 D 617	C1860	C 1,500 D 588			
11	RY095	B 592	B 856				
12	RY102		B 410	B 1020			
13	RY108		E 631				
14	RY130	B 1,410			B 139		
15	RY144			D 637		D 369	D 106
16	RY148		C 476			C 114	
17	RY160	B 789			B 180		
18	RY176		E 2190				
19	RY193	D 519		C 533			C 133
20	RY234						D 326
21	RY271		D 481	D 1,030			D 221
22	RY277		D 525				
23	RY284	A 1,020	A 506		A 157		
24	RY352		C 452	C 488			
25	RY483	B 502		D 577			
26	RY485	F 434			F 104		
27	RY597			D 1120		D 253	
28	RY616			A 867		A 332	

ppm = parts per million (mg/kg)
"A-G" Letter designates individual sampling location at the property
All concentrations are CLP laboratory results in mg/kg
- Shading indicates that concentrations were below 400 ppm Lead or below 100 ppm Arsenic

Exhibit 2-3. Potential Additional Non-Residential Properties to be Remediated

Index	Property ID	Sampling Area > 400 ppm Lead			Sampling Area > 100 ppm Arsenic		
		Depth Interval (inches)					
		0-2	2-6	6-12	0-2	2-6	6-12
1	RY097	C 477					
2	RY098	A 1,160 B 475	A 1,260 C 1,040	A 1,350 C 811	A 125	A 151 C 139	A 131
3	RY099	B 495					
4	RY100	A 530	A 437	A 470 B 715			
5	RY111			B 1,330			B 439
6	RY136		B 434	B 608			
7	RY146						B 425
8	RY213	B 717	B 1,190	B 1,960	B 119	B 144	B 169
9	RY289		F 763 G 7080				
10	RY332	A 406	A 578	D 755			B 350
11	RY366			A 592 D 495			D 167
12	RY369		B 1,160				
13	RY386	D 452	A 705 B 564	A 475	B 191		A 111
14	RY398	A 932 B 451	A 1,250 B 2,480	A 1,310 B 1,150		B 462	B 201
15	RY402	A 13,900					
16	RY627	B 6,700 C 1,270	B 3,690 C 5,810 D 6,000	B 1,460 C 2,790 D 1,980	B 2,620 C 269	B 985 C 1,240 D 933	B 311 C 555 D 376

ppm = parts per million (mg/kg)
"A-E" Letter designates individual sampling location at the property
All concentrations are CLP laboratory results in mg/kg
- Shading indicates that concentrations were below 400 ppm lead, 100 ppm arsenic, or 130 ppm antimony

Section 3 Remedial Action Objectives

Section 300.430(e) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) requires that the remedial alternative development process be initiated by developing PRAOs, identifying GRAs that address these PRAOs, and performing an initial screening of applicable remedial technologies. The goal of the remedy selection process is "to select remedies that are protective of human health and the environment, maintain protection over time, and minimize untreated waste."

PRAOs are media-specific and source-specific goals achieved through completion of a remedial action that is protective of human health and the environment. These objectives are typically expressed in terms of the contaminant, the concentration of the contaminant, and the exposure route and receptor.

PRAOs are typically developed by evaluating several sources of information, including results of the HHRA and tentatively identified ARARs. These inputs provide the basis for determination of whether protection of human health and the environment is achieved for a remedial alternative.

This section presents the ARARs, PRAOs, and the PRGs that are tentatively identified for the site. Final ARARs, remedial action objectives (RAOs), and remedial goals (RGs) will be developed from evaluations presented within this FS and set forth in the ROD as performance standards for any and all remedial design and subsequent remedial actions.

3.1 Applicable or Relevant and Appropriate Requirements

Identification and evaluation of ARARs are integral components of the FS process to determine whether remedial alternatives can protect human health and the environment. The following paragraphs were developed from EPA's *Introduction to Applicable or Relevant and Appropriate Requirements* (EPA 1998); they give an overview of why ARARs must be identified and evaluated as part of the CERCLA process.

CERCLA and the NCP establish a standardized process through which EPA must respond to spills and clean up the nation's most dangerous hazardous waste sites. The CERCLA response process, while it sets acceptable risk-based goals for cleanups, does not impose specific restrictions on the various activities (such as treatment, storage and disposal of wastes, construction and use of remediation equipment, and release of contaminants into air, soil, and water) that may occur during a response. EPA instead relies on other federal and state environmental laws and regulations to govern response activities.

A site-specific risk assessment is the foundation on which the selection of a CERCLA remedy is based. When developing PRGs, EPA, and DEQ must also consider readily available, generically applicable information, such as chemical-specific ARARs. In addition, when carrying out the chosen remedy, EPA and DEQ must implement other substantive and administrative requirements that are applicable or relevant and appropriate to the conditions or actions at each CERCLA site. These ARARs may affect a remedial or a removal response by limiting concentrations of hazardous substances present in wastes or discharges, restricting activities at sensitive locations, or regulating certain actions such as the design and operation of cleanup equipment.

The laws that most often contribute ARARs to the CERCLA response process are federal environmental laws, but other federal, state, and local standards may also be applicable or relevant and appropriate to CERCLA activities. ARARs fill in the substantive gaps in CERCLA's risk-based response framework, ensuring protection of human health and the environment.

EPA and DEQ have conducted initial discussion concerning potential federal and state ARARs and have tentatively identified regulations that may be applicable or relevant and appropriate to the site. Appendix A constitutes the initial identification and detailed description of ARARs for the implementation of a remedial action at OU1.

3.1.1 ARAR Identification Process

Determining exactly which laws and regulations will affect a CERCLA response is somewhat different than determining the effect of laws and regulations on activities that take place outside the boundaries of a site remediated under CERCLA. For onsite activities, CERCLA requires compliance with both directly applicable requirements (i.e., those that would apply to a given circumstance at any site or facility) and those that EPA deems to be relevant and appropriate (even though they do not apply directly), based on the unique conditions at a site.

ARARs are designated as either "applicable" or "relevant and appropriate," according to EPA guidance, and may stem either from federal or state law. ARARs must be identified on a site-specific basis and involve a two-part analysis. A determination must first be made on whether a given requirement is applicable. If it is not applicable, then a second determination must be made on whether it is both relevant and appropriate. When the analysis determines that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA 1988). Compliance with ARARs is a threshold criterion that any selected remedy must meet unless a legal waiver as provided by CERCLA Section 121(d)(4) is invoked.

State requirements are potential ARARs for CERCLA response actions as long as they meet the following eligibility criteria:

- State law or regulation

- Environmental or facility siting law or regulation
- Promulgated (of general applicability and legally enforceable)
- Substantive (not procedural or administrative)
- More stringent than federal requirements
- Identified in a timely manner
- Consistently applied

Many state requirements listed as ARARs are promulgated with identical or nearly identical requirements to federal law pursuant to delegated environmental programs administered by EPA and the state. The preamble to the NCP provides that such a situation results in citation to the state provision and treatment of the provision as a federal requirement.

3.1.1.1 Applicable Requirements

Section 300.5 of the NCP defines "applicable requirements" as cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental laws that specifically address a hazardous substance, pollutant, contaminant, response action, location, or other circumstances at a CERCLA site.

3.1.1.2 Relevant and Appropriate Requirements

Relevant and appropriate requirements specifically refer to cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or state environmental or facility siting laws. These requirements are not directly applicable to hazardous substances, pollutants, contaminants, remedial actions, locations, or other circumstances at a CERCLA site but address problems or situations sufficiently similar (relevant) to those encountered at the CERCLA site such that their use is well suited to the particular site.

The determination that a requirement is relevant and appropriate is a two-step process: (1) the determination of whether a requirement is relevant and (2) the determination of whether a requirement is appropriate. In general, this involves comparing a number of site-specific factors, including examining the purpose of the requirement and the purpose of the proposed CERCLA action, the medium and substances regulated by the requirement and the proposed remedial action, the actions or activities regulated by the requirement and the remedial action, and the potential use of resources addressed in the requirement and the remedial action.

When the analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable (EPA 1988).

3.1.1.3 Information to be Considered

In addition to ARARs, the NCP states that where ARARs do not exist, agency advisories, criteria, or guidance are to be considered useful "in helping to determine what is protective at a site or how to carry out certain actions or requirements" (55 Federal Register 8745). These sources of information are referred to as TBC.

The NCP preamble states, however, that provisions in the TBC category "should not be required as cleanup standards, because they are, by definition, generally neither promulgated nor enforceable, so they do not have the same status under CERCLA as do ARARs."Although not enforceable requirements, these documents are important sources of information that EPA and the state may consider during selection of the remedy, especially regarding the evaluation of public health and environmental risks, or which will be referred to, as appropriate, in selecting and developing cleanup actions [40 CFR (Code of Federal Regulations) § 300.400(g)(3), 40 CFR § 300.415(I)].

Appendix A also contains a complete list of preliminary TBCs for OU1.

3.1.1.4 Other Regulatory Requirements Not Considered ARARs

There are other laws and regulations that have not been identified as ARARs for the site because they are not specifically related to environmental cleanup or facility siting. One example would be the U.S. Department of Transportation (DOT) regulations for transport of hazardous and nonhazardous materials or wastes; another would be Occupational Safety and Health Administration (OSHA) general construction safety regulations.

3.1.2 Categories of ARARs

Environmental laws and regulations fit (more or less) into three categories: 1) those that pertain to the management of certain chemicals; 2) those that restrict activities at a given location; and 3) those that control specific actions. Thus there are three primary types of ARARs: chemical-, location-, and action-specific. An ARAR can be one or a combination of all three types of ARARs.

Chemical-specific requirements address chemical or physical characteristics of compounds or substances on sites. These values establish acceptable amounts or concentrations of contaminants that may be found in, or discharged to, the ambient environment.

Location-specific requirements are restrictions placed on the concentrations of hazardous substances or the conduct of cleanup activities because they are in specific locations. Location-specific ARARs relate to the geographical or physical positions of sites rather than the nature of contaminants at sites.

Action-specific requirements are usually technology-based or activity-based requirements, or limitations on actions taken with respect to hazardous substances, pollutants, or contaminants. A given cleanup activity will trigger an action-specific requirement. Such requirements do not themselves determine the cleanup alternative but define how chosen cleanup methods should be performed.

3.1.3 Waivers of Specific ARARs

CERCLA Section 121(d)(4) authorizes that any ARAR may be waived under one of the following six conditions if the protection of human health and the environment is ensured:

- It is part of a total remedial action that will attain such level or standard of control when completed (i.e., interim action waiver).
- Compliance with the ARAR at a given site will result in greater risk to human health and the environment than alternative options that do not comply with the ARAR.
- Compliance with such a requirement is technically impracticable from an engineering perspective.
- The remedial action will attain a standard or performance equivalent to that required by the ARARs through use of another method or approach.
- The ARAR in question is a state standard and the state has not consistently applied (or demonstrated the intention to consistently apply) the ARAR in similar circumstances at other sites.
- In meeting the ARAR, the selected remedial action will not ensure a balance between the need for protection of public health and welfare and the environment at the site and the availability of Superfund monies to respond to other facilities.
- It is not anticipated that ARAR waivers will be required for selecting or implementing a remedy at the site.

3.1.4 ARARs for Onsite and Offsite Actions

The types of legal requirements applying to CERCLA responses will differ to some extent depending on whether the activity in question takes place on site or off site. The term "on site" is defined in the NCP as "the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action" (40 CFR § 300.5).

Implementation of onsite remedial actions for the site would not require federal, state, or local permits in accordance with Section 121(e) of CERCLA. Onsite CERCLA actions must comply with all substantive requirements that are "applicable" or "relevant and appropriate." Offsite CERCLA actions would not only require compliance with applicable requirements, but compliance with both substantive and administrative components of the applicable regulations, as well. Permits are considered to be procedural or administrative requirements. Thus, onsite activities of a remedial action for the site do not need to obtain permits or meet other administrative requirements contained in ARARs in accordance with Section 121(e) of CERCLA. CERCLA Section 121(e)(1), 42 United States Code (U.S.C). § 9621(e)(1), states, "No Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely on site, where such remedial action is selected and carried out in compliance with this section." The onsite activities must, however, comply with substantive permit requirements.

In most cases, the classification of a particular requirement as substantive or administrative will be clear, but some requirements may fall in an area between provisions related primarily to program administration and those concerned primarily with environmental and human health goals.

3.1.5 Identification of Potential ARARs for Remedial Alternatives

Appendix A lists potential ARARs and TBCs, and with a brief description of ARARs for the implementation of a remedial action at OU1. The ARARs are organized by whether they are federal or Montana ARARs or TBCs. The ARARs or group of related ARARs included in Appendix A are identified by a statutory or regulatory citation, followed by a brief explanation of the ARAR and how, and to what extent, the ARAR is expected to apply to potential activities to be conducted. The tables in Appendix A also identify whether the ARAR or TBC is chemical-, location-, and/or action-specific.

Appendix A identifies potential ARARs for the purpose of evaluating remedial alternatives in this FS. The potential ARARs in this FS are not binding; final ARARs will be determined in the ROD as performance standards for remedial design and subsequent remedial actions.

3.1.6 Effect of ARARs on Waste Classifications for Contaminated Soil

ARARs identified in Appendix A address waste classifications for contaminated soil generated during remedial action. Thus these ARARs warrant further discussion here since they potentially affect remedial alternatives identified in this FS.

The primary regulatory driver for waste classifications is the Resource Recovery and Conservation Act (RCRA), and specifically RCRA Subtitle C which address identification of hazardous wastes. The Bevill Amendment excludes from regulation under Subtitle C "solid wastes from the extraction, beneficiation, and processing of ores and minerals." The contaminated soils at the site, having been derived from mining activities, potentially meet the criteria of the Bevill exclusion and therefore could be exempted for regulation as an environmental medium containing hazardous waste.

This determination would be significant as RCRA Subtitle C disposal requirements would not be applicable for the contaminated soils generated from OU1. However, it is assumed that contaminated soils would be classified under State of Montana regulations (ARM 17.50.503) as Group II solid wastes and would require disposal in a Class II facility if excavated for disposal.

3.2 Anticipated Land Uses

The current and anticipated future land uses for the site are an important consideration for the development of PRAOs and PRGs to ensure remedial alternatives are protective of human health and the environment. The final condition of the site after remediation must be considered in evaluating future land uses or activities and the related protection to human health that is provided.

The expectation and assumption in this FS is that areas that are remediated that result in acceptable risks for residential use would also result in acceptable risks for non-residential uses (assuming the remedial measures, such as caps, put in place to address human health risks are kept intact). Land uses or activities (residential or non-residential) that would compromise the remedial measures such as caps implemented under a remedial action would be considered unacceptable.

3.3 Preliminary Remedial Action Objectives

PRAOs are media-specific and source-specific goals to be achieved through completion of a remedy that is protective of human health and the environment. These objectives are typically expressed in terms of the chemicals, the concentration of the chemicals, and the exposure routes and receptors.

PRAOs are typically developed by evaluating several sources of information, including results of the HHRA discussed in Section 2.6 and tentatively identified ARARs presented in Appendix A. These inputs are the basis for determining whether protection of human health and the environment is achieved for a particular remedial alternative.

The PRAOs presented are initially based on anticipated future use of OU1 by people for primarily residential and commercial purposes:

1. Mitigate the potential for inhalation and ingestion exposures by human receptors to lead in soil resulting in risks exceeding a 5 percent probability of blood lead in children above 10 μg/dL.

2. Mitigate the potential for inhalation and ingestion exposures by human receptors to arsenic in soil resulting in cancer risks that exceed 1E-04.

3. Mitigate the potential for inhalation and ingestion exposures by human receptors to antimony in soil resulting in cancer risks that exceed 1E-04.

4. Control erosion of lead, arsenic, and antimony in soil by wind and water to prevent the spread of contamination to unimpacted locations and media.

3.4 Preliminary Remediation Goals

PRGs are defined as the average concentration of a chemical in an exposure unit associated with a target risk level such that concentrations at or below the PRG do not pose an unacceptable risk. As stated in Section 3.3, the PRAOs for the site include protection of human and ecological receptors from contaminated soil distributed across the site.

Identification and selection of the PRGs are typically based on PRAOs, the current and anticipated future land uses, and the tentatively identified ARARs. The PRGs are typically presented as chemical- and media-specific values that directly address the PRAOs. These values are typically used as a preliminary value in the FS to guide evaluations of remedial alternatives.

The HHRA identified lead, arsenic, and antimony as the contaminants that constituted unacceptable risk at the site. The following subsections describe development of the PRGs for these contaminants.

3.4.1 Lead

Lead risks were evaluated in the HHRA using the IEUBK model to evaluate blood lead levels. Risk was assessed for properties using only the analytical data for the surface depth interval (0 to 2 inches). Exposures were based on a yard-wide average for each property.

Blood Lead Levels of Concern

As summarized in the RI, risks from lead are evaluated using a different approach than for most other chemicals. EPA identified 10 ug/dL as the concentration at which effects begin to occur that warrant avoidance, and has set a risk based goal of a 5 percent probability that blood lead in children would exceed 10 ug/dL (EPA 1991b, 1994).

Risk Management

During the risk management process, EPA takes into account input from its regulatory stakeholders and also considers precedent at sites in the same state or region to arrive at acceptable cleanup decisions. Risk-based action levels are not set in the HHRA, but are part of the risk management process. The following factors illustrate rationale for the adoption of a more conservative cleanup goal than identified in the HHRA:

- **Sampling locations vs. yards.** Exposures in the HHRA were evaluated on a yard-wide average for each property. However, in recent years, DEQ and EPA have shown a preference for moving away from use of the entire yard as the exposure point and have used the smaller area represented by the individual sampling location to make cleanup decisions.

- **Below surface depths**. The HHRA assessed only the upper two inches of soil, which does not account for future risk. Residents could disturb the soils from the 2 to 12 inches for which data are available with only minor home improvement activities, such as digging a flowerbed, installing a vegetable garden, or building a play area or patio.

- **Non-residential properties**. The HHRA looked only at current risks for residential properties. However, the lack of zoning regulations in Superior allows for many of the non-residential properties to be used for residential purposes in the future, which could present a potential for unacceptable risk.

Based on the results of the HHRA and risk management decisions by EPA and DEQ, a PRG of 400 mg/kg for concentrations of lead in soils was selected.

3.4.2 Arsenic

Arsenic risk was assessed in the HHRA for properties using only the analytical data for the surface depth interval (0 to 2 inches). Exposures were based on a yard-wide average for each property.

Cancer Effects

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. In general, the EPA considers excess cancer risks that are below 1E-06 to be so small as to be negligible, and risks above 1E-04 to be sufficiently large that some sort of remediation is desirable[1]. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be acceptable (EPA 1991a)

Risk Management

As described in Section 3.4.1, EPA takes into account input from its regulatory stakeholders and also considers precedent at sites in the same state or region to arrive at acceptable cleanup decisions, during the risk management process. Factors such as evaluating individual sample locations for cleanup decisions versus property-wide averages, including subsurface samples in cleanup decisions, and including non-residential properties in cleanup decisions provide rationale for adopting a more conservative cleanup goal than identified in the HHRA.

Based on the results of the HHRA and risk management decisions by EPA and DEQ, a PRG of 100 mg/kg for concentrations of arsenic in soils was selected.

3.4.3 Antimony

Antimony risk was assessed in the HHRA for properties using only the analytical data for the surface depth interval (0 to 2 inches). Exposures were based on a yard-wide average for each property.

Cancer Effects

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. In general, the EPA considers excess cancer risks that are below 1E-06 to be so small as to be negligible, and risks above 1E-04 to be sufficiently large that some sort of

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[1] Excess cancer risk can be expressed in several formats. A cancer risk expressed in scientific notation as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000 or 10^{-4}. For the purposes of this document, all excess cancer risks are presented in a scientific notation.

remediation is desirable[2]. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be acceptable (EPA 1991a)

Risk Management

As described in Section 3.4.1, EPA takes into account input from its regulatory stakeholders and also considers precedent at sites in the same state or region to arrive at acceptable cleanup decisions, during the risk management process. Factors such as evaluating individual sample locations for cleanup decisions versus property-wide averages, including subsurface samples in cleanup decisions, and including non-residential properties in cleanup decisions provide rationale for adopting a more conservative cleanup goal than identified in the HHRA.

Based on the results of the HHRA and risk management decisions by EPA and DEQ, a PRG of 130 mg/kg for concentrations of antimony in soils was selected.

[2] Excess cancer risk can be expressed in several formats. A cancer risk expressed in scientific notation as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000 or 10^{-4}. For the purposes of this document, all excess cancer risks are presented in a scientific notation.

Section 4
Identification and Screening of General Response Actions, Remedial Technologies, and Process Options

4.1 Overview

This section identifies GRAs, remedial technologies, and process options that are potentially useful to address the PRAOs identified in Section 3 for the contaminated media that pose a potential threat to human health and the environment. This section presents the screening of GRAs, remedial technologies, and process options in accordance with the NCP to retain representative technologies and process options that can be assembled into remedial alternatives, which are discussed in Section 5.

The identification and screening process consists of the following general steps:

- Identify the contaminants and affected media that pose risks to human health and the environment and group these into a category or categories of contaminated media for FS evaluation purposes.

- Develop GRAs for the contaminated media that will satisfy the PRAOs identified in Section 3.

- Compile remedial technologies and process options for each GRA that are potentially viable for remediation of the contaminated media.

- Screen the remedial technologies and process options with respect to technical implementability for the contaminated media at the site. Technologies and process options that are not technically implementable relative to the contaminated media are eliminated from further consideration in this FS.

- Evaluate and screen the retained remedial technologies and process options with respect to effectiveness, ease of implementability, and relative cost. Technologies and process options that have low effectiveness, low implementability, or high cost relative to the contaminated media are eliminated from further consideration in this FS.

- Combine and assemble the retained technologies and process options for the contaminated media into remedial alternatives as presented in Section 5.

The remainder of this section describes the contaminated media and evaluates GRAs, technologies, and process options that are potentially viable for addressing them to meet the PRAOs and ARARs discussed in Section 3.

4.2 Contaminants and Affected Media

The purpose of this subsection is to identify the contaminants and affected media that exhibit a potential risk to human health and the environment, and group these into categories of contaminated media. Creating categories of contaminated media facilitates identification of GRAs, remedial technologies, and process options that can be used to address the PRAOs.

The nature and extent of contamination within media at the site and the human health risks posed by the contaminated media are summarized in Section 2 and fully discussed in the RI report (CDM 2011). The following subsections describe the three contaminants posing human health and/or ecological risks at OU1 (lead, arsenic, and antimony) and the categories of media affected by these contaminants.

4.2.1 Lead

The original source of the mining-related contamination at OU1 is the tailings from the IMM mine. Mine waste tailings were transported to town on an individual basis by land owners or government entities for use as fill material. Lead was identified in the RI Report (CDM 2011) as one of the contaminants that pose potential human health risk as the site. Elevated lead concentrations were found in gravel driveways, residential yards, gardens, and alleys.

4.2.2 Arsenic

Arsenic was identified in the RI Report (CDM 2011) to pose a health risk at the site. Like lead, arsenic contamination at the site resulted from the transport of mine tailings to the town from the IMM mine. Arsenic contamination at the site was found at various locations including driveways, residential yards, gardens, and alleys.

4.2.3 Antimony

Antimony was identified in the RI Report (CDM 2011) to pose a health risk at the site. Like lead and arsenic, antimony contamination at the site resulted from the transport of mine tailings to the town from the IMM mine. Antimony contamination at the site was found at various locations including driveways, residential yards, gardens, and alleys.

4.2.4 Affected Media

Soil is the predominant contaminated media at the site. Lead, arsenic, and antimony contamination is widely distributed throughout the site and occurs within surface and subsurface soil between 0 to 12 inches bgs. Distribution of properties targeted for remediation with lead, arsenic, and antimony contamination at the site is shown on Figure 2-5.

To simplify FS evaluations and alternative descriptions, the contaminated media (soil contaminated with lead, arsenic, and/or antimony) are grouped together and herein defined as "contaminated soils". This grouping was based on the assumption that lead, arsenic, and antimony can generally be addressed using many of the same remedial technologies and process options.

4.3 General Response Actions

GRAs are initial broad response actions considered to address the PRAOs for the contaminated soils identified at the site. GRAs include several remedial categories, such as containment, removal, disposal, and treatment of contaminated soils. Site-specific GRAs are first developed to satisfy the PRAOs and/or ARARs, and then are evaluated as part of the identification and screening of remedial technologies and process options for the contaminated soils.

The GRAs considered for remediation of contaminant materials include the following:

- No Action
- Monitoring
- Land Use Controls
- Reuse, Reclamation, Recovery
- Containment
- Removal/Transport/Disposal
- Treatment

No Action leaves contaminated soils in their existing condition with no control or cleanup planned. In accordance with the NCP, this GRA must be considered to provide a baseline against which other options can be compared.

Monitoring involves physical and/or chemical measures used at the site to determine if there is contaminant migration. Monitoring is not intended to substitute any engineering aspect of a selected remedy and does not physically address contaminants.

Land Use Controls involve administrative, legal, and/or informational measures intended to control or prevent present and future use of contaminated soils, and inform and warn of dangers associated with these materials. Land use controls are not intended to substitute for engineering aspects of a selected remedy and do not physically address contaminants.

Containment involves physical measures applied to contaminated soils to control the release of contaminants and/or prevent direct contact or exposure to the contaminants.

Removal/ Transport/Disposal involve a complete or partial removal (i.e. excavation) of contaminated soils followed by transportation and disposal at an onsite/offsite location.

Treatment involves biological, chemical, thermal, and/or physical measures applied to the contaminated soils that reduce toxicity, mobility, and/or volume of the contaminants present.

Reuse, Reclamation, Recovery involves processes that can remove or treat contaminated soils while recovering usable or saleable materials.

4.4 Identification of Remedial Technologies and Process Options

In this step of the FS process, remedial technology types and process options that are capable of addressing contaminated soils are identified and organized under each GRA listed in Section 4.3. This section provides potentially viable remedial technologies and process options for the contaminated soils.

The primary source of information used to identify remedial technologies and process options for the contaminated soils is the Federal Remediation Technologies Roundtable (FRTR) Remediation Technologies Screening Matrix and Reference Guide, Version 4.0 (FRTR 2007). Other sources of information used for identification of remedial technologies and process options include previous studies and work conducted at the site, relevant EPA guidance, published literature and vendor information, and engineering judgment based on other mine waste-related remediation projects (particularly those involving lead, arsenic, and antimony).

Potentially viable remedial technologies and associated process options identified for the contaminated soils are presented and described on Table 4-1.

4.5 Screening of Remedial Technologies and Process Options for Technical Implementability

The remedial technologies and process options presented on Table 4-1 were first evaluated and screened based on technical implementability. The preliminary screening was very broad, looking at the suitability of a technology for addressing contaminated soils. The sources of information discussed in Section 4.4 were also used to perform screening.

A given technology or process option was eliminated from further consideration in this FS if site conditions or site characterization data indicated that the technology or process option is incompatible with the contaminants or media or cannot be implemented effectively due to physical limitations or constraints at OU1.

Some of the process options may be technically implementable on a small-scale basis for a specific location; however, the technical implementability screening and elimination were performed by evaluating use of the process options for the contaminated soils on a large-scale, operable unit-wide basis.

Each of the process options identified in Section 4.4 for contaminated soils has been screened to eliminate those that are not implementable technically at the site. The process options for contaminated soils eliminated from further consideration in this FS (with the rationale for elimination) are indicated on Table 4-1, using grey shading.

Remedial technologies and process options that were not deemed to be technically implementable relative to the contaminated soils were eliminated from further consideration. Retained technologies and process options were then carried forward to the second step of the evaluation process as discussed in Section 4.6.

4.6 Evaluation of Remedial Technologies and Process Options for Effectiveness, Implementability, and Relative Cost

Each of the technically implementable remedial technologies and process options retained from the preliminary screening process presented in Section 4.5 were further evaluated in the second step of the screening process to determine whether they should be eliminated from further consideration in the FS or retained for assembly into remedial alternatives.

4.6.1 Evaluation Criteria

Each remedial technology or process option was qualitatively evaluated for effectiveness, implementability, and relative cost. The criteria used, as defined in this step of the FS process, are as follows:

Effectiveness
This evaluation of the effectiveness of a remedial technology or process option focuses on:

- Potential effectiveness in handling the estimated volumes of contaminated soils and meeting the objectives identified in the PRAOs
- Potential impacts to human health and the environment during construction and implementation
- How proven the remedial technology or process option is with respect to the contaminants and conditions at the site

Implementability
Technically implementable technologies and process options retained from the screening step described in Section 4.5 are evaluated with respect to both the technical and administrative feasibility of implementing a remedial technology or process option. Technical implementability was used as an initial screening step in Section 4.5 to eliminate remedial technologies and process options that were clearly ineffective or unworkable at OU1. This subsequent screening criterion places greater emphasis on the institutional aspects of implementability. This criterion focuses on:

- Ability to obtain permits for offsite actions
- Availability and capacity of treatment, storage, and disposal services
- Availability of necessary equipment and skilled workers

Relative Cost
Cost plays a limited role in the screening of remedial technologies and process options. Relative capital and operation and maintenance (O&M) costs are used rather than detailed estimates. The cost analysis is evaluated based on engineering judgment and is ranked relative to other process options in the same technology type.

4.6.2 Screening Evaluation

Each of the remedial technologies and process options retained from the first screening step for the contaminated soils were evaluated against the three criteria identified in Section 4.6.1 to determine whether they should be eliminated from further consideration in the FS or retained for assembly into remedial alternatives. The results of this second screening step are presented on Table 4-2.

This evaluation and screening process is inherently qualitative. The evaluation criteria described in Section 4.6.1 are specified by EPA RI/FS guidance (EPA 1988); however, the degree to which the criteria are weighted against each other is not specified. Determination of how the individual evaluation criterion should influence the overall rankings is subjective and based on site-specific considerations and professional judgment. The factors considered for each of the three criteria that justify retention or elimination are rated using a qualitative rating system. Exhibit 4-1 presents the qualitative rating system used in conjunction with the stated rationale to justify the ratings with respect to each criterion.

Exhibit 4-1. Qualitative Rating System for Screening of Remedial Technologies and Process Options

	Effectiveness and Implementability		Relative Cost
⓿	None	⓿	None
❶	Low	$	Low
❷	Low to moderate	$$	Low to moderate
❸	Moderate	$$$	Moderate
❹	Moderate to high	$$$$	Moderate to high
❺	High	$$$$$	High

Remedial technologies or process options deemed to have low effectiveness, low implementability, and/or high relative cost for contaminated soils are eliminated from further consideration in the FS, and are indicated on the tables (with the rationale for elimination) using grey shading.

4.7 Retained GRAs, Remedial Technologies, and Process Options

Based on the results of the two-step screening process described in Sections 4.5 and 4.6, a reduced number of remedial technologies and process options for contaminated soils were retained for further evaluation and the development of remedial action alternatives as discussed further in Section 5. These retained remedial technologies and process options are presented on Table 4-3.

Remedial technologies and process options identified to address the contaminated soils are retained because they either have substantial potential and applicability as a stand-alone remedy, or have remedial benefits in combination with other remedial technologies but would only have cost-effective application for specific site elements and particular conditions.

It is unlikely that using or applying a single remedial technology/process option to the contaminated soils will solely be able to achieve the PRAOs or comply with ARARs. Thus, using various remedial technologies/process options in combination is likely to be necessary. Conventional and innovative remedial technologies/process options for contaminated soils are used in various combinations for assembly of remedial alternatives as discussed in Section 5.

The retained remedial technologies and process options are identified in Exhibit 4-2.

Exhibit 4-2. Remedial Technologies and Process Options for Contaminated Soils

Remedial Technology	Process Option
Physical and/or Chemical Monitoring	■ Non-Intrusive Visual Inspection ■ Intrusive Visual Inspection ■ Sample Collection and Analysis
Institutional Controls	■ Governmental Controls, Proprietary Controls, and Informational Devices
Community Awareness Activities	■ Informational and Educational Programs
Access Controls	■ Posted Warnings
Surface Source Controls	■ Soil or Rock Exposure Barrier/Cover ■ Asphalt or Concrete Exposure Barrier/Cover ■ Geosynthetic Multi-Layer Exposure Barrier/Cover
Removal	■ Mechanical Excavation ■ Pneumatic Excavation (Vacuum Extraction/Pumping)
Transport	■ Mechanical Transport (Hauling/Conveying) ■ Pneumatic Transport (Vacuum Extraction/Pumping)
Disposal	■ Disposal – Mine Waste Joint Repository ■ Disposal – Licensed Solid Waste Disposal Facility
Physical and/or Chemical Treatment	■ Ex Situ Pozzolan- or Cement-Based Stabilization/Solidification ■ Ex Situ Chemical Immobilization/ Stabilization

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Section 5
Development and Screening of Alternatives

5.1 Overview

In this section, remedial action alternatives (herein referred to as remedial alternatives) are assembled by combining the retained remedial technologies and process options for contaminated soils presented in Section 4. Remedial alternatives are developed from either stand-alone process options or combinations of the retained process options.

These remedial alternatives are then screened using a qualitative process with standard evaluation to determine overall effectiveness, implementability, and cost. The purpose of alternative screening presented in this section is to reduce the number of remedial alternatives retained for detailed analysis in Section 7.

The remedial alternatives for the site span a range of categories defined by the NCP as follows:

- No action alternative
- Alternatives that address the principal threats but involve little or no treatment; protection would be by prevention or control of exposure through actions such as containment and/or land use controls
- Alternatives that, as their principal element, employ treatment that reduces the toxicity, mobility, or volume of the contaminants

5.2 Assumptions Affecting Development of Remedial Alternatives

Several fundamental assumptions affect the development of remedial alternatives evaluated in this FS (other than a "no action alternative"). These assumptions are driven by requirements of the PRAOs and ARARs identified in Section 3 and site limitations and constraints that cannot be overcome by using one or more remedial technology/process options as described in Section 4. These fundamental assumptions were taken into consideration during development of remedial alternatives for this FS and include the items listed in Exhibit 5-1:

Exhibit 5-1. Assumptions Affecting Development of Remedial Alternatives

Fundamental Assumption	Rationale
Land Use is Generally Considered to be Residential or Commercial	Land use for privately owned properties is assumed to be residential or commercial under all remedial alternatives. ■ It is assumed that properties (whether currently developed and occupied or not) could be developed and occupied in the future. ■ It is assumed that structures such as homes or businesses would not be affected during remediation of the soil contamination.
Comprehensive Approach of GRAs within Alternatives	The GRAs provided within the alternatives address the lead- , arsenic-, and antimony-related contaminants and risks for the site as a whole (i.e. a property by property approach was not taken for alternatives evaluation). Combinations of GRAs to address specific property-related issues will be addressed by EPA and DEQ during identification of the preferred alternative after finalization of the FS and subsequent development of the proposed plan.
Land Use Controls is Essential GRA Component of All Alternatives (Except the No Further Action Alternative)	Remediation of contaminated soils using the GRAs assembled for each remedial alternative would be conducted to the extent practicable. However, it may not be possible to fully address contaminated soils underneath or adjacent to structures or obstructions such as homes, trees, subsurface utilities, and roads on some properties. Thus all remedial alternatives are expected to leave contaminated soils in place at some properties with contaminant concentrations above PRGs that would not allow for unlimited use and unrestricted exposure under the current and potential future land uses. For purposes of this FS, land use controls (combinations of institutional controls, community awareness activities, and/or access controls) are assumed to address these situations on a property by property basis for all remedial alternatives except the "no further action' alternative.
Monitoring is Essential GRA Component of All Alternatives	It is assumed that monitoring (visual inspection and/or sampling/analysis) are essential GRA components of all remedial alternatives since it is assumed contaminated soils above PRGs will remain in place. It is assumed that these activities must be performed to determine protectiveness of the remedy after implementation and the need for any future additional remedial measures.
50-year Period of Cost Analysis for All Alternatives	It is likely that all remedial alternatives will leave contaminated soils above PRGs in-place and thus will require an indefinite duration of maintenance and monitoring to ensure protectiveness. The alternatives are expected to require cost expenditures for perpetuity since soils left beneath structures could have contaminant concentrations above PRGs that would not allow for unlimited use and unrestricted exposure under the current and potential future land uses. However, cost evaluations for long durations of maintenance and monitoring are cumbersome and are generally not necessary for comparative evaluation between alternatives due to cost discounting under present value analysis. The period of analysis is assumed to be 50 years because the increase of present value cost due to small periodic expenditures for maintenance and monitoring after 50 years is minimal relative to the accuracy range of the estimates. Thus for FS purposes a default 50-year period of analysis has been selected for all remedial alternatives.
Contaminated soils are exempt from regulation as RCRA hazardous waste	As discussed in Section 3.1.6, it is assumed for purposes of this FS that contaminants in soils are exempt from regulation as RCRA hazardous waste because they are derived from mineral processing. However, if offsite disposal is required, it is assumed that contaminated soils would be classified under State of Montana regulations as Group II solid wastes and would require disposal in a Class II facility.

Secondary factors and considerations have also been tentatively identified to aid development of remedial alternatives but are not fundamental controlling considerations. Since these considerations vary depending on the remedial approach used in each alternative, they are discussed in Section 7 for retained remedial alternatives.

5.3 Description of Remedial Alternatives

Remedial alternatives were assembled by combining the retained remedial technologies and process options that are capable of addressing the contaminated medium (soils). Table 5-1 provides a comprehensive list of the tentatively-retained remedial technologies/process options that were used to develop each remedial alternative. The fundamental site assumptions and factors described in Sections 5.2 were also considered during development of the remedial alternatives.

The remedial alternatives evaluated for OU1 include:

- Alternative 1: No Further Action
- Alternative 2: In-Place Capping of Contaminated Soils
- Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities
- Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository
- Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

The following subsections provide generalized descriptions of the remedy components for remedial alternatives to be evaluated during the screening process presented in this section. Each remedial alternative description includes discussion of how contaminated soils will be addressed at both residential and commercial properties and the repository located at the Mineral County Airport. Detailed information for remedy components, including but not limited to specific quantities of contaminated soils and types of samples collected for analyses, will be developed for the alternatives retained after screening.

5.3.1 Alternative 1: No Further Action

Alternative 1 would leave contaminated soils in their current conditions.

Contaminated soils previously excavated under removal action activities conducted in 2002 and 2010 are currently stockpiled within a repository at the Mineral County Airport. Prior to placement within the airport repository, the contaminated soils stockpiled in 2002 were treated using Portland cement and the contaminated soils stockpiled in 2010 were treated using TSP. Contaminated soils also currently exist in driveways and yards of 52 properties within OU1.

No new remedial action activities would be initiated at the site to address remaining contaminated soils or otherwise mitigate the associated risks to human health and the environment. A "no action"/"no further action" alternative is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared.

Five-year site reviews would be performed as required by the NCP to evaluate whether adequate protection of human health and the environment is provided since contaminated soils would remain at the site with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses. Monitoring (consisting primarily of non-intrusive visual inspections) would be performed as necessary to complete the 5-year site reviews.

5.3.2 Alternative 2: In-Place Capping of Contaminated Soils

Alternative 2 includes in-place capping (covering) of contaminated soils on residential properties. The contaminated soils within the repository at the Mineral County Airport would also receive a permanent cover. Covers would be constructed over contaminated soils to the extent practicable. Covers used to contain contaminated soils are assumed to be constructed from clean soil or rock that is transported from offsite borrow areas tested to ensure that contamination is not present. The specific type of cover used at a particular property would be determined during remedial design.

Land use controls would be implemented to protect and restrict use of covered areas, and provide awareness of risks from potential exposure to contaminated soils. Monitoring would consist of visual inspections to ensure that covers and land use controls are protective of human health and the environment. Maintenance of covers would be performed as necessary to maintain protectiveness.

Five-year site reviews would be performed since contaminated soils under covers as well as under or adjacent to structures and obstructions would remain at properties within the site with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses.

5.3.3 Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities

Alternative 3 includes excavation of contaminated soils on residential and commercial properties and within the repository at the Mineral County Airport to facilitate disposal. Excavation of contaminated surface materials would be conducted to the extent practicable. Confirmation that soils remaining within excavations are below PRGs will be determined using visual inspections coupled with sample collection and analysis. However, it may not be possible to fully excavate contaminated soils underneath or adjacent to structures or obstructions such as homes, trees, subsurface utilities, and roads. Thus contaminated soils may be left in place under or adjacent to these structures or obstructions. For purposes of this FS, land use controls are assumed to address these situations on a property by property basis.

Clean soil or rock would be used to backfill excavation areas to match the surface conditions that previously existed. Clean soil or rock is assumed to be transported from offsite borrow areas tested to ensure that contamination is not present. The backfill placed in yards would be covered with topsoil and revegetated.

Excavated contaminated soils would be transported offsite for disposal at one or more existing licensed solid waste facilities. The closest Class II facility to the site is approximately 60 miles one-way and the next closest is approximately 170 miles one-way. Generally, mining waste exempted from RCRA Subtitle C regulation will be accepted at these two facilities without prior treatment. However, final acceptance of the contaminated soils is determined by the individual facilities and thus some of the soils may require treatment prior to disposal. It is assumed for the purpose of this FS that contaminated soils addressed under this alternative will not require treatment prior to disposal.

Five-year site reviews would be performed since contaminated soils would remain under or adjacent to structures and obstructions at some properties within the site with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses.

5.3.4 Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository

Alternative 4 includes excavation of contaminated soils on residential and commercial properties and within the repository at the Mineral County Airport to facilitate disposal. Excavation of contaminated surface materials would be conducted to the extent practicable. Confirmation that soils remaining within excavations are below PRGs will be determined using visual inspections coupled with sample collection and analysis. However, it may not be possible to fully excavate contaminated soils underneath or adjacent to structures or obstructions such as homes, trees, subsurface utilities, and roads. Thus contaminated soils may be left in place under or adjacent to these structures or obstructions. For purposes of this FS, land use controls are assumed to address these situations on a property by property basis.

Clean soil or rock would be used to backfill excavation areas to match the surface conditions that previously existed. Clean soil or rock is assumed to be transported from offsite borrow areas tested to ensure that contamination is not present. The backfill placed in yards would be covered with topsoil and revegetated.

Excavated contaminated soils would be transported for disposal at a permanent mine waste joint-repository for mine waste rock and tailings associated with the Flat Creek/IMM Site. The mine waste joint repository (herein referred to as Wood Gulch Repository) is located in Wood Gulch on State of Montana – Department of Natural Resources and Conservation (DNRC) managed lands north of the Town of Superior. Wood Gulch Repository will be constructed, operated, and maintained as part of OU3.

Five-year site reviews would be performed since contaminated soils would remain under or adjacent to structures and obstructions at some properties within the site with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses.

5.3.5 Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

Alternative 5 includes excavation of contaminated soils on residential and commercial properties and within the repository at the Mineral County Airport to facilitate disposal. Excavation of contaminated surface materials would be conducted to the extent practicable. Confirmation that soils remaining within excavations are below PRGs will be determined using visual inspections coupled with sample collection and analysis. However, it may not be possible to fully excavate contaminated soils underneath or adjacent to structures or obstructions such as homes, trees, subsurface utilities, and roads. Thus contaminated soils may be left in place under or adjacent to these structures or obstructions. For purposes of this FS, land use controls are assumed to address these situations on a property by property basis. Excavated contaminated soils would undergo treatment prior to disposal at the Wood Gulch Repository as discussed for Alternative 4.

Clean soil or rock would be used to backfill excavation areas to match the surface conditions that previously existed. Clean soil or rock is assumed to be transported from offsite borrow areas tested to ensure that contamination is not present. The backfill placed in yards would be covered with topsoil and revegetated.

Alternative 5 also includes treatment of newly-excavated contaminated soils prior to disposal. A treatment additive such as Portland cement, TSP, or other types of stabilization agents would be added to the newly-excavated contaminated soils prior to disposal to bind the contaminants and reduce their mobility from leaching. Soils excavated from the repository at the Mineral County Airport have previously been treated using Portland cement or TSP. Thus no further treatment of these soils would be required prior to final disposal at the mine waste joint repository.

Five-year site reviews would be performed since contaminated soils would remain under or adjacent to structures and obstructions at some properties within the site with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses.

5.4 Screening Evaluation of Alternatives

The purpose of this screening evaluation is to reduce the number of proposed remedial alternatives that undergo the more thorough and extensive analysis presented in Section 7. These alternatives are qualitatively evaluated using a smaller set of screening evaluation criteria than what is used for detailed analysis of retained alternatives after screening. Each of these proposed alternatives is screened using the short- and long-term aspects (where applicable) of three broad criteria: effectiveness, implementability, and cost.

5.4.1 Effectiveness

Effectiveness relates to the ability of the remedial alternative to satisfy screening evaluation criteria detailed in Exhibit 5-2.

Exhibit 5-2. Effectiveness Criteria

Effectiveness Criteria
Overall protection of human health and the environment[1]
Compliance with ARARs[1]
Short-term effectiveness (during the remedial construction and implementation period)
Long-term effectiveness and permanence (following remedial construction)
Reduction of toxicity, mobility, or volume through treatment

[1] These criteria are referred to as “threshold criteria” that an alternative must meet to be viable (except the “no further action” alternative); threshold criteria are described further in Section 6.

Effectiveness of each of the proposed alternatives is judged against the five effectiveness screening criteria using the qualitative ratings system in Exhibit 5-3.

Exhibit 5-3. Effectiveness Qualitative Ratings System

Effectiveness Ratings Categories	
⓿	None
❶	Low
❷	Low to moderate
❸	Moderate
❹	Moderate to high
❺	High

5.4.2 Implementability

Implementability relates to the ability of the remedial alternative to satisfy screening evaluation criteria detailed in Exhibit 5-4.

Exhibit 5-4. Implementability Criteria

Implementability Criteria	
Technical feasibility	Ability to construct, reliably operate, and meet technology-specific regulations for process options until a remedial action is complete
	Ability to operate, maintain, replace, and monitor technical components after the remedial action is complete
Administrative feasibility	Ability to obtain approvals from other agencies
	Availability and capacity of treatment, storage, and disposal services
	Availability of property, specific materials and equipment, and technical specialists required for a remedial action

Implementability of each of the proposed alternatives is judged against the screening criteria using the qualitative ratings system presented in Exhibit 5-5.

Exhibit 5-5. Implementability Qualitative Ratings System

Implementability Ratings Categories	
⓿	None
❶	Low
❷	Low to moderate
❸	Moderate
❹	Moderate to high
❺	High

A determination that an alternative is not technically feasible will usually preclude it from further consideration. Negative factors affecting administrative feasibility will normally involve coordination steps to lessen the negative aspects of the alternative but will not necessarily eliminate an alternative from consideration.

5.4.3 Cost

Cost estimates prepared for screening alternatives are typically comparative estimates with relative accuracy so that cost decisions among alternatives are sustained as the accuracy of cost estimates improve in the detailed analysis of alternatives. The procedures used to develop cost estimates for alternative screening are similar to those used for detailed analysis; the differences are in the degree of alternative refinement and cost component development.

The focus of comparative screening estimates is to identify and include items that are essential to the alternatives that control the magnitude of the overall cost. Cost estimates at this step of the FS process are generally determined using cost curves, generic unit costs, vendor information, conventional cost-estimating guides, and prior similar estimates modified by site-specific information rather than detailed cost estimates. Both capital and O&M costs are considered in these estimates. Present value analyses are performed to discount all costs to a common base year. This is performed to fairly evaluate expenditures occurring over different time frames.

The development of alternatives during the alternatives screening process is incomplete because a detailed analysis of the alternative components (such as development of detailed quantities, detailed scoping of remedy components, etc.) has not been performed. Thus the costs developed for the screening analysis of these proposed alternatives are not held to the accuracy required for the detailed analysis of alternatives (i.e. +50 percent to -30 percent of actual costs). Typical cost accuracy ranges for alternative screening are +100 percent to -50 percent of actual costs.

A simplified approach was developed for determining alternative screening costs due to the lack of detailed remedy component scope and associated quantities. This simplified approach involves identifying specific GRAs for contaminated soils that are fundamental cost drivers for the alternative in question and providing costs for these GRA remedy components. If these fundamental GRAs are included in the screening cost estimates, they should be within the accuracy range acceptable for these estimates without development of the secondary remedy components.

The specific GRAs identified as fundamental cost drivers for each alternative are listed below:

- Alternative 1:
  - Monitoring
- Alternative 2:
  - Monitoring, Land Use Controls, and Containment
- Alternative 3 and 4:
  - Monitoring, Land Use Controls, and Removal/Transport/Disposal
- Alternative 5:
  - Monitoring, Land Use Controls, Removal/Transport/Disposal, and Treatment

It should be noted that GRA components identified for screening cost development purposes pertain only to contaminated soils. For instance, the GRA of "Transport" is specifically for contaminated soils; transport of backfill required to construct covers or place excavation backfill are inherent to the GRAs of "Containment" or "Removal" rather than "Transport". Unit quantities (areas and volumes) required to develop costs for these items are presented in Appendix B.

The cost of each proposed alternative is rated on a comparative basis with other alternatives using a scale determined from the range of costs for the screened alternatives. Due to the likely alternative costs for the site, the cost ranges for the ratings categories are large. The cost rating categories are as follows in Exhibit 5-6:

Exhibit 5-6. Cost Qualitative Ratings System

Cost Ratings Categories		Cost Ranges (Present Value Dollars)
$	**Low**	Less than 0.75 million dollars
$$	**Low to moderate**	Between 0.75 million and 1.5 million dollars
$$$	**Moderate**	Between 1.5 million and 2.25 million dollars
$$$$	**Moderate to high**	Between 2.25 million and 3 million dollars
$$$$$	**High**	Greater than 3 million dollars

5.5 Summary of Alternatives Screening

Appendix C presents the evaluation and screening of each remedial alternative using the three screening criteria. This evaluation and screening process is inherently qualitative in nature (with the exception of approximate cost). The evaluation criteria described in Section 5.4 are specified by EPA CERCLA guidance; however the degree to which the criteria are weighted against each other is not specified. A determination of how the individual evaluation criteria influence the overall rankings is based on site-specific considerations and requires engineering judgment.

Remedial alternatives with similar scope and essential components would have overall rankings that are similar, unless other considerations such as large differences in waste volumes or differing construction durations exist between them. Factors that affect the threshold criteria (overall protection of human health and the environment and compliance with ARARs) are given considerable weight in the overall ranking for effectiveness since alternatives must meet these criteria to be selected as a remedy. Section 6 describes the threshold criteria in further detail.

Each alternative developed and described in Section 5.3 was evaluated to determine its overall effectiveness, implementability, and cost in Appendix C using the qualitative ratings system discussed in Section 5.4.

Exhibit 5-7 summarizes the results for the screening of alternatives for the site. All alternatives were retained for detailed analysis. The remedial alternatives that were retained for detailed analysis are identified in Section 5.6.

Exhibit 5-7. Summary of Alternatives Screening

Alternative	Description	Effectiveness	Implementability	Approximate Cost (Present Value Dollars)	
1	No Further Action	⓿	⓿	$	$120,000
2	In-Place Capping of Contaminated Soils	❸	❸	$$	$1,260,000
3	Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities	❹	❸	$$$$	$2,930,000
4	Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository	❹	❹	$$$	$1,740,000
5	Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository	❺	❸	$$$$	$2,420,000

Notes:

1. The alternatives screening process involves a qualitative assessment of the degree to which remedial alternatives meet the evaluation criteria presented in Appendix C. The numerical designations for the qualitative ratings system used in this table are not used to quantitatively assess remedial alternatives (for instance, rankings for a remedial alternative are not additive).
2. All remedial alternatives have been retained for detailed analysis in Section 7.
3. Screening cost backup information (screening cost estimate summaries and present value analyses) for each alternative are presented in Appendix C.

Legend for Qualitative Ratings System:

Effectiveness and Implementability		Cost (Present Value Dollars)	
⓿	None	⓿	None ($0)
❶	Low	$	Low ($0 through $0.75M)
❷	Low to moderate	$$	Low to moderate ($0.75M through $1.5M)
❸	Moderate	$$$	Moderate ($1.5M through $2.25M)
❹	Moderate to high	$$$$	Moderate to high ($2.25M through $3M)
❺	High	$$$$$	High (Greater than $3M)

5.6 Alternatives Retained for Detailed Analysis

Based on the screening of the alternatives in Section 5.5, all of the alternatives were sufficiently viable to be retained for detailed analysis as presented in Section 7.

- Alternative 1: No Further Action
- Alternative 2: In-Place Capping of Contaminated Soils
- Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities
- Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository
- Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

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Section 6
Definition of Criteria Used in the Detailed Analysis of Retained Alternatives

The remedial alternatives retained after completion of the alternative screening step of the FS process (summarized in Section 5) are further evaluated in Section 7 using nine evaluation criteria. These criteria were developed to address statutory requirements and considerations for remedial actions in accordance with the NCP and additional technical and policy considerations that have proven to be important for selecting among remedial alternatives (EPA 1988). The following subsections describe the nine evaluation criteria used in the detailed analysis of remedial alternatives and the priority in which the criteria are considered.

6.1 Overall Protection of Human Health and the Environment

Each alternative is assessed to determine whether it can provide adequate protection of human health and the environment (short- and long-term) from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at the site. Evaluation of this criterion focuses on how site risks are eliminated, reduced, or controlled through treatment, engineered controls, or institutional controls and whether an alternative poses any unacceptable cross-media impacts.

Criteria Used to Evaluate Remedial Alternatives Address Multiple Areas

- Protection of Human Health and Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

6.2 Compliance with ARARs

For this criterion, we evaluate each alternative to determine how chemical-, location-, and action-specific ARARs identified in Appendix A of this document will be met.

If the assessment indicates an ARAR will not be met, then the basis for justifying one of the six ARAR waivers allowed under CERCLA is required to be discussed. These ARAR waivers are detailed in Exhibit 6-1.

Exhibit 6-1. ARAR Waivers

Waiver	Description
Interim Measures	The remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed. (CERCLA §121(d)(4)(A).)
Greater Risk to Health and the Environment	Compliance with such requirement at the facility will result in greater risk to human health and the environment than alternative options. (CERCLA §121(d)(4)(B).)
Technical Impracticability	Compliance with such requirement is technically impracticable from an engineering perspective. (CERCLA §121(d)(4)(C).)
Equivalent Standard of Performance	The remedial action selected will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, criteria, or limitation through use of another method or approach. (CERCLA §121(d)(4)(D).)
Inconsistent Application of State Requirements	With respect to a state standard, requirement, criteria, or limitation, the state has not consistently applied (or demonstrated the intention to consistently apply) the standard, requirement, criteria, or limitation in similar circumstances at other remedial actions. (CERCLA §121(d)(4)(E).)
Fund Balancing	In the case of a remedial action to be undertaken solely under Section 104 using the fund, selection of a remedial action that attains such level or standard of control will not provide a balance between the need for protection of public health and welfare and the environment at the facility under consideration and the availability of amounts from the fund to respond to other sites which present or may present a threat to public health or welfare or the environment, taking into consideration the relative immediacy of such threats. (CERCLA §121(d)(4)(F).)

6.3 Long-Term Effectiveness and Permanence

Long-term effectiveness evaluates the likelihood that the remedy will be successful and the permanence that it affords. Factors to be considered, as appropriate, include the following:

- Magnitude of residual risk remaining from untreated waste or treatment residuals remaining at the conclusion of the remedial activities. The characteristics of the residuals are considered to the degree that they remain hazardous, taking into account their toxicity, mobility, or volume and propensity to bioaccumulate.

- Adequacy and reliability of controls that are used to manage treatment residuals and untreated waste remaining at the site. This factor includes an assessment of containment systems and institutional controls to determine if they are sufficient to ensure that any exposure to human and ecological receptors is within protective levels. This factor also addresses the long-term reliability of management controls for providing continued protection from residuals, the assessment of the potential need to replace technical components of the alternative, and the potential exposure pathways and risks posed should the remedial action need replacement.

6.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Each alternative is assessed for the degree to which it employs technology to permanently and significantly reduce toxicity, mobility, or volume, including how treatment is used to address the principal threats posed by the site. Factors to be considered, as appropriate, include the following:

- The treatment processes the alternatives use and materials they will treat
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or treated, including how the principal threat(s) will be addressed
- The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment
- The degree to which the treatment is irreversible
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents
- Whether the alternative would satisfy the statutory preference for treatment as a principal element of the remedial action

6.5 Short-Term Effectiveness

This criterion reviews the effects of each alternative during the construction and implementation phase of the remedial action until remedial response objectives are met. The short-term impacts of each alternative are assessed, considering the following factors, as appropriate:

- Short-term risks that might be posed to the community during implementation of an alternative
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures
- Potential adverse environmental impacts resulting from construction and implementation of an alternative and the reliability of the available mitigation measures during implementation in preventing or reducing the potential impacts
- Time until protection is achieved

6.6 Implementability

The technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation is evaluated under this criterion. The ease or difficulty of implementing each alternative will be assessed by considering the following factors detailed in Exhibit 6.2.

Exhibit 6-2 Implementability Factors to be Considered during Alternative Evaluation

Criterion	Factors to be Considered
Technical Feasibility	Technical difficulties and unknowns associated with the construction and operation of a technology Reliability of the technology, focusing on technical problems that will lead to schedule delays Ease of undertaking additional remedial actions, including what, if any, future remedial actions would be needed and the difficulty to implement additional remedial actions Ability to monitor the effectiveness of the remedy, including an evaluation of risks of exposure should monitoring be insufficient to detect a system failure
Administrative Feasibility	Activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for offsite actions)
Availability of Services and Materials	Availability of adequate offsite treatment, storage capacity, and disposal capacity and services Availability of necessary equipment and specialists and provisions to ensure any necessary additional resources Availability of services and materials plus the potential for obtaining competitive bids, which is particularly important for innovative technologies Availability of prospective technologies

6.7 Cost

Types of costs that are assessed for each alternative include the following:

- Capital costs
- Annual O&M costs
- Periodic costs
- Present value of capital and annual O&M costs

Cost estimates are developed according to *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000). Flexibility is incorporated into each alternative for the location of remedial facilities, the selection of cleanup levels, and the period in which remedial action will be completed. Assumptions of the project scope and duration are defined for each alternative to provide cost estimates for the various remedial alternatives. Important assumptions specific to each alternative are summarized in the description of the alternative. Additional assumptions are included in the detailed cost estimates in Appendix F.

The levels of detail employed in making these estimates are conceptual but are considered appropriate for making choices between alternatives. The information provided in the cost estimate is based on the best available information regarding the anticipated scope of the remedial alternatives.

The costs are evaluated with respect to the following categories:

- Capital costs are those expenditures that are required to construct a remedial action. They are exclusive of costs required to operate or maintain the action throughout its lifetime. Capital costs consist primarily of expenditures initially incurred to build or install the remedial action. Capital costs include all labor, equipment, and material costs (including contractor markups, such as overhead and profit) associated with activities, such as mobilization/demobilization; site work; installation of containment systems; and disposal. Capital costs also include expenditures for professional/technical services that are necessary to support construction of the remedial action.

- Annual O&M costs are those post-construction costs necessary to ensure or verify the continued effectiveness of a remedial action. These costs are estimated mostly on an annual basis. Annual O&M costs include all labor, equipment, and material costs (including contractor markups, such as overhead and profit) associated with activities, such as monitoring, operating and maintaining containment systems, and disposal. Annual O&M costs also include expenditures for professional/technical services necessary to support O&M activities.

- Periodic costs are those costs that occur only once every few years (e.g., five-year reviews, equipment replacement) or expenditures that occur only once during the entire O&M period or remedial time frame (e.g., site closeout, remedy failure/replacement). These costs may be either capital or O&M costs but, because of their periodic nature, it is more practical to consider them separately from other capital or O&M costs in the estimating process.

- The present value of each alternative provides the basis for the cost comparison. The present value cost represents the amount of money that, if invested in the initial year of the remedial action at a given rate, would provide the funds required to make future payments to cover all costs associated with the remedial action over its planned life. Future O&M and periodic costs are included and reduced by the appropriate present value discount rate as outlined in *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000). Per the guidance, the present value analysis was performed on remedial alternatives using a 7 percent discount (interest) rate over the period of evaluation for each alternative. Inflation and depreciation were not considered in preparing the present value costs.

- The project duration for each alternative evaluated in Section 7 is longer than the period of evaluation for present value analysis. The guidance indicates in those situations that site-specific justification for the selected period of evaluation should be provided. Those justifications were provided in Section 5.

- In addition, a "no-discounting" scenario is included for the present value analysis of each alternative as recommended by the guidance for long-term projects (e.g., project duration exceeding 30 years). A non-discounted constant dollar cash flow over time demonstrates the impact of a discount rate on the total present value cost and the relative amounts of future annual expenditures. Non-discounted constant dollar costs are presented for comparison purposes only and should not be used in place of present value costs in the Superfund remedy selection process.

6.8 State Acceptance

This criterion evaluates the technical and administrative issues and concerns the state may have regarding each of the alternatives. Assessment of state concerns will be completed after comments on the FS and proposed plan are received by EPA and addressed in the ROD. Thus, state acceptance is not considered in the detailed evaluation of alternatives presented in this FS.

6.9 Community Acceptance

Assessment of concerns from the public will be completed after comments on the FS and proposed plan are received by EPA and addressed in the ROD. Thus, community acceptance is not considered in the detailed evaluation of alternatives presented in this FS.

6.10 Criteria Priorities

The nine evaluation criteria are separated into three groups to establish priority among these criteria during detailed evaluation of the remedial alternatives as detailed in Exhibit 6-3.

Exhibit 6-3. Criteria Priorities

Group	Criteria	Definition
Threshold Criteria	Overall Protection of Human Health and the Environment Compliance with ARARs	Must be satisfied by the remedial alternative being considered as the preferred remedy
Balancing Criteria	Long-Term Effectiveness and Permanence Reduction of Toxicity, Mobility, or Volume through Treatment Short-Term Effectiveness Implementability Cost	Technical criteria evaluated among those alternatives satisfying the threshold criteria
Modifying Criteria	State Acceptance and Community Acceptance	Not evaluated in this FS; evaluated after comments received on the FS and PP

Section 7
Detailed Analysis of Retained Alternatives

7.1 Overview

This section presents the detailed analysis of the remedial alternatives retained in Section 5. During detailed analysis, each alternative is assessed using the two threshold criteria and five balancing criteria presented in Section 6. The results of the detailed analysis for each remedial alterative are then compared to identify the key tradeoffs between alternatives.

The following alternatives were retained for detailed analysis:

Alternative 1: No Further Action

Alternative 2: In-Place Capping of Contaminated Soils

Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities

Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository

Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

7.2 Secondary Assumptions Affecting Detailed Analysis of Remedial Alternatives

Section 5 presents the fundamental assumptions for all remedial alternatives used during alternative development and screening. In addition, there are numerous secondary assumptions that affect the detailed analysis of alternatives but are not fundamental controlling considerations and can vary between alternatives. Some of these secondary assumptions are grouped into distinct categories and include the items listed in Exhibit 7-1.

Exhibit 7-1. Secondary Assumptions Affecting Refinement and Detailed Analysis of Remedial Alternatives

Secondary Assumption Category	Secondary Assumption Description	Rationale
Land Use Control Assumptions	Land Use Controls for Alternatives 2, 3, 4, and 5 are Primarily Institutional Controls and Community Awareness Activities	Establishment of access control such as posted warnings may be difficult on residential properties that are occupied and are actively used. It is also uncertain whether legal authority exists to install access controls extensively on residential properties. However the legal authority exists to implement certain types of institutional controls (for instance informational devices) as well as community awareness activities. Thus, land use controls for residential and commercial properties are assumed to be primarily institutional controls and community awareness activities. Access controls may have limited use at the repository at the Mineral County Airport.
Capping (Cover) Assumptions	Type and Thickness of Covers For Capping	The type of cover is assumed for FS purposes is soil or rock covers since they are easily installed, borrow soil and rock resources should be available, and borrow soil and rock is relatively inexpensive compared to other types of cover materials such as geosynthetic materials or concrete/asphalt. The actual types of cover placed at a particular property would be addressed during remedial design. Thickness of the cover for in-place capping is assumed to be a minimum of 24 inches (18 inches of subsoil and 6 inches of topsoil for soil covers or 18 inches of structural fill and 6 inches of gravel) to prevent upward migration of contaminated soil and subsequent exposure through frost heave processes. A preliminary review of estimated frost depth in Mineral County is between 2 and 2.5 feet bgs, based on Figure 2-1 within Engineer Manual (EM) 1110-1-1905 “Bearing Capacity of Soils” published by the U.S. Army Corps of Engineers (USACE 1992). However the frost depths indicated within this figure are approximate and do not account for effects of types of soil, types of surface materials, or moisture content of soils on frost depth. For FS purposes it is assumed that the cover thickness assumptions are sufficient for protectiveness based on this preliminary determination of average frost depth. If necessary, the frost depth will be confirmed and the cover thickness assumptions will be revised during remedial design/remedial action.
	Permanent Soil Cover for the Existing Repository at the Mineral County Airport Under Alternative 2	An interim soil cover was placed over the existing repository at the Mineral County Airport during the removal actions conducted in 2010. The specific properties of the cover were not indicated in removal action reports. It is assumed the interim cover on the existing repository would require modification to ensure permanence for the in-place capping alternative (Alternative 2). A permanent soil cover would not be required for Alternatives 3, 4, and 5, since the existing repository at the airport would be excavated and disposed of at licensed solid waste facilities or the mine waste joint repository.

Exhibit 7-1. Secondary Assumptions Affecting Refinement and Detailed Analysis of Remedial Alternatives (continued)

Secondary Assumption Category	Secondary Assumption Description	Rationale
Excavation Assumptions	Assumed Depth of Excavation for Surface and Subsurface Contamination	Alternatives 3, 4, and 5 include excavation of contaminated soils. As identified in the RI, contamination above PRGs for lead, arsenic, and antimony extends to a depth of 12 inches bgs in some locations. The depth of excavation for Alternatives 3, 4, and 5 will be assumed to extend an additional 6 inches vertically (18 inches bgs) to meet PRGs for lead, arsenic, and antimony.
	Assumed Horizontal Extent of Excavation for Surface and Subsurface Contamination	Alternatives 3, 4, and 5 include excavation of contaminated soils. As identified in the RI, contamination above PRGs for lead, arsenic, and antimony extends horizontally within sectors around the main structure (usually a house) on residential properties. The horizontal extent of excavation for Alternatives 3, 4, and 5 will be assumed to extend to natural or manmade boundaries in that sector (e.g. hillsides, sidewalks, edges of driveways, property boundaries, etc.) to meet PRGs for lead, arsenic, and antimony.
	Excavation Near Onsite Structures and Large Trees	Excavation in some portions of OU1 may not be practicable, especially near the onsite residential and commercial structures due to stability issues and large trees due to potential damage to root systems. These areas or portions of the site are assumed to be excavated to a depth of 18 inches bgs to the extent practicable, backfilled with clean soil or covered with other barrier materials such as concrete.
Borrow Material Assumptions	Uncontaminated Rock, Structural Fill, Subsoil, and Topsoil Borrow from Offsite Locations	All alternatives except Alternative 1 would require the use of uncontaminated soil and rock for construction (soil cover and/or clean backfill material). Onsite materials within OU1 are not assumed to be suitable because most of the area within the OU1 boundary is developed and/or has the potential to be contaminated. Borrow soil could potentially be obtained from locations on either private or public property or commercial quarries. It is assumed that the offsite borrow areas would be located within 10 miles of OU1. It is assumed that the commercial gravel quarry would be located within 50 miles of OU1
	Organic Materials for Topsoil from Offsite Areas	All alternatives except Alternative 1 would require the use of some uncontaminated topsoil for construction of covers and reclamation of excavated borrow areas. It is assumed that topsoil would be manufactured from the clean borrow soil brought from offsite borrow locations using organic materials derived from composting facilities. It is assumed that organic materials could be obtained from Missoula.
Disposal Assumptions	Use of Licensed Solid Waste Disposal Facilities for Alternative 3	Alternative 3 assumes offsite disposal of contaminated soils at licensed disposal facilities authorized by DEQ for disposal of Group II solid waste. There are a number of licensed disposal facilities for Class II solid waste in the State of Montana. The closest facility is located approximately 60 miles from Superior in Missoula. It is assumed that the Missoula facility would have the capacity to accept all of the contaminated soils generated from Alternative 3.

Exhibit 7-1. Secondary Assumptions Affecting Refinement and Detailed Analysis of Remedial Alternatives (continued)

Secondary Assumption Category	Secondary Assumption Description	Rationale
Disposal Assumptions (continued)	Use of Mine Waste Joint Repository for Alternatives 4 and 5	Alternatives 4 and 5 assume the construction of the new mine waste joint repository (Wood Gulch Repository) under OU3 to consolidate and contain the excavated contaminated materials. The Wood Gulch Repository will be located approximately 3 miles north of Superior on Flat Creek Road. The design, construction, and O&M of the Wood Gulch Repository and related costs would be addressed as part of OU3. Alternatives 4 and 5 only include hauling of contaminated soils to the repository and placement (grading) of the soils within the repository.
	Stabilization/Solidification Treatment of Contaminated Soils for Alternative 5	Newly-excavated contaminated soils would be treated with a stabilization/solidification agent. Numerous chemical agents are available for stabilization/solidification of metal contaminated soils, but the use of Portland cement is assumed for FS purposes. It is assumed that the percentage by weight of cement for stabilization treatment is 7 percent, based on results from the 2002 TCRA's Bench Scale Stabilization Test (UOS 2002).
Treatment Assumptions	Wastes from the Existing Repository at the Mineral County Airport Would not Require Treatment for Alternative 5	Wastes currently located at the existing repository at the Mineral County Airport have previously been treated by stabilization/solidification. The excavated soils from the 2002 TCRA were treated with Portland cement prior to disposal and the excavated soils from the 2010 TCRA were treated with TSP prior to disposal. It is assumed that the treatment during the 2002 TCRA and 2010 TCRA were sufficient and no further treatment of these wastes would be required prior to disposal at the Wood Gulch Repository.
Miscellaneous Assumptions	Water-Based Dust Suppression	Dust suppression measures would be implemented under all alternatives except Alternative 1. Water is assumed to be used as the primary option for dust suppression to provide protection of human health and the environment.
	Alternatives Would Incorporate Relevant Elements of EPA Region 8's Green Remediation Policy Except Where Protectiveness is Affected	It is assumed that all alternatives would address relevant elements of EPA Region 8's Green Remediation policy (EPA 2009b) to the extent possible. Under the policy, use of the indicated elements and other green cleanup technologies are standard unless a site-specific evaluation demonstrates impracticability or favors an alternative green approach. Examples of the "Green Remediation" policy include: ■ Recovering landfill gas for energy production. ■ Installing solar panels on old landfills. ■ Using solar panels, wind turbines or small hydro plants to power on-site treatment systems. ■ Retrofitting diesel-powered construction equipment with particulate traps. ■ Using alternative fuels to power construction equipment.

Exhibit 7-1. Secondary Assumptions Affecting Refinement and Detailed Analysis of Remedial Alternatives (continued)

Secondary Assumption Category	Secondary Assumption Description	Rationale
Miscellaneous Assumptions (continued)	Alternatives Would Incorporate Relevant Elements of EPA Region 8's Green Remediation Policy Except Where Protectiveness is Affected (continued)	■ Purchasing construction materials that have environmentally friendly attributes such as: - Recycled content - Certified Wood - Rapidly renewable materials (wheatboard) ■ Reuse and recycle construction and demolition (C&D) materials. ■ Use of non-potable water for dust suppression. ■ Use concrete made with coal combustion products (CCPs), such as fly ash, to replace a portion of traditional Portland cement. The Clean & Green Policy does not fundamentally change how and why cleanup decisions are made, but calls for more sustainable methods of implementing those cleanups. Some of these elements may not be relevant to the alternatives considered for the site (for instance, there is no anticipated collection of landfill gasses). The policy also does not preclude remedy components that are required to ensure protectiveness. The use of Clean & Green practices will be considered during implementation of a selected remedy at the site.

Note: The list of secondary assumptions provided is a summary and is not all-inclusive; additional secondary assumptions are contained in Appendices B and F.

7.3 Alternative 1: No Further Action

7.3.1 Detailed Remedy Component Descriptions

Alternative 1 is required by the NCP to provide an environmental baseline against which impacts of the various remedial alternatives can be compared. A summary of the remedial components of Alternative 1 is provided in Section 5.3.1. The following text provides additional detail about the remedial components of this alternative.

Alternative 1 would leave removal action activities previously performed in their current conditions. No new remedial action activities would be initiated at the site to address contaminated materials or otherwise mitigate the associated risks to human health and the environment.

The only actions that would be implemented for Alternative 1 are completion of 5-year site reviews as required by the NCP and monitoring (specifically non-intrusive visual inspections) only as required to support conclusions made in the 5-year site reviews.

7.3.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative 1 is provided in Table E-1 using the evaluation criteria along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 1 is "none." ⓿

7.3.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative 1 is provided in Table E-2 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative 1 is “none.” ⓿

7.3.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative 1 is provided in Table E-3 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 1 is “none.” ⓿

7.3.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative 1 is provided in Table E-4 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 1 is “none.” ⓿

7.3.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative 1 is provided in Table E-5 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 1 is “none.” ⓿

7.3.7 Implementability

Evaluation of implementability for Alternative 1 is provided in Table E-6 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 1 is “none.” ⓿

7.3.8 Cost

Evaluation of cost for Alternative 1 is provided in Table E-7 using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The overall rating on this criterion for Alternative 1 is “low.” $

7.4 Alternative 2: In-Place Capping of Contaminated Soils

7.4.1 Detailed Remedy Component Descriptions

A summary of the remedial components of Alternative 2 is provided in Section 5.3.2. The location of properties targeted for remediation and the location of the repository located at the Mineral County Airport are illustrated on Figure 7-2. The following text provides additional detail about the remedial components of this alternative.

Covers

Alternative 2 would cap all contaminated soils both on residential and commercial properties using covers. This alternative would also include construction of a permanent cover over the existing waste repository at the Mineral County Airport to ensure the interim cover installed in 2010 is protective. This alternative assumes placement of 24 inches of clean cover material over contaminated soils at residential and commercial properties to serve as a permanent cover at those properties. Additionally, the repository at the airport would receive an earthen cap to ensure protectiveness at the repository.

Land Use Controls

Land use controls would consist of a combination of institutional controls (legal and administrative controls), access controls (physical controls such as posted warnings), and community awareness activities (informational and educational programs) to restrict access and use of contaminated areas and provide awareness of risks from exposure to contaminated soils. The types of land use controls would be tailored for each property, with the type and extent of contaminated soils and type of ownership in mind to provide protection of human health and maintain the integrity of the remedy put in place (covers and posted warnings) to the extent possible.

Institutional controls would consist of a combination of governmental controls, proprietary controls, and/or informational devices that would be selected on a property by property basis depending on the ownership status and the degree of contamination present on the property. "Layering" of institutional controls may be required to enhance the overall protectiveness of institutional controls. Issuance and periodic review and update of a comprehensive institutional control plan likely would be required to keep track of the various institutional control measures taken for each property.

Access controls (specifically posted warnings) would be implemented primarily at the current waste repository located at the Mineral County Airport. Access controls could also be used for specific areas of contamination on any property in consultation with the property owner. Long-term O&M would be required to maintain access controls damaged by weather or vandalism.

Community awareness activities include informational and educational programs to inform the public about site risks and the activities being performed to reduce these risks. Dissemination of this information could use electronic communication (e-mails and web site updates), printed communication (flyers, facts sheets, newspaper articles, or signs), and/or personal communication (public meetings or personal visits). Community awareness activities would be put in place throughout the remedial process, especially during implementation of remedial action and subsequent 5-year site reviews.

Monitoring

Monitoring would be performed during the construction of the remedial action remedy components (covers and access controls) and routinely after the remedy is in place to determine whether there is adequate protection of human health and the environment.

Monitoring during construction of the remedy components would consist of borrow source testing. Borrow samples would be collected from potential soil borrow areas and analyzed for COPCs (lead, arsenic, and antimony at a minimum). Results of the sample analysis would be used to determine that contamination is not present in proposed offsite borrow area materials before use in construction.

Routine monitoring would be performed for all properties with covers. Monitoring protocol for covered portions of properties would include routine non-intrusive visual inspections (i.e., surface inspections) to ensure integrity of the covers; these are assumed to be performed at least annually.

Five-year site reviews would be performed as required by the NCP since contaminated soils would remain at OU1 with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses. Non-intrusive visual inspections (i.e., surface inspections) would be performed in support of 5-year site reviews. Monitoring would be performed on all properties with covers within OU1.

Remedial Component Quantity Summary

Exhibit 7-2 provides a summary of the major remedial components for Alternative 2 requiring construction and the estimated quantities for these components.

Exhibit 7-2. Summary of Major Remedial Components and Associated Quantities for Alternative 2

Remedial Component	Unit	Estimated Quantity
Surface Area of Covers	Acres	6.2
Common Backfill Required to Construct Covers	Loose Cubic Yards	16,872
Topsoil Required to Construct Covers	Loose Cubic Yards	4,438
Gravel Wearing Course Required to Construct Covers	Loose Cubic Yards	1,207
Residential Properties Potentially Requiring Land Use Controls	Each	35
Non-Residential Properties Potentially Requiring Land Use Controls	Each	17

Note: Quantities summarized in this exhibit are contained in Appendices B and F. Although quantities provided are detailed, they should be considered approximate for FS evaluation purposes only.

7.4.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative 2 is provided in Table E-8 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 2 is “moderate.” ❸

7.4.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative 2 is provided in Table E-9 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative 2 is “moderate to high.” ❹

7.4.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative 2 is provided in Table E-10 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 2 is “moderate.” ❸

7.4.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative 2 is provided in Table E-11 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 2 is “none.” ⓿

7.4.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative 2 is provided in Table E-12 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 2 is “moderate to high.” ❹

7.4.7 Implementability

Evaluation of implementability for Alternative 2 is provided in Table E-13 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 2 is “moderate.” ❸

7.4.8 Cost

Evaluation of cost for Alternative 2 is provided in Table E-14 using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The overall rating on this criterion for Alternative 2 (present value cost) is “moderate.” $$$

7.5 Alternative 3: Excavation and Disposal of Contaminated Soils at Licensed Solid Waste Facilities

7.5.1 Detailed Remedy Component Descriptions

A summary of the remedial components of Alternative 3 is provided in Section 5.3.3. The location of properties targeted for remediation and the location of the repository located at the Mineral County Airport are illustrated on Figure 7-2. The following text provides additional detail about the remedial components of this alternative.

Excavation of Contaminated Soils

All contaminated soils on residential and commercial properties would be excavated. For purposes of the FS, contaminated soils would be fully excavated to a depth of 18 inches bgs. Confirmation that soils remaining within excavations are below PRGs for lead, arsenic, and antimony would be determined using visual inspections for mine waste coupled with sample collection and analysis. Additionally, the repository at the Mineral County Airport would be completely excavated. Trucks or other mechanical conveyance would be used to transport excavated contaminated soils to the licensed solid waste disposal facilities.

Health and safety precautions, dust suppression, use of personal protective equipment (PPE), and monitoring, would be performed during excavation of contaminated soils to reduce risks to workers. Either water- or chemical-based dust suppression would be used during excavation to prevent inhalation exposure risks from airborne contaminants.

Excavation of contaminated surface materials would be conducted to the extent practicable. However, it may not be possible to fully excavate contaminated soils underneath or adjacent to structures or obstructions such as homes or structures, trees, subsurface utilities, and roads. Thus residual contaminated soils may be left in place underlying or adjacent to these structures or obstructions. For purposes of this FS, a thin profile of clean soil backfill or another barrier material placed in excavations coupled with land use controls are assumed to address these situations on a property by property basis.

Offsite Disposal at Licensed Facilities

Excavated contaminated soils would be transported offsite for disposal. It is assumed for purposes of this FS that contaminants in soils are exempt from regulation under RCRA as hazardous waste because they are derived from mineral processing. However it is assumed that contaminated soils would be classified under State of Montana regulations as Group II solid wastes and would require disposal in a Class II facility. The closest Class II facility to the site is approximately 60 miles away and the next closest is approximately 170 miles away. The location of the nearest Class II facility is shown in Figure 7-3. Generally, Bevill exempt mining waste will be accepted at these two facilities without prior treatment. However, final acceptance of the contaminated soils is determined by the individual facilities and therefore some of the soils may require treatment prior to disposal. It is assumed for the purpose of this FS that contaminated soil under this alternative would not require treatment prior to disposal.

Excavation Backfill

Excavations would be backfilled to existing grade under this alternative. Clean soil is assumed to be transported from offsite borrow areas tested for contamination. The backfill would be covered with topsoil and revegetated, or otherwise restored to match the surface conditions that previously existed, such as structural fill and gravel for a driveway.

Land Use Controls

Land use controls would consist of a combination of institutional controls (legal and administrative controls) and community awareness activities (informational and educational programs) to restrict use of contaminated areas and provide awareness of risks from exposure to contaminated soils. The types of land use controls would be tailored for each property, with the type and extent of contaminated soils and type of ownership in mind to provide protection of human health to the extent possible.

Institutional controls would consist of a combination of governmental controls, proprietary controls, and/or informational devices that would be selected on a property by property basis depending on the ownership status and the degree of contamination present on the property. "Layering" of institutional controls may be required to enhance the overall protectiveness of institutional controls. Issuance and periodic review and update of a comprehensive institutional control plan likely would be required to keep track of the various institutional control measures taken for each property.

Community awareness activities include informational and educational programs to inform the public about site risks and the activities being performed to reduce these risks. Dissemination of this information could use electronic communication (e-mails and web site updates), printed communication (flyers, facts sheets, newspaper articles, or signs), and/or personal communication (public meetings or personal visits). Community awareness activities would be put in place throughout the remedial process, especially during implementation of remedial action and subsequent 5-year site reviews.

Monitoring

Monitoring during construction of the remedy components would consist of borrow source testing. Borrow samples would be collected from potential soil borrow areas and analyzed for COPCs (lead, arsenic, and antimony at a minimum). Results of the sample analysis would be used to determine that contamination is not present in proposed offsite borrow area materials before use in construction.

Five-year site reviews would be performed as required by the NCP since contaminated soils would remain at OU1 with contaminant concentrations above PRGs that do not allow for unlimited use and unrestricted exposure under the current and potential future land uses. Non-intrusive visual inspections (i.e., surface inspections) would be performed in support of 5-year site reviews. Monitoring would be performed on all properties with contamination above PRGs left in place within OU1.

Remedial Component Quantity Summary

Exhibit 7-3 provides a summary of the major remedial components for Alternative 3 requiring construction and the estimated quantities for these components.

Exhibit 7-3. Summary of Major Remedial Components and Associated Quantities for Alternative 3

Remedial Component	Unit	Estimated Quantity
Surface Area of Excavations	**Acres**	6.2
Volume of Contaminated Soils Excavated	**Loose Cubic Yards**	29,904
Estimated Weight of Contaminated Soils for Offsite Disposal	**Tons**	34,202
One-Way Distance to Nearest Offsite Disposal Facility	**Miles**	60
Common Backfill Required for Excavations	**Loose Cubic Yards**	11,257
Topsoil Required for Excavations	**Loose Cubic Yards**	4,438
Gravel Wearing Course Required for Excavations	**Loose Cubic Yards**	1,207
Residential Properties Remediated	**Each**	35
Non-Residential Properties Remediated	**Each**	17

Note: Quantities summarized in this exhibit are contained in Appendices B and F. Although the quantities provided are detailed, they should be considered approximate for FS evaluation purposes only.

7.5.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative 3 is provided in Table E-15 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 3 is “moderate to high”. ❹

7.5.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative 3 is provided in Table E-16 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative 3 is “high.” ❺

7.5.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative 3 is provided in Table E-17 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 3 is “moderate to high.” ❹

7.5.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative 3 is provided in Table E-18 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 3 is "none." ⓿

7.5.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative 3 is provided in Table E-19 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 3 is "moderate." ❸

7.5.7 Implementability

Evaluation of implementability for Alternative 3 is provided in Table E-20 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 3 is "moderate." ❸

7.5.8 Cost

Evaluation of cost for Alternative 3 is provided in Table E-21 using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The overall rating on this criterion for Alternative 3 (present value cost) is "moderate to high." $$$$

7.6 Alternative 4: Excavation and Disposal of Contaminated Soils at the Mine Waste Joint Repository

7.6.1 Detailed Remedy Component Descriptions

A summary of the remedial components of Alternative 4 is provided in Section 5.3.4. The location of properties targeted for remediation, the location of the repository located at the Mineral County Airport, and the location of the Wood Gulch Repository are illustrated on Figure 7-2. The following text provides additional detail about the remedial components of this alternative.

Excavation of Contaminated Soils

Excavation of contaminated soils for disposal would be performed as described in Section 7.5.1.

Onsite Consolidation/Disposal

The excavated contaminated soils would be disposed of at the Wood Gulch Repository, located 3 miles north of Superior on Flat Creek Road within State of Montana–DNRC managed lands. Health and safety precautions, dust suppression, use of PPE, and monitoring, would be used during placement of contaminated soils at the Wood Gulch Repository to reduce risks to workers. The Wood Gulch Repository will be constructed, operated, and maintained under OU3. The location of the Wood Gulch Repository is shown on Figure 7-2.

Excavation Backfill

Excavation backfill would be performed as described in Section 7.5.1.

Land Use Controls

Land use controls would be performed as described in Section 7.5.1.

Monitoring

Monitoring would be performed as described in Section 7.5.1.

Remedial Component Quantity Summary

Exhibit 7-4 provides a summary of the major remedial components for Alternative 4 requiring construction and the estimated quantities for these components.

Exhibit 7-4. Summary of Major Remedial Components and Associated Quantities for Alternative 4

Remedial Component	Unit	Estimated Quantity
Surface Area of Excavations	**Acres**	6.2
Volume of Contaminated Soils Excavated	**Loose Cubic Yards**	29,904
Common Backfill Required for Excavations	**Loose Cubic Yards**	11,257
Topsoil Required for Excavations	**Loose Cubic Yards**	4,438
Gravel Wearing Course Required for Excavations	**Loose Cubic Yards**	1,207
Residential Properties Remediated	**Each**	35
Non-Residential Properties Remediated	**Each**	17

Note: Quantities summarized in this exhibit are contained in Appendices B and F. Although quantities provided are detailed, they should be considered approximate for FS evaluation purposes only.

7.6.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative 4 is provided in Table E-22 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 4 is “moderate to high.” ❹

7.6.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative 4 is provided in Table E-23 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative 4 is “high.” ❺

7.6.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative 4 is provided in Table E-24 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 4 is “moderate to high.” ❹

7.6.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative 4 is provided in Table E-25 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 4 is “none.” ⓿

7.6.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative 4 is provided in Table E-26 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 4 is “moderate to high.” ❹

7.6.7 Implementability

Evaluation of implementability for Alternative 4 is provided in Table E-27 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 4 is “moderate.” ❹

7.6.8 Cost

Evaluation of cost for Alternative 4 is provided in Table E-28 using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The overall rating on this criterion for Alternative 4 (present value cost) is “moderate.” $$$

7.7 Alternative 5: Excavation of Contaminated Soils, Treatment, and Disposal of Treated Soils at the Mine Waste Joint Repository

7.7.1 Detailed Remedy Component Descriptions

A summary of the remedial components of Alternative 5 is provided in Section 5.3.5. The location of properties targeted for remediation, the location of the repository located at the Mineral County Airport, and the location of the Wood Gulch Repository are illustrated on Figure 7-2. The following text provides additional detail about the remedial components of this alternative.

Excavation of Contaminated Soils

Excavation of contaminated soils for disposal would be performed as described in Section 7.5.1.

Treatment/Disposal

The excavated contaminated soils would be transported to the Wood Gulch Repository, located 3 miles north of Superior on Flat Creek Road within DNRC managed lands. Prior to disposal the contaminated soils would be treated with a stabilization/solidification agent at a treatment staging area adjacent to the Wood Gulch Repository. Following treatment, the treated soils would be disposed of within the Wood Gulch Repository, similar to Alternative 4. Soils excavated from the repository at the Mineral County Airport have previously been treated using Portland cement or TSP, thus no further treatment is assumed to be required of these soils prior to final disposal.

Health and safety precautions, including establishment of a treatment staging area, dust suppression, use of PPE, and monitoring, would be used during treatment and placement of contaminated soils at the Wood Gulch Repository to reduce risks to workers. The Wood Gulch Repository will be constructed, operated, and maintained under OU3. The location of the Wood Gulch Repository is shown on Figure 7-2.

Excavation Backfill

Excavation backfill would be performed as described in Section 7.5.1.

Land Use Controls

Land use controls would be performed as described in Section 7.5.1.

Monitoring

Monitoring would be performed as described in Section 7.5.1.

Remedial Component Quantity Summary

Exhibit 7-5 provides a summary of the major remedial components for Alternative 5 requiring construction and the estimated quantities for these components.

Exhibit 7-5. Summary of Major Remedial Components and Associated Quantities for Alternative 5

Remedial Component	Unit	Estimated Quantity
Surface Area of Excavations	**Acres**	6.2
Volume of Contaminated Soils Excavated	**Loose Cubic Yards**	29,904
Volume of Stabilization/Solidification Agents Required	**Loose Cubic Yards**	952
Common Backfill Required for Excavations	**Loose Cubic Yards**	11,257
Topsoil Required for Excavations	**Loose Cubic Yards**	4,438
Gravel Wearing Course Required for Excavations	**Loose Cubic Yards**	1,207
Residential Properties Remediated	**Each**	35
Non-Residential Properties Remediated	**Each**	17

Note: Quantities summarized in this exhibit are contained in Appendices B and F. Although the quantities provided are detailed, they should be considered approximate for FS evaluation purposes only.

7.7.2 Overall Protection of Human Health and the Environment

Evaluation of overall protection of human health and the environment for Alternative 5 is provided in Table E-29 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 5 is "moderate to high". ❹

7.7.3 Compliance with ARARs

Evaluation of compliance with ARARs for Alternative 5 is provided in Table E-30 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. ARARs evaluated for this alternative are included in Appendix A. The overall rating on this criterion for Alternative 5 is "high." ❺

7.7.4 Long-Term Effectiveness and Permanence

Evaluation of long-term effectiveness and permanence for Alternative 5 is provided in Table E-31 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 5 is "high." ❺

7.7.5 Reduction of Toxicity, Mobility, or Volume through Treatment

Evaluation of reduction of toxicity, mobility, or volume through treatment for Alternative 5 is provided in Table E-32 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 5 is "moderate." ❸

7.7.6 Short-Term Effectiveness

Evaluation of short-term effectiveness for Alternative 5 is provided in Table E-33 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 5 is "moderate." ❸

7.7.7 Implementability

Evaluation of implementability for Alternative 5 is provided in Table E-34 using the evaluation criteria considerations along with the qualitative rating for each and the justification for the rating. The overall rating on this criterion for Alternative 5 is "moderate." ❸

7.7.8 Cost

Evaluation of cost for Alternative 5 is provided in Table E-35 using the evaluation criteria considerations along with the cost rating for each and the justification for the rating. Detailed cost estimates for this alternative are included in Appendix F. The overall rating on this criterion for Alternative 5 (present value cost) is "high." $$$$$

7.8 State (Support Agency) Acceptance

State (support agency) acceptance is a modifying criterion under the NCP. Assessment of state acceptance will not be completed until comments on the final FS report are submitted to EPA. Thus, state acceptance is not considered in the detailed analysis of alternatives presented in the FS.

7.9 Community Acceptance

Community acceptance is also a modifying criterion under the NCP. Assessment of community acceptance will include responses to questions that any interested person in the community may have regarding any component of the remedial alternatives presented in the proposed plan. This assessment will be completed after EPA receives public comments on the proposed plan during the public commenting period. Thus, community acceptance is not considered in the detailed analysis of alternatives presented in the FS.

7.10 Comparative Analysis of Alternatives

This FS evaluated the five retained remedial alternatives discussed in this section against the two threshold criteria and five balancing criteria. The results of the detailed analysis for each remedial alterative are presented in Table 7-1 to allow a comparative analysis of the alternatives and identify the key tradeoffs between them. Comparative analysis for the remedial alternatives using the threshold and balancing criteria has been put into narrative form in the following subsections. Only significant comparative differences between alternatives are presented; the full set of rationale for the qualitative ratings is provided in Appendix E.

It should be noted that the site is complex, with not only varying degrees of contamination from property to property but also various types of ownership, land uses, and levels of occupancy. It is possible that elements of several remedial alternatives will need to be compiled into a preferred remedy for the site to address all of the parcel-specific issues. This will be addressed in the proposed plan after issuance of this report.

7.10.1 Overall Protection of Human Health and the Environment

Of the six retained alternatives, only the no action alternative (i.e., Alternative 1) fails to provide protection for human health and the environment and did not address the PRAOs for contaminated materials. Thus, Alternative 1 was given a rating of “none.”

Alternative 2 addresses the PRAOs primarily through in-place capping of contaminated soils using covers to reduce risks from contact with these materials. Capping provides an exposure barrier to the contaminated soils. However contaminated soils still remain beneath covers across a large extent of the site and could pose risks if the covers are compromised. Thus this alternative was given a rating of “moderate.”

Alternative 3 addresses the PRAOs primarily through excavation of contaminated soils and offsite disposal at licensed solid waste disposal facilities. Since the majority of contaminated soils are excavated and disposed of offsite, overall protection of human health and the environment for this alternative was given a rating of "moderate to high."

Alternative 4 addresses the PRAOs primarily through excavation of contaminated soils and disposal at the nearby Wood Gulch Repository. Since the majority of contaminated soils are excavated and disposed of at the Wood Gulch Repository, overall protection of human health and the environment was given a rating of "moderate to high."

Alternative 5 addresses the PRAOs primarily through excavation and treatment of the contaminated soils and disposal at the nearby Wood Gulch Repository. Since the majority of contaminated soils are excavated and treated prior to disposal at the Wood Gulch Repository, overall protection of human health and the environment is more certain than alternatives that do not treat the newly-excavated contaminated soils prior to disposal. Thus this alternative was given a rating of "moderate to high."

7.10.2 Compliance with ARARs

Alternative 1 fails to be compliant with the chemical-specific ARARs identified for the site since no further action is taken. Thus, this alternative was given a rating of "none."

Alternatives 2, 3, 4, and 5 would address the location- and action-specific ARARs through adherence of the ARARs during implementation of the remedial action.

Under Alternative 2, contaminated soils still remain beneath covers across a large extent of OU1 and could pose risks if the covers are compromised. Thus compliance with chemical-specific ARARs is more questionable in the future than other alternatives. Thus this alternative was given a rating of "moderate to high"

Alternatives 3, 4, and 5 fully address the chemical-specific ARARs by removing the exposure pathways to contaminated materials through excavation and disposal. Thus these alternatives were all given a rating of "high."

7.10.3 Long-Term Effectiveness and Permanence

Alternative 1 fails to provide long-term effectiveness and permanence since no action is taken. Thus, this alternative was given a rating of "none."

Alternative 2 addresses contaminated soils primarily through in-place capping using covers to reduce risks from contact with these soils. Capping provides an exposure barrier to the contaminated soils. However, contaminated soils still remain beneath covers across a large extent of OU1 and could pose risks if the covers are compromised. Thus, long-term effectiveness and permanence is not as certain as for remedies that excavate contaminated soils for disposal. Thus, this alternative was given a rating of "moderate."

Alternatives 3 and 4 address contaminated soils through excavation and disposal, at offsite licensed disposal facilities or at the nearby Wood Gulch Repository. Excavation and disposal outside of OU1 increases the long-term effectiveness and permanence of the remedy for locations where excavation of contaminated soil takes place. Although contaminated soil may be left in place under or adjacent to structures or obstructions at a limited number of properties, exposure to these contaminated soils would be addressed through a combination of land use controls. Thus, these alternatives were both given a rating of "moderate to high."

Alternative 5 addresses contaminated soils primarily through excavation and disposal at the nearby Wood Gulch Repository. Additionally, contaminated soils would be treated with chemical agents such as TSP, Portland cement, or other stabilization agents. Although contaminated soil may be left in place under or adjacent to structures or obstructions at a limited number of properties, exposure to these contaminated soils would be addressed through a combination of land use controls. Excavation and disposal of contaminated soils along with additional treatment of newly-excavated soils increases the long-term effectiveness and permanence of the remedy compared to remedies without additional treatment due to the added protection from leaching of contaminants to surrounding soils and groundwater. Thus, this alternative was given a rating of "high."

7.10.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives 1, 2, 3, and 4 fail to provide a reduction of toxicity, mobility, or volume through treatment since additional treatment of contaminated soils is not a component of these alternatives. Thus, all of the retained alternatives were given a rating of "none."

Under Alternative 5, contaminated soils would by treated by solidification/stabilization prior to disposal of the soils in the Wood Gulch Repository. Treatment would provide additional protection to surrounding soils and groundwater from contaminated soils that contain concentrations of lead, arsenic, and antimony that are potentially leachable. Thus, this alternative was given a rating of "moderate."

7.10.5 Short-Term Effectiveness

Alternative 1 fails to provide short-term effectiveness since no action is taken. Thus, this alternative was given a rating of "none".

Alternative 2 addresses short-term risks to workers, the community, and the environment. Land use controls could be quickly implemented to address potential exposure to contaminated soils. Construction of covers could be implemented shortly after the implementation of land use controls to protect the community and the environment. While construction of covers would involve surface disturbance of contaminated soils, short-term risks to workers would be mitigated through the use of safety measures such as PPE. Short-term risks to workers, the community, and the environment could be mitigated through measures such as water-based dust suppression. Trucks used to haul offsite borrow used to construct the covers slightly increase short-term risks to the community. Transport and placement of borrow has potential environmental impacts from equipment emissions and disturbance of borrow locations. Thus Alternative 2 was given a rating of "high."

Excavation and offsite disposal under Alternative 3 requires disturbance of a large amount of contaminated soils across the site and a longer duration of construction, which poses increased short-term risks to workers and the community than the predominately surface disturbance activities under Alternative 2. Land use controls could be implemented shortly after construction to protect the community and the environment from contaminated soils left in place at a limited number of properties. Hauling of contaminated soils for offsite disposal at licensed solid waste facilities as well as transport of borrow materials for backfilling excavations increases truck traffic and related risks workers and to the community as compared to Alternative 2.Excavation and transport of contaminated soils longer distances to the offsite disposal facilities as well as transport and placement of borrow has potential environmental impacts from equipment emissions and disturbance of borrow locations. Thus, this alternative was given a rating of "moderate."

Excavation and disposal of contaminated soils at the Wood Gulch Repository and excavation backfilling under Alternative 4 poses similar short-term risks to workers and the community as Alternative 3. However most of the truck traffic would occur within or near OU1 due to the use of the Wood Gulch Repository. Thus, this alternative was given a rating of "moderate to high."

Alternative 5 is similar to Alternative 4, except that there is an additional step of treating newly-excavated contaminated soils by stabilization. This step involves additional contact with the by workers to contaminated soils during treatment as well as additional truck traffic to deliver the stabilization agent. Thus this alternative was given a rating of "moderate".

7.10.6 Implementability

Alternative 1 has no action taken other than 5-year site reviews. Since no new remedial action is taken, this alternative was given a rating of "none."

Alternative 2 involves in-place capping of contaminated soils through construction of covers. The construction resources and materials needed to construct the quantity of covers for this alternative should be available, but borrow materials would require transportation to the properties requiring covers. There may be difficulties transitioning covers into existing grades on properties that are relatively level while still facilitating residential uses. There may be additional difficulties associated with implementation of institutional controls. Access controls would be relatively easy to install. Maintenance of the covered areas and monitoring, especially on residential properties, could provide difficulties in the future. Thus, this alternative was given a rating of "moderate."

Alternative 3 involves excavation of contaminated soils and offsite disposal at licensed solid waste facilities. Excavation of contaminated soils could be difficult in areas of underground utilities, trees, roads, and near structures. There may be additional difficulties associated with implementation of institutional controls, although they would only be needed on a limited number of properties where contaminated soils would be left in place under or adjacent to structures or obstructions. Monitoring, especially on residential properties, could provide difficulties in the future but would only be implemented on a limited number of properties with contaminated soil left in place. The construction resources and materials needed to backfill excavations for this alternative should be available, but borrow materials would require transportation to the properties requiring backfill. Logistical coordination is needed since both contaminated soils and offsite borrow would be transported simultaneously. Offsite disposal of large volumes of contaminated soils requires coordination with trucks transporting backfill to excavation areas as well as additional coordination with the offsite disposal facilities. The ability to obtain the necessary approvals and the logistics of transporting and disposing of large volumes of contaminated soils for long distances to offsite disposal facilities decreases the implementability of this alternative. Thus, this alternative was given a rating of "moderate."

Alternative 4 involves excavation of contaminated soils and disposal at the Wood Gulch Repository. Excavation of contaminated soils could be difficult in areas of underground utilities, trees, roads, and near structures. There may be additional difficulties associated with implementation of institutional controls, although they would only be needed on a limited number of properties where contaminated soils would be left in place under or adjacent to structures or obstructions. Monitoring, especially on residential properties, could provide difficulties in the future but would only be implemented on a limited number of properties with contaminated soil left in place. The construction resources and materials needed to backfill excavations for this alternative should be available, but borrow materials would require transportation to the properties requiring backfill. Logistical coordination would be required since both contaminated soils and offsite borrow would be transported simultaneously. The disposal of contaminated soils at the Wood Gulch Repository should be relatively easy to coordinate since the repository will be managed under OU3. Thus this alternative was given a rating of "moderate to high."

Alternative 5 is similar to Alternative 4, but includes treatment of contaminated soils using stabilization which requires additional coordination for delivery of stabilization agents as well as implementation of the treatment process before disposal at the Wood Gulch Repository. Thus this alternative was given a rating of "moderate".

7.10.7 Cost

Present value costs for all alternatives were evaluated over a 50-year period (Years 0 through 49).

The present value cost for Alternative 1 was given a rating of "low." The present value cost for this alternative is approximately $123,000.

The present value cost for Alternative 2 and 4 were given a rating of "low to moderate." The present value cost for these alternatives are approximately $1,292,000 and $1,496,000, respectively.

The present value cost for Alternatives 5 was given a rating of "moderate." The present value costs for this alternative is approximately $2,174,000.

The present value cost for Alternative 3 was given a rating of "moderate to high." The present value costs for this alternative is approximately $2,811,000.

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Section 8
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