United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R06-93/078
September 1993

EPA

Superfund
Record of Decision:

Cleveland Mill, NM

50272-101

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15. Supplementary Notes

PB94-964209

16. Abstract (Limit: 200 words)

The 18-acre Cleveland Mill site is an inactive mill and mining site located near Silver City, Grant County, New Mexico. The site includes material discarded during mining and ore processing operations, a water storage reservoir, access roads, building foundations (including the mill foundation), the mine portal, and portions of streambed of the mill valley tributary and the Little Walnut Creek itself; and borders Gila National Forest and private lands. Land use in the area is predominantly recreational, with some agricultural and residential uses. The Continental Divide runs east and west between the mine to the north and the mill to the south, and is situated at the headwaters of the mill valley tributary. The estimated 1,200 people who reside within a three-mile radius of the site rely on private wells for potable water and agricultural uses. Beginning in the 1900s, the Cleveland Mill site was used for the mining of gold, silver, zinc, and lead. In 1913, the Empire Zinc Company built the Cleveland Mill to process ore. The mill originally consisted of a gravity separator, which in 1916, was replaced by a flotation process. Between 1913 and 1919, records indicated that 121,507 tons of lead, zinc, and copper ore were taken from the mine and processed at the mill. Contamination at the site has resulted from 34 years of intermittent stockpiling of mill tailings and mine waste. Materials in the mill area include two main tailings

(See Attached Page)

17. Document Analysis a. Descriptors

Record of Decision - Cleveland Mill, NM
First Remedial Action - Final
Contaminated Media: soil, sediment, debris, gw, sw
Key Contaminants: metals (arsenic, lead)

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) None	21. No. of Pages 146
	20. Security Class (This Page) None	22. Price

(See ANSI-Z39.18) *See Instructions on Reverse* OPTIONAL FORM 272 (4-77) (Formerly NTIS-35) Department of Commerce

Abstract (Continued)

piles, a cobbed ore pile, western hillside waste piles, dust piles, and roadbed soil. Other contaminated areas include the mine spoils located in a small drainage adjacent to the Cleveland Mine portal, and tailings sediment located within the streambed of the mill valley tributary and the Little Walnut Creek. In 1919, the company ceased mining operations for unknown reasons. In 1941, Douglas White leased the Cleveland Group of Mines and operated a small dual-cell flotation lead-zinc recovery mill to reprocess onsite tailings until 1950. The Mining Remedial Recovery Company (MRRC) is the current property owner after numerous changes in ownership between 1950 and 1989. Citizen complaints led to State investigations in 1985 and 1986, and an EPA investigation in 1988, which indicated that the site posed a significant risk to human health and the environment. This final source control ROD addresses the surficial contaminated areas, the ground water, and surface water at the Cleveland Mill site, as OU1. The primary contaminants of concern affecting the soil, sediment, debris, ground water, and surface water are metals, including arsenic and lead.

The selected remedial action for this site includes excavating and transporting approximately 70,900 yd^3 of contaminated tailings and sediment offsite, including those contaminated tailings and sediment found in the roadbed, the mill area, the mine spoils area, the streambed of the mill valley tributary to Little Walnut Creek, and the streambed of Little Walnut Creek; treating the contaminated tailings and sediment offsite at a reprocessing facility using froth flotation, acid heap leaching, or other effective reprocessing technology; disposing of and treating the residuals offsite at the reprocessing facility; monitoring the air to ensure that airborne particulates or other air emissions from the removal of site materials or transportation of these materials do not pose a risk to the workers or inhabitants of the area; monitoring ground water and surface water; installing and monitoring additional wells, and sampling the springs in the mill area; revegetating disturbed areas; implementing ground water contingency measures after 5 years, if the selected remedy cannot meet the specified remedial action goals at any or all of the monitoring points; and implementing institutional and engineering controls, including deed, land, and ground water use restrictions. The estimated present worth cost for this remedial action is $6,214,036, which includes an estimated annual O&M cost of $51,250.

PERFORMANCE STANDARDS OR GOALS:

Soil and sediment cleanup goals are based on a health-risk level of 10^{-6} or background risk, and include arsenic 30 mg/kg; beryllium 4 mg/kg; cadmium 140 mg/kg; lead 500 mg/kg; and zinc 82,000 mg/kg.

RECORD OF DECISION

CLEVELAND MILL SUPERFUND SITE
SILVER CITY, NEW MEXICO

FINAL SOURCE ACTION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SEPTEMBER 1993

RECORD OF DECISION
CONCURRENCE DOCUMENTATION
FOR THE
CLEVELAND MILL SUPERFUND SITE
FINAL SOURCE ACTION

SEPTEMBER 1993

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DECLARATION
CLEVELAND MILL SUPERFUND SITE
RECORD OF DECISION

Statutory Preference for Treatment as a Principal Element is Met and Five-Year Review is Required

SITE NAME AND LOCATION

Cleveland Mill Superfund Site
Grant County, New Mexico

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Cleveland Mill Superfund Site (hereinafter, the "Site"), in Grant County, New Mexico, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by the Superfund Amendments and Reauthorization Act (SARA), ("CERCLA"), 42 U.S.C. §9601 et seq., and to the extent practicable, the National Contingency Plan 40 CFR Part 300. This decision is based on the Administrative Record for the Site.

The State of New Mexico concurs on the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision ("ROD"), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

The Site is being handled as one operable unit, in which all the surficial contaminated areas (soils, main tailings piles, the western hillside waste piles, the cobbed ore pile, dust piles, roadbed soils, mine spoils, and creek sediment), and the contaminated ground water and surface water are being addressed.

The major components of the selected remedy include:

- Institutional Controls: land use restrictions, access restrictions, posting of signs, and deed restrictions on the extraction and use of ground water in the mill area;

- On-site ground water monitoring of existing and new wells (including installation of additional monitoring wells in the mill area) to determine whether over time, conditions improve, remain constant, or worsen;

- Excavation of soils, including, but not limited to, tailings and sediment that are contaminated above Remedial Action Goals.

- Off-site treatment of the contaminated soils, including, but not limited to, tailings and sediment through reprocessing and reclamation of beneficial metals.

- Disposal of the treatment residuals at the off-site reprocessor.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. Contaminated soils, including, but not limited to, tailings and sediment are considered to be principal threats at the Site. This remedy satisfies the statutory preference for treatment that reduces toxicity, mobility or volume, as a principal element of the remedy. The selected remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the Site.

Because the ground water and surface water portions of the remedy may result in hazardous substances remaining in contaminated media on-site, above health-based levels, a review of the selected remedy will be conducted within five years after commencement of the remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

[signature]

Joe D. Winkle
Acting Regional Administrator

9-22-93
Date

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THE DECISION SUMMARY

I. SITE NAME, LOCATION AND DESCRIPTION

The Cleveland Mill Superfund Site (the "Site") is located in southwestern New Mexico, approximately 5.5 miles north of Silver City in Grant County, New Mexico as shown on Figure 1. The Site is situated within the Northeast quarter of Section 2, Township 17 South, Range 14 West at the headwaters of a small tributary of Little Walnut Creek. The Continental Divide runs east and west between the mine to the north and the mill to the south. The Site includes material discarded during mining and ore processing operations, a water storage reservoir, access roads and other roads which traverse the Site, building foundations (including the mill foundation), the mine portal, and the surrounding areas consisting of about 4 acres. The Site also encompasses about 14 acres in and along the streambed of both a small tributary to Little Walnut Creek, the "mill valley tributary", and Little Walnut Creek itself.

Natural slopes surrounding the mill area are steep; however, the slopes become more gentle to the west and proceeding down the Little Walnut Creek drainage toward Picnic Creek. The elevation, at the top of the Site, is approximately 7,200 feet above mean sea level (msl). The elevation at the confluence of Little Walnut Creek and Silva Creek (Figure 1), is approximately 5,500 feet above msl.

The Cleveland Mill and Mine are situated in a sparsely populated area adjacent to the Gila National Forest and private lands. Land use in the areas adjacent to the Site is primarily recreational with some small scale agriculture and livestock grazing. The reservoir located on the Site, adjacent to the mill area, has been used for swimming and fishing by local residents. Downstream residences are concentrated along Little Walnut Creek. The population within a three mile radius of the Site is estimated at 1,200 people, almost all of which rely on private wells for potable water and agricultural uses. The nearest residence, located approximately 3,200 feet south-southwest of the tailings piles, does not have a well and imports water for domestic use. The nearest domestic well is located approximately 4,600 feet south-southwest of the tailings piles.

The Site is contaminated with hazardous substances. The contamination at the Site is a result of at least 34 years of intermittent stockpiling of mill tailings and mine wastes from operations at the now abandoned Cleveland Mill and nearby Cleveland Mine. Contaminated wastes in the mill area on the Site (Figure 2) include two main tailings piles (east and west), a cobbed ore pile (unprocessed, low grade ore), western hillside waste piles, dust piles, and roadbed soils. Other contaminated

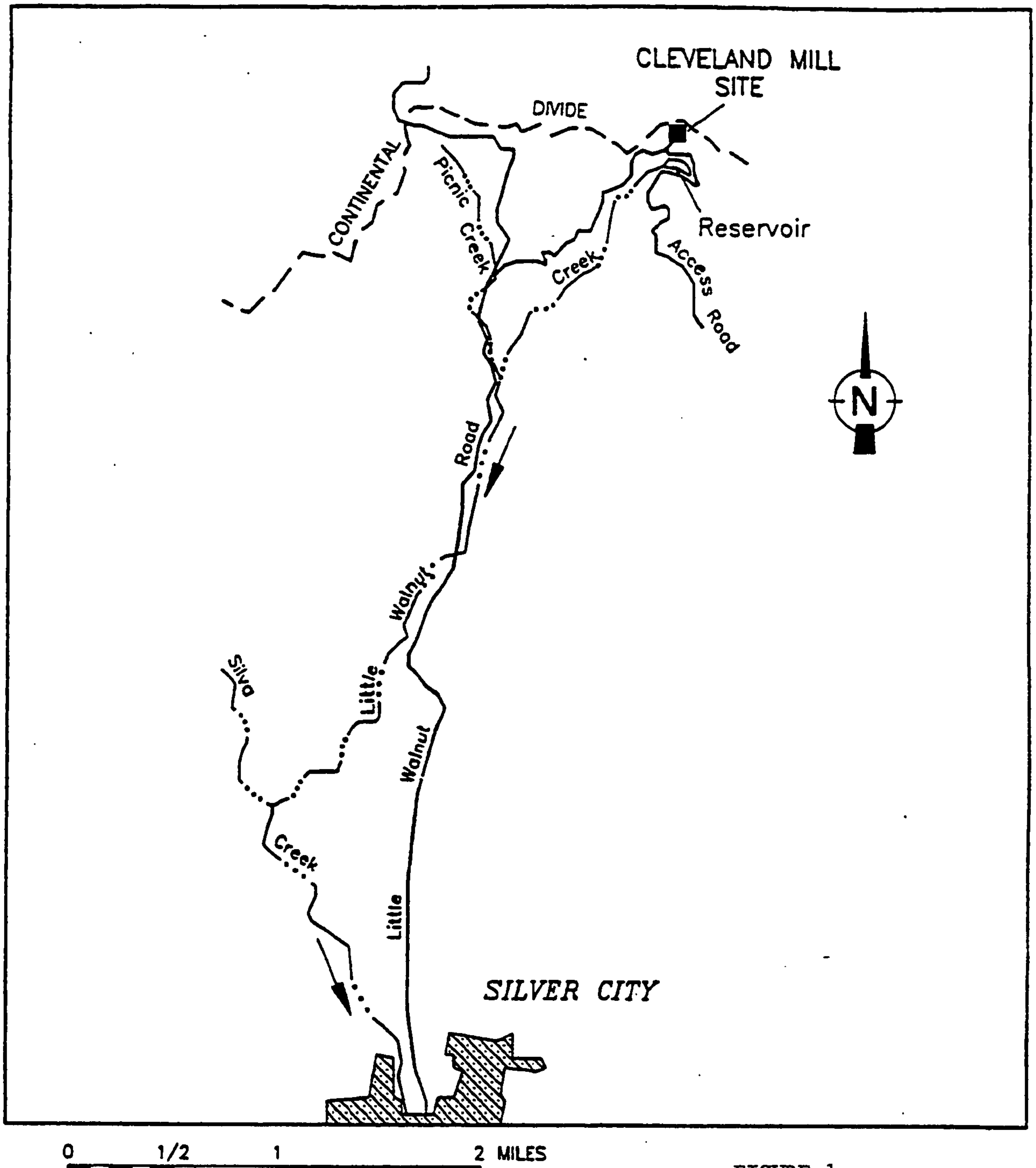
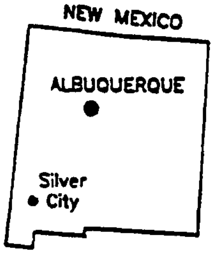


FIGURE 1

LOCATION MAP



LEGEND

■ Site location

CLEVELAND MILL SUPERFUND SITE Grant County, New Mexico	
TITLE: SITE LOCATION MAP Project No. EN3017	
ecology & environment, inc. ALBUQUERQUE, NEW MEXICO	FIG. 1-1
Date: 10/92 Drawn by: RSM Scale: ______	

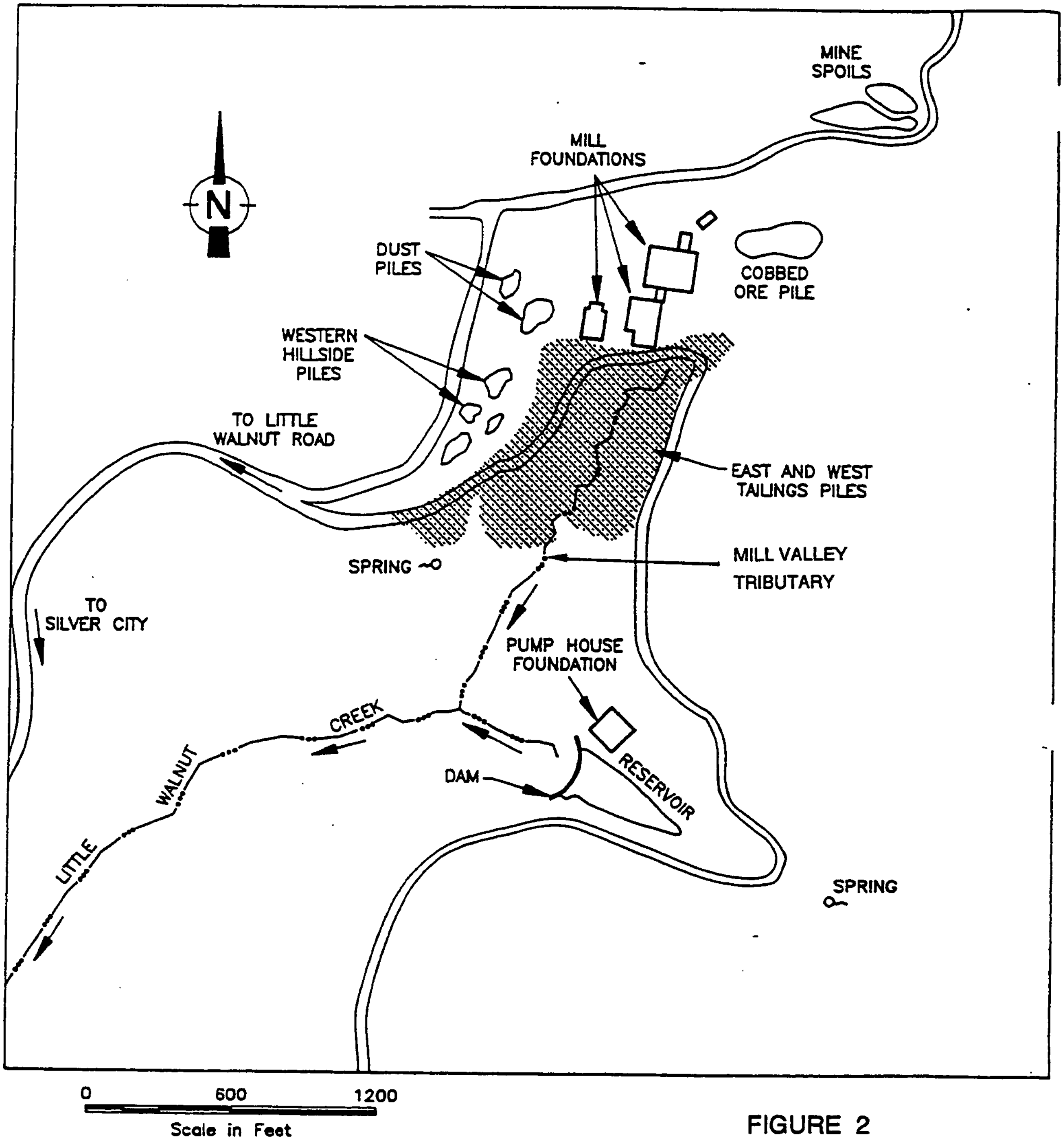


FIGURE 2

CLEVELAND MILL SUPERFUND SITE
Grant County, New Mexico

TITLE:

MILL AREA MAP

Project No. EN3017

ecology & environment, inc.
ALBUQUERQUE, NEW MEXICO

FIG. 1-2

Date: 10/92 Drawn by: RSM Scale: 1" =600'

Source: Modified from Site Screening Report (EPA 1990) areas include the mine spoils located in a small drainage adjacent to the Cleveland Mine portal, and tailings sediment located within the streambed of the mill valley tributary to Little Walnut Creek and within the streambed of Little Walnut Creek itself.

II. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Cleveland Mill Superfund Site encompasses an area which has been used for the disposal of mining and ore processing materials since the early 1900s. The Cleveland Mine, located approximately 1/2 mile north of the Cleveland Mill main tailings piles, is one of the Cleveland Group of Mines located in the West Pinos Altos Mining District. The West Pinos Altos Mining District was one of New Mexico's major producers of gold, silver, zinc, and lead during the early 1900s.

George H. Utter of Silver City staked the Cleveland Mine claims in the early 1900s and developed the mine until 1913 when he sold his claims to the Empire Zinc Company, a subsidiary of New Jersey Zinc Company. Empire Zinc Company operated the mine until 1919. To process the ore, Empire Zinc Company built a milling operation, the Cleveland Mill, consisting of a specific gravity separator. This gravity separator was replaced with a flotation process in 1916 and operated from 1916 to 1919. Records indicate that 121,507 tons of lead, zinc, and copper ore were taken from the Cleveland Mine (and possibly other properties) and processed at the Mill during the period from 1913 until 1919. As of 1929, the following waste materials in the noted quantities, resulting from Empire Zinc Company's mining activities, could be found at the Site: dust - 12,081 tons, middling - 14,777 tons, tailings - 33,126 tons.

The Empire Zinc Company discontinued mining and milling operations in 1919 for unknown reasons and moved the original mill equipment to Hanover, New Mexico. In 1941 Douglas White leased the Cleveland Group of Mines and operated a small dual-cell flotation lead-zinc recovery mill at the Site until approximately 1950. The White Mill reprocessed tailings that covered the hillslope west of the mill buildings' foundations and above the currently existing western tailings pile. This reprocessing was completed sometime between late 1949 and early 1950.

In the late 1960s, New Jersey Zinc Company, which then owned the Cleveland Mill property, merged into Gulf & Western Industries, Inc. which thereby acquired the Cleveland Mill property. Gulf & Western Industries, Inc. changed its name to Gulf + Western Inc. in 1986, and to Paramount Communications Inc. in 1989. Sharon Steel purchased the Cleveland Mill property in 1979 and filed for bankruptcy in 1987. Mining Remedial Recovery Company (MRRC), then named Bayard Copper Corporation, purchased the Cleveland Mill property in 1989. MRRC is the present owner of the property.

Citizen complaints to the New Mexico Environment Department (NMED), formerly the New Mexico Environmental Improvement Division, led to NMED's 1985 identification of the Site as an area of potential concern. As a result of the complaints, NMED conducted investigations in October of 1985 and November of 1986 under provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). A more detailed site assessment was conducted by the EPA Technical Assistance Team (TAT) in August 1988. The Site information and the sampling data were used to determine if the Site posed a significant environmental and human health risk. The Site was proposed for inclusion on the National Priorities List (NPL) of Federal Superfund sites in June 1988 (53 Fed. Reg. 23988 (June 24, 1988)). In March 1989, (54 Fed. Reg. 13296 (March 31, 1989)), the EPA added the Cleveland Mill Site to the NPL pursuant to Sections 105 of the Comprehensive Environmental Response, Compensation and Liability Act as amended (CERCLA), 42 U.S.C. Section 9605, qualifying the Site for investigation and remediation under CERCLA.

After the Site was placed on the NPL, the Agency for Toxic Substances and Disease Registry (ATSDR) prepared a preliminary Health Risk Assessment for the Site in May of 1990. Based on the HRS data and a site visit, ATSDR concluded that the Site was of potential health concern because of the potential risk to human health resulting from possible exposure to hazardous substances. In July 1990, Lockheed Engineering and Sciences Company conducted additional site characterization studies in conjunction with the EPA Environmental Monitoring Systems Laboratory (EMSL).

On December 27, 1989, EPA sent special notice letters to certain parties, known as potentially responsible parties (PRPs), who may be liable, under CERCLA, for the remediation of the Site. The special notice letters gave the PRPs notification of their potential liability and offered the PRPs the opportunity to undertake the Remedial Investigation and Feasibility Study (RI/FS) for the Site. The RI is an investigation undertaken to determine the nature and extent of the problem presented by the release of hazardous substances at a Superfund Site. The FS is a study undertaken to develop and evaluate options for remedial actions. Because the PRPs either did not respond to the Special Notice or declined to conduct or finance the RI/FS, EPA performed the RI/FS using CERCLA funds. NMED acted as the lead agency for these studies through a cooperative agreement with EPA.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

This decision document presents the selected remedial action for the Cleveland Mill Superfund Site, Silver City, New Mexico, chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA) and, to the extent practicable, the National Contingency Plan (NCP). The decision for this site is based on the Administrative Record. An index for the Administrative Record is included as Appendix F to this Record of Decision (ROD).

The public participation requirements of CERCLA, Subsection 113(k)(2)(B)(i-v) and Section 117, 42 U.S.C. Subsection 9613(k)(2)(B)(i-v) and Section 9617, were met during the remedy selection process, as illustrated in the following discussion.

A series of community interviews were conducted in August 1991 during which NMED met with citizens, local officials and state and federal agencies regarding site concerns. A Community Relations Plan was completed in January of 1992 and made available to the public at public information repositories maintained at the Silver City Public Library in Silver City, New Mexico; the New Mexico Environment Department Library in Santa Fe, New Mexico; the EPA Region 6 office in Dallas, Texas; the NMED District III Field Office in Silver City, New Mexico; and the Geotechnical Information Center in Socorro, New Mexico. Three fact sheets summarizing the progress of the RI/FS were mailed out to all individuals on the Site mailing list. The Site mailing list has been continuously updated as Site activities progress. A notice of availability for a Technical Assistance Grant was published in the Silver City Daily Press on October 31, 1991, and mailed to all individuals on the mailing list. EPA may provide Technical Assistance Grants, under Section 117 of CERCLA, 42 U.S.C. Section 9617, to any group of individuals which may be affected by a release of hazardous substances in order for such a group to obtain technical assistance in interpreting information with regard to the nature of the hazard and the CERCLA remediation process.

The NMED and EPA held an open house in Silver City on August 27, 1991, to explain the Superfund process and to notify the public that RI activities were going to begin. The RI fieldwork was discussed and information about the Site was solicited.

The Remedial Investigation report and the Feasibility Study report, released in March 1993, and EPA's Proposed Plan for the remediation of the Site, released on April 8, 1993, were all made available to the public in both the administrative record and information repositories maintained at the Silver City Public Library in Silver City, New Mexico; the New Mexico Environment Department Library in Santa Fe, New Mexico; and the EPA Region 6 Office in Dallas, Texas. The RI and FS reports were also made available at information repositories maintained at the NMED District III field office in Silver City, New Mexico and at the New Mexico Bureau of Mines and Mineral Resources, Geotechnical Information Center in Socorro, New Mexico. The notice of availability for these, documents was published in the newspaper of record, the Silver City Daily Press, on April 9, 1993.

On April 8, 1993 the NMED and EPA held an open house in Silver City to inform the public of the findings of the Remedial Investigation and Feasibility Study reports including the results of the Baseline Risk Assessment. The Baseline Risk Assessment is a study which characterizes the current and potential threats to human health and the environment that may be posed by the release of hazardous substances at a site. A public meeting was held in Silver City on April 27, 1993. At this meeting, representatives from NMED and EPA solicited comments and answered questions about the Site, the remedial alternatives under consideration, and the Proposed Plan. NMED and EPA held a 30-day public comment period regarding the Proposed Plan, the RI and FS Reports, and the Administrative Record from April 9, 1993 to May 9, 1993. The public comment period was extended to June 9, 1993, due to a request for an extension. A notice of extension to the public comment period was announced at the April 27, 1993, public meeting and published in the Silver City Daily Press on May 15, 1993. A response to verbal and written comments received during this period is included in the Responsiveness Summary, which is part of this ROD (Appendix E).

IV. SCOPE AND ROLE OF RESPONSE ACTION

The contamination at the Site is principally in the soil medium which is referred to, for convenience sake, throughout this ROD as "tailings and sediment." The phrase "tailings and sediment" should be read with the broadest meaning possible to include, but not be limited to, the main (east and west) tailings piles, the cobbed ore pile, mine spoils, western hillside piles, roadbed soils, dust piles, mining and milling wastes, streambed accumulations, contaminated soils and any other contaminated material of any kind at the Site.

This ROD addresses the risks posed by conditions at the Site. Some or all of the contaminants identified at the Site are "hazardous substances" as that term is defined in section 101(14) of CERCLA, 42 U.S.C. §9601(14), and 40 CFR §300.5 and §302.4. Response actions authorized by this ROD will address the source of contamination including all the contaminated tailings and sediment at the Site and the contaminated sediment in Little Walnut Creek and the mill valley tributary. The entire action will be treated as a single phase, or operable unit.

The studies undertaken at the Site have identified the contaminated tailings and sediment as a principal threat and the shallow perched ground water as a low level, but significant, long term threat. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably controlled and that present a significant risk to human health and the environment should exposure occur. The contaminated tailings and sediment, including sediments in areas of the Little Walnut Creek streambed, were found to contain levels of hazardous substances that pose an unacceptable health risk. These wastes are a threat because of the potential for exposure of the public to the contaminants via ingestion, dermal contact and inhalation. There is an additional threat in that, without remediation, contaminated tailings and sediment would continue to provide a source of contaminated leachate generation. Without remediation, this leachate will continue to contaminate shallow ground water at the base of the main tailings piles, migrate into Little Walnut Creek, and potentially contaminate additional aquifers which are currently used as a source of drinking water.

The shallow perched aquifer, located at the toe of the tailings pile, is contaminated with hazardous substances, within the meaning of CERCLA Section 101(14), 42 U.S.C. §9601(14) and 40 CFR §§300.5 and §302.4, at concentrations that exceed EPA Safe Drinking Water Act Maximum Contaminant Levels, 40 CFR 141.2 (MCLs), and New Mexico Water Quality Control Commission (NM WQCC) standards. This contaminated ground water at the Site is a low level, but significant, long term threat because of the possibility that contaminants in the perched aquifer may migrate via surface water to other downstream aquifers which are used as drinking water sources.

The wells on residential land along Little Walnut Creek, downstream of the tailings and sediment, are completed in aquifers that are not directly hydraulically connected to the shallow perched aquifer at the toe of the tailings pile. These residential wells are used for irrigation and drinking water purposes. No CERCLA hazardous substances have been detected above MCLs and NM WQCC standards in the residential wells. Thus, human health is not threatened by ingestion of the ground water in the residential wells in their current condition. EPA and NMED believe that the residential wells are currently safe for human use.

The Remedial Objectives for the Site are the following:

1. Prevent dermal contact, ingestion of, and inhalation of contaminated tailings and sediment.

2. Prevent direct contact with and ingestion of contaminated ground water and surface water.

3. Prevent the downstream aquifers from becoming contaminated with hazardous substances from the tailings and sediments, at concentrations which exceed MCLs and NM WQCC standards.

4. Return the shallow perched aquifer at the toe of the tailings to a condition where the concentration of contaminants is below MCLs and NM WQCC standards.

V. SUMMARY OF SITE CHARACTERISTICS

A. Regional Geology

The geology of the area is diverse and consists of sedimentary, metamorphic, and igneous rocks (Figure 3). The Paleozoic and Mesozoic rocks have been folded, offset by faults and intruded by numerous dikes, sills and stocks. Cretaceous and Tertiary volcanics form an unconformable cover over much of area.

Sedimentary rocks in the mill area and the Little Walnut Creek drainage include the Pennsylvanian-age Oswaldo Formation, a crinoidal limestone and mudstone, and the Cretaceous Colorado Formation, a shallow marine sequence consisting of arkose, sandstone, shale, and limestone. Intrusive igneous rocks in the local area include a Cretaceous hornblende andesite porphyry and Tertiary mafic porphyry dikes. Metamorphic rocks include the Cretaceous Beartooth Quartzite, a thick metamorphic sandstone with minor interspersed conglomerate beds.

The stratigraphy in the mill valley tributary of Little Walnut Creek consists of a sequence of Oswaldo Formation limestone overlain by Beartooth Quartzite which is in turn overlain by Cretaceous hornblende andesite porphyry. A northeast-trending normal fault (down to the west), parallel to and within the mill valley drainage, juxtaposes Cretaceous Beartooth Quartzite west of the fault and Pennsylvanian Oswaldo limestone east of the fault (Figure 3). The fault is approximately vertical and trends directly down the valley floor beneath the two main tailings piles resulting in the west tailings pile overlying the Beartooth Quartzite and the east tailings pile overlying the Oswaldo limestone. Tertiary mafic porphyry dikes intrude the Oswaldo limestone and Beartooth Quartzite, predominantly on the east side of the mill valley. Outcrops of limestone in the vicinity of the these intrusions appear to have been contact-metamorphosed leaving the limestone dense and massive with no well developed joints or fractures.

Approximately 2,200 feet southwest and downstream of the mill area are the contacts between the Oswaldo Formation, Tertiary andesites and the Colorado Formation which predominate the remainder of Little Walnut Creek streambed. The interbedded

FIGURE 3

LEGEND

TQal	Alluvium
Tgp	Intermediate stocks
Tmp	Mafic porphyry dikes
Tpc	Pyroxene porphyry
TKva	Andesites, andesite breccias, and dacite
Kc	Colorado Formation
Kb	Beartooth Quartzite
IPo	Oswaldo Formation

Source: Geologic Map of Silver City Quadrangle, New Mexico, USGS 1974

CLEVELAND MILL SUPERFUND SITE
Grant. County, New Mexico

TITLE:

GEOLOGIC MAP

Project No. EN3011

ecology & environment, inc.
ALBUQUERQUE, NEW MEXICO

FIG. 3–1

Date: 07/91 Drawn by: RSM Scale:

sandstones, siltstones, limestones and shales of the Colorado Formation are overlain by a thin layer of Quaternary alluvium along Little Walnut Creek.

B. Ground Water Hydrology

The Cleveland Mill Site can be divided into two separate hydrogeologic areas containing aquifers which are not directly hydraulically connected (although contaminants may travel from one aquifer to the other via surface water transport). The first area, within 1/2 mile radius of the mill, consists of the Oswaldo Limestone, the Beartooth Quartzite, and intrusive and extrusive volcanic rocks. Approximately 1/2 mile south and downstream of the mill area, the Colorado Formation and overlying Quaternary alluvium constitute a second hydrologic area along the streambed of Little Walnut Creek. Regional ground water flow generally follows topography and coincides with the surface water flow direction. Ground water in the vicinity of the mill and Little Walnut Creek generally flows to the south and southwest, while ground water in the vicinity of the mine generally flows to the northwest.

The Oswaldo limestone and the volcanic rocks are locally water-bearing with unpredictable yields to domestic wells, while the Beartooth Quartzite is not known to be a water-bearing formation. Several active and inactive springs were identified in surface water drainages in the vicinity of the mine and mill. Within the mill valley, the Oswaldo limestone has been intruded with numerous mafic dikes and sills and subsequently marbleized, resulting in decreased porosity and permeability. These intrusive dikes and marbleized limestone may act as impermeable barriers, blocking both vertical and lateral movement of groundwater.

During the RI, shallow groundwater was identified within the colluvium and weathered bedrock on the steeply sloping hillsides of the mill valley. A monitoring well constructed at the toe of the west tailings pile encountered ground water within a saturated zone from 7 to 14 feet below ground surface. The ground water appears to be perched on the unweathered surface of the marbleized Oswaldo limestone and intrusive dikes. The perched colluvium and weathered bedrock aquifer is dissected by the mill valley tributary and Little Walnut Creek, and is laterally discontinuous and limited in extent. In an effort to locate a deeper bedrock aquifer, four exploratory borings were drilled along the toe of the main tailings piles to depths ranging from 20 to 110 feet below ground surface. A deeper bedrock aquifer was not encountered in these borings. Drilling indicated that the shallow perched aquifer, located at the base of the main tailings pile, is not hydraulically connected with a deeper bedrock aquifer in the vicinity of the tailings piles.

Deep ground water was encountered on the Continental Divide above the mill area at a depth of 145 feet in the Oswaldo limestone within fractures associated with historical faulting. Ground water within the Oswaldo limestone is locally confined.

In the second hydrologic area, downstream of the mill area, the Colorado Formation and overlying alluvium constitute the primary aquifer along the Little Walnut Creek valley. This aquifer is not directly hydraulically connected with the shallow perched ground water in the mill area, although contaminants may migrate via the surface water from the shallow perched aquifer, to the downstream aquifers. A majority of the domestic wells along Little Walnut Creek are constructed in the alluvial deposits and/or the Colorado Formation. The Colorado Formation and overlying alluvium are hydraulically connected, with the degree of connectivity controlled by the permeability of the bedrock. Groundwater was encountered in residential and monitoring wells completed in the Colorado Formation, at depths ranging from 8 to 155 feet below the ground surface.

The shallow perched aquifer in the mill area is classified by EPA as a Class III A aquifer because it is not a potential sole source of drinking water, due to insufficient yield. The ground water within the Colorado Formation and overlying alluvium, in which residential wells along Little Walnut Creek are completed, is classified as a Class II A aquifer because it is a current source of drinking water. However, all ground water identified at the Site is protected under the New Mexico Water Quality Control Act and Regulations. The NM WQCC regulations, protect all ground water of the state of New Mexico, which has a concentration of 10,000 mg/l or less total dissolved solids, for present and potential future use as domestic and agricultural water supply (NM WQCC Regulations 82-1, Sections 3-101 and 103).

C. Surface Water Hydrology

Surface water in the Cleveland Mill Superfund Site area includes the mill valley tributary to Little Walnut Creek, the intermittent Little Walnut Creek, intermittent Picnic Creek tributary to Little Walnut Creek with its confluence approximately 2 miles downstream of the mill area, and the water storage reservoir at the head of Little Walnut Creek. As the surface water flows to the south and south west from the mill area down Little Walnut Creek it crosses several discrete geologic units with increasing distance downstream. Several springs occur within surface water drainages in the mill area.

The water storage reservoir at the mill site was built initially with a capacity of 3.2 million gallons. It was filled with water drained from the Cleveland Mill, rainfall, and flow from a natural spring located above and approximately 500 feet east of the reservoir.

D. Biota

According to the U.S. Department of the Interior, Fish and Wildlife Service, there are two species that are endangered or threatened in the region of the Site, although they have not been observed at the Site. They are the Mimbres figwort (Scrophularia macrantha) and the Southwestern willow flycatcher (Empidonax traillii extimus). The Mexican spotted owl (Strix occidentalis lucida), which is being proposed as an endangered or threatened species, may also be in the region.

E. Contamination Characterization

The media and associated contaminants of concern at the Site were identified during the Remedial Investigation (RI). Detailed results from the RI sampling can be found in the Remedial Investigation report which is a part of the administrative record for the Site. Background soils samples were collected from natural geologic formations to assist in distinguishing between contamination associated with tailings and sediments and naturally-occurring chemical concentrations. The concentrations that represent these naturally-occurring chemical concentrations are called "background concentrations" or "background values". Background values were determined in the RI on a media-specific basis, so the background values for each chemical detected during sampling differ depending upon the media in which the chemical was found.

Table 1 of this ROD shows the concentrations of the chemicals of potential concern (COPCs) at the Site and the background soil concentrations of these contaminants. A COPC is a contaminant that is detected at a concentration that is higher than the background concentration of that contaminant at a particular site. Chemicals of potential concern are furthered evaluated in a site risk assessment to determine if they pose an unacceptable risk to either human health or the environment. Those chemicals of potential concern which pose an unacceptable risk at a particular site are referred to as contaminants of concern. At the Cleveland Mill Site different media contain different contaminants of concern. The contaminants of concern are discussed in detail in Section VI of this ROD.

Based on the results of the RI the following contaminated media were identified:

- Tailings and Sediment
- Surface Water
- Ground Water

1. Tailings and Sediment

The contaminated tailings and sediment remaining at the mill and mine areas are found in several places including two main tailings piles, a cobbed ore pile, several lesser mill waste piles, the roadbed sediment, and mine spoils piles, as shown in Figure 2. The mill tailings have been partially eroded and redeposited in the streambed of Little Walnut Creek. The volume of contaminated tailings and sediment including sediment in the streambed is as follows:

Waste Area	**Volume (cubic yards)**
Main Tailings Piles	30,000
Cobbed Ore Pile	15,000
Mine Spoils	15,000
Creek Sediment	6,000
Western Hillside Waste Piles	2,500
Roadbed Soils	1,500
Dust Piles	900
Total Volume	70,900

Seventy-four surface samples were collected for metals analysis, from the mine and mill areas, from the roadbed soils and from background soils. Subsurface samples were collected from six boreholes that were drilled through the main tailings piles into bedrock beneath the piles. Results of these metals analyses identified several contaminants, in tailings, sediments, and soils, at concentrations above background concentrations as shown in Table 1. Contaminants identified in tailings, sediments and soils, at concentrations above background, included the CERCLA hazardous substances arsenic, beryllium, cadmium, lead, copper, mercury, and zinc.

Six chemicals of potential concern, arsenic, cadmium, lead, copper, silver, and zinc, were identified in creek sediments within the mill valley tributary and Little Walnut Creek. An estimated 6,000 cubic yards of tailings material have accumulated in the upper 7,200 feet of the Little Walnut Creek drainage. Accumulations of tailings and sediment in the streambed are a source of contamination for surface water and ground water.

TABLE 1 CONCENTRATIONS OF METALS OF CONCERN (Mg/Kg)

Metal	West Tailings Pile [2] range	West Tailings Pile [2] average	East Tailings Pile [2] range	East Tailings Pile [2] average	Western Hillside Waste Piles range	Western Hillside Waste Piles average	Dust Piles range	Dust Piles average
Arsenic	25 – 3,020	366	9.8 – 132	69.9	101 – 2,730	738	5.1 – 62.9	32.8
Beryllium	1.6 – 11.4	2.2	3.5 – 12.8	9.5	5.2 – 10	6.6	0.49U – 6.7	3.4
Cadmium	1.4 – 190	33.4	2.7 – 298	59.6	4.3 – 376	101.7	15.7 – 130	227.9
Chromium	2.1 – 37.6	8.1	4.2 – 71.6	13.6	6.8 – 9.5	8.3	4 – 10.5	6.9
Copper	35.8 – 6,000	2029.5	271 – 6,780	2118.2	692 – 4,730	2563	852 – 4,890	2493
Lead	5.8 – 11,500	1118.5	18.9 – 4,040	1034	348 – 13,500	5779	41.2 – 444	224
Manganese	11.8 – 13,000	550.5	190 – 9,020	2191	258 – 6,460	2099	944 – 3,940	2901
Mercury	0.08 – 1.7	0.3	0.09 – 0.9	0.2	0.73 – 3.4	1.8	0.1U – 0.38	0.24
Silver	.82 – 156	49.7	23.4 – 159	79	26.6 – 77.8	43.8	1.3 – 23.6	12.3
Zinc	57.3 – 54,800	9969	3,320 – 53,400	19556	2,830 – 122,000	36924	9,850 – 9,630	4618

Metal	Cobbed Ore Pile range	Cobbed Ore Pile average	Mine Spoils range	Mine Spoils average	Creek Sediment [3] range	Creek Sediment [3] average	Background Soils range	Background Soils average
Arsenic	54.5 – 205	145	24.4 – 89.1	59.5	71.6 – 273	139.8	4.1U – 26.6	11.0
Beryllium	3.1 – 7.5	5.6	2.7 – 5.5	4.1	0.25 – 0.98	0.5	1.6 – 3.7	2.4
Cadmium	5.5 – 130	45.6	16.3 – 157	75.6	0.15 – 26.9	6.1	1U – 3.4	1.8
Chromium	5.4 – 12.6	7.7	9.2 – 36.3	27.3	5.6 – 19.6	9.7	14.4 – 69.8	42.3
Copper	251 – 6,280	1445	699 – 4,320	2256	257 – 3,310	1073.3	34.1 – 209	95.2
Lead	98.8 – 512	309	172 – 833	414	135 – 1,390	706.7	35.7 – 61.6	45.5
Manganese	1,100 – 3,290	2053	2,080 – 4,170	2994	264 – 818	439.9	621 – 2100	1042
Mercury	0.09U – 1.2	0.3	0.09U – 0.84	0.5	0.08U – 0.2	0.12	0.08U – 0.09U	0.09U
Silver	0.86U – 17.6	4.4	0.85U – 3.8	2.3	3.2 – 59	28.6	R	R
Zinc	1,300 – 27,700	1145	2,710 – 42,100	21802	803 – 6,070	2736	124 – 402	243

1 All analyses are for total metals

2 Includes concentrations in both surface and subsurface samples.

3 Includes all sediment samples from toe of the main tailings piles to 7350 feet downstream

U = Indicates the element was analyzed for, but was undetected

R = Analyzed but data rejected

2. Surface Water

Samples of surface water and stream sediment were collected, for metals analysis, at 1,000 foot intervals extending seven miles downstream of the mill area in the mill valley tributary and Little Walnut Creek (Figure 4). Acid drainage from the tailings piles has increased the levels of metals and lowered the pH in these waters as have several large accumulations of tailings and sediment in the upper 7200 feet of the Little Walnut Creek drainage. Results from the analysis of the surface water samples collected during the RI indicate that concentrations of metals in the mill valley tributary and portions of Little Walnut Creek are significantly higher than natural background concentrations of metals in Picnic and Silva Creeks which are unaffected by the Site. Background pH in Picnic and Silva Creeks ranged from 7.9 to 8.7 as compared to a pH ranging from 2.1 to 4.4 in the affected creeks.

Several chemicals of potential concern (COPCs) were detected in the surface water samples. Contaminants of concern identified in surface water are arsenic, beryllium, cadmium, chromium, copper, lead and zinc. Surface water is a source of contamination for hydraulically discrete aquifers through infiltration of contaminated surface water as the stream flows across these units. Concentrations of metals in surface water decrease with distance away from the mill area, with the highest concentrations immediately downstream of the main large tailings piles, and immediately downstream of each of the tailings accumulations in the streambed. Further downstream of these accumulations, the concentrations of metals steadily decrease in sediment and water with the most significant decrease occurring immediately downstream of the confluence of Picnic Creek and Little Walnut Creek.

3. Ground Water

Four ground water monitoring wells were drilled and installed during the RI. Information from these wells, together with data from 11 domestic wells (Figure 5) and 4 active springs, were used to evaluate the hydrogeology and the potential for ground water contamination. Results of the ground water sampling indicate that ground water contamination is limited to a shallow perched aquifer located at the base of the main tailings piles. This shallow perched ground water found in the colluvium and weathered bedrock at a depth of 7 feet is contained within a thin saturated zone which is limited in lateral extent. No underlying bedrock aquifer was identified above a depth of 110 feet and exploratory borings indicate no hydraulic connection between the perched water and the underlying bedrock. Ground water collected from

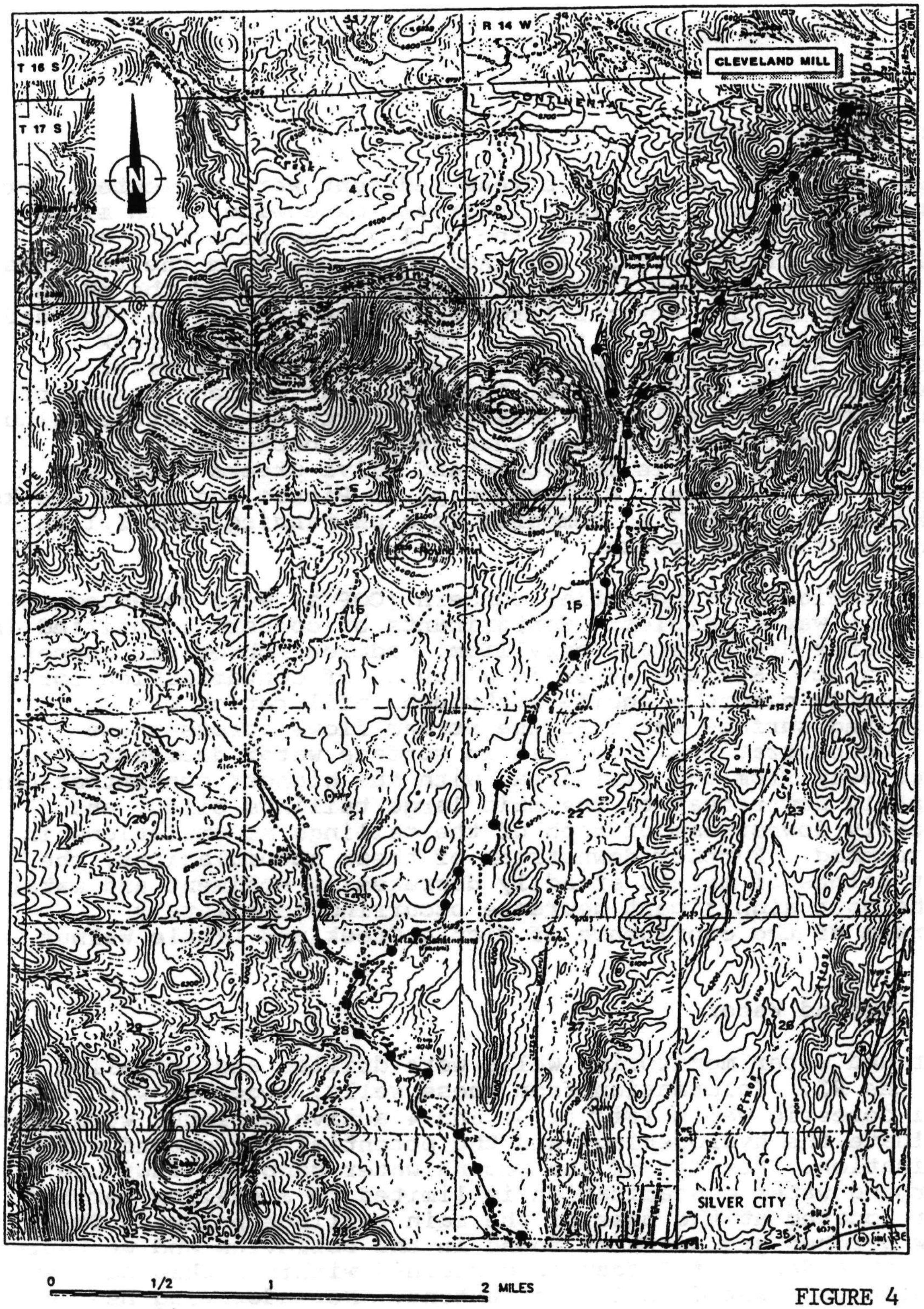


FIGURE 4

LEGEND

1000 ft. stream sediment samples

5 sediment samples and 1 surface water sample will be collected from each segment.

Source: Silver City Quadrangle, New Mexico. USGS, 1950

CLEVELAND MILL SUPERFUND SITE
Grant County, New Mexico

TITLE:

HYDROLOGIC CHARACTERIZATION
SAMPLE LOCATIONS

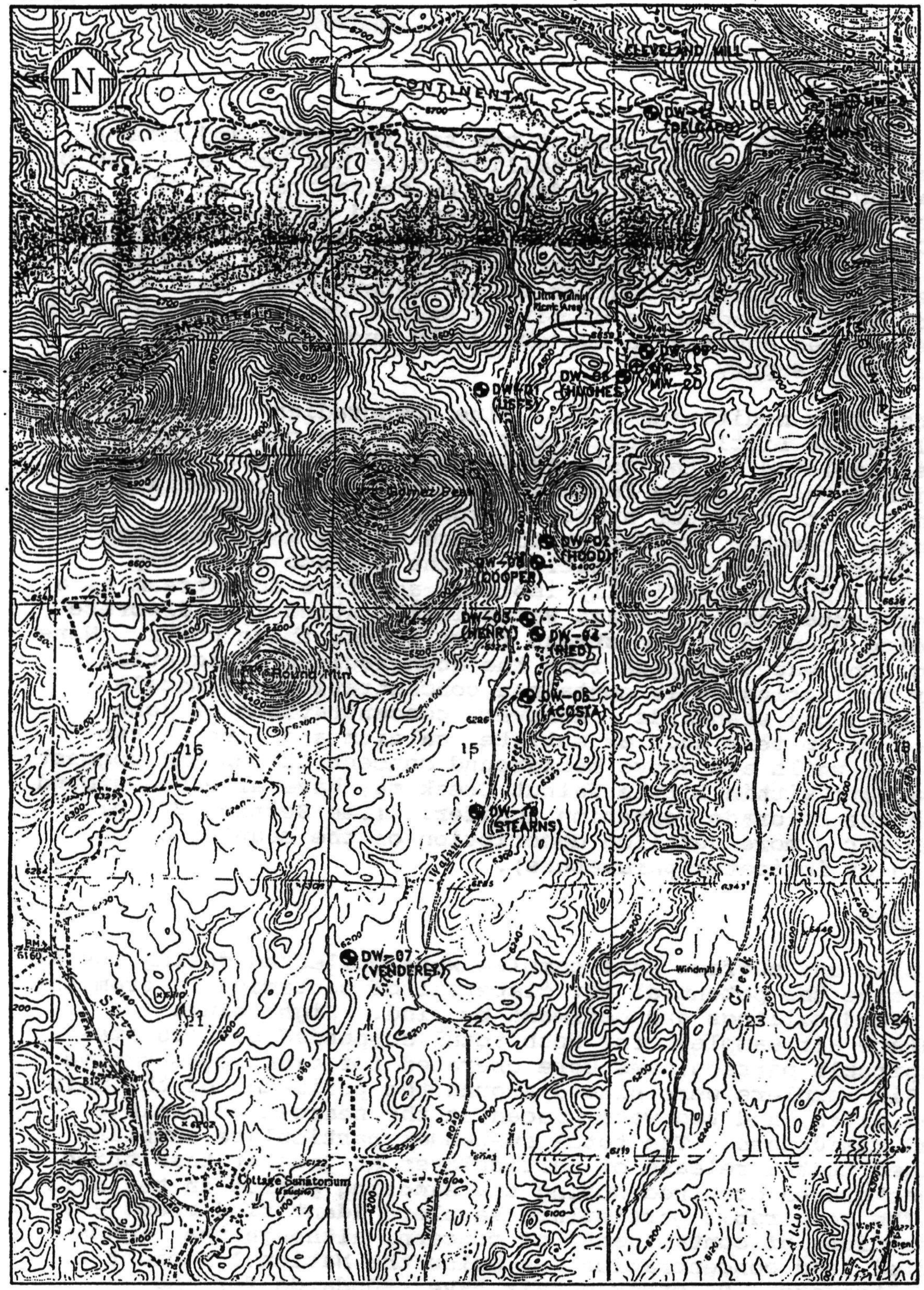
Project No. EN3011

ecology & environment, inc.
ALBUQUERQUE, NEW MEXICO

FIG. 3-2

Date: 07/91 Drawn by: RSM Scale:

CLEVMIL10



0 1/2 1 2 MILES

1:24,000

FIGURE 5

LEGEND

⊕ DOMESTIC WELL (OWNER)

⊕ MONITORING WELL

Source: Silver City Quadrangle, New Mexico. USGS, 1950

CLEVELAND MILL SUPERFUND SITE Grant County, New Mexico	
TITLE: DOMESTIC AND MONITORING WELL LOCATIONS Project No. EN3017	
ecology & environment, inc. ALBUQUERQUE, NEW MEXICO	FIG. 2-1
Date: 3/93 Drawn by: RSM Scale:	

the monitoring well at the toe of the tailings pile and from a spring adjacent to the western tailings pile has been affected by infiltration of leachate as evidenced by concentrations of dissolved metals, sulfate and total dissolved solids elevated above MCLs and NM WQCC standards and background concentrations (Tables 2, 3 and 4). This contaminated ground water discharges from the shallow perched aquifer to the intermittent mill valley tributary at the headwaters of Little Walnut Creek. Ground water from the perched aquifer is not currently used as a source of domestic water supply.

Two of the four monitoring wells, nine downgradient residential wells along the Little Walnut Creek valley, and one background well are completed in the Colorado Formation aquifer. Ground water within the Colorado Formation and overlying Quaternary alluvium is not in direct hydraulic connection with the contaminated perched aquifer at the base of the main tailings piles. However, the contamination in the surface water may migrate to other hydraulically isolated aquifers downstream as a result of contaminated surface water infiltrating into discrete hydrogeologic units as the stream flows across these units. None of the ground water samples from the downgradient residential wells or monitoring wells contained concentrations of metals above regulatory standards. However, concentrations of some indicator parameters such as sulfate, calcium and zinc in two residential wells are above background concentrations and suggest that leachate within Little Walnut Creek may have affected ground water in the Colorado Formation aquifer. (See Section VII of this ROD for a more detailed description of the meaning of the detection of indicator parameters).

4. Air

Air samples and surface soil samples were collected during the RI to determine the potential for dispersal of contaminants from the contaminated tailings and sediment by wind. High volume particulate air samplers for both total suspended particulates and respirable particulates were operated for eight consecutive days. Six samplers were placed around the perimeter of the main tailings piles, and two were placed at the nearest accessible downwind residences. The total suspended particulate sampling determined that a release of particulates at greater than three times background occurred during the sampling period in the mill area. The respirable particulate samplers identified measurable concentrations of contaminants of concern, although the highest identified lead concentration was below the National Ambient Air Quality Standard. No other metals have standards for the respirable fraction.

Soil samples were also collected upwind and downwind of the Site and at nearby residences to evaluate the potential historical dispersion and deposition of contaminants from the Site via

TABLE 2

MONITORING WELLS (CMMW)
DISSOLVED METALS, μg/L
June 1992

Sample #	CMMW-101	CMMW-102	CMMW-103	CMMW-104	CMMW-105	CMMW-106	
Location	MW-2S Hughes	MW-2D Hughes	MW-2D (duplicate)	MW-3 Background	MW-1 Tailings	Field Blank	MCLs
Aluminum	45 U	45 U	45 U	126 J	5650	45 U	50-200^{S}
Antimony	20 U	20 U	20 U	20 U	366	20 U	10/5^{Pr}
Arsenic	1.1 UJ	1.5 UJ	1.5 UJ	1 UJ	100 UJ	1 U	50
Barium	67.1 J	49.8 J	49.8 J	50.5 J	30.5 J	1 U	1000
Beryllium	1 U	1 U	1 U	1 U	24.8	1 U	1^{Pr}
Cadmium	3 U	3 U	3 U	3 U	5080	3 U	5^{Pr}
Calcium	188000	223000	227000	113000	382000	127 U	—
Chromium	5.6 J	5 U	5 U	9 U	5 U	5 U	50
Cobalt	5 U	5 U	5 U	5 U	2670	5 U	—
Copper	4 U	4 U	4 U	4.9 J	17200	4 U	1000^{S}[1300]^{D}
Iron	27 U	68.1 J	220	255 J	2520000 J	157 J	300^{S}
Lead	1 UJ	1 UJ	1 UJ	1 U	1 UJ	1 U	50[15]^{D}
Magnesium	62600	64000	65000	13300	833000	74.4 J	—
Manganese	3 U	369	343	164	364000	21.3	50^{S}
Mercury	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	2
Nickel	8 U	8 U	8 U	8 U	1030	8 U	100^{Pr}
Potassium	670 J	1050 J	1020 J	1950 U	3520 U	746 U	—
Selenium	1 UJ	1 UJ	1 UJ	1.8 J	10 UJ	1 UJ	50
Silver	6 U	6 U	6 U	6 U	6 U	6 U	100^{S}
Sodium	43800	48400	50200	50300	88100	23 U	—
Thallium	1 UJ	1 UJ	1 UJ	1 U	23.8 J	1 U	2/1^{Pr}
Vanadium	5.8 J	5 U	5 U	5 U	5 U	5 U	—
Zinc	18.7 J	10.5 J	9.9 J	85.9	1190000	78.3	5000^{S}

MCL - Maximum Contaminant Level, all MCLs are primary unless otherwise noted
S - Secondary (based on on aesthetic considerations)
Pr - Proposed MCL
D - Drinking Water Action Level (FR:56; June 7, 1991)
R - Analysis was attempted; however, the data have been rejected.
U - Indicates the element was analyzed for but was undetected. The associated numerical value is the sample quantitation limit.
J - The element was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.
UJ - The element was analyzed for, but was not detected. The associated sample quantitation limit is an estimated value.

TABLE 3

SPRINGS/LEACHATE (CMSP) and
MINE WATER (CMM)
DISSOLVED METALS, µg/L

Sample #	CMSP-001	CMSP-002	CMSP-003	CMSP-004	CMSP-005	CMM-001	
Spring #	SP-01	SP-02	SP-03	--	SP-04	--	
Location	6000 feet Downgradient	East of Reservoir	Toe of West Tailings	Tailings Leachate	West of Mine Spoils	Mine Water	MCL
Aluminum	20 U	48.4 U	20 U	238000	20 U	31 U	$50\text{-}200^{S}$
Antimony	20 UJ	20 U	20 UJ	200 UJ	20 U	47 U	$10/5^{Pr}$
Arsenic	1 UJ	1.3 J	5 U	22 J	1 U	5.2	50
Barium	62.2 J	16.6 J	4.8 J	38.1 J	18.1 J	2.6 U	1000
Beryllium	3.4 J	1.1 J	5.3	91.6	2.9 J	1 U	1^{Pr}
Cadmium	1 U	1.1 U	7.6	9640	21.2	8	5^{Pr}
Calcium	345000	102000	541000	454000	288000	183000	—
Chromium	3 U	3 U	3 U	30 U	3 U	9.5 U	50
Cobalt	1 U	1 U	1 U	6080	1 U	8 U	—
Copper	3 U	3 U	5.5 J	176000	6.1 U	8.2 U	$1000^{S}[1300]^{D}$
Iron	20 U	20 U	20 U	3490000	20 U	17.2 U	300^{S}
Lead	1 U	1 U	1 UJ	1 UJ	1 U	1.2 UJ	$50[15]^{D}$
Magnesium	100000	39600	290000	1260000	54500	19600	—
Manganese	404	334 J	22.7	536000	49.4 J	41.7	50^{S}
Mercury	0.2 U	0.2 UJ	0.2 U	0.2 U	0.2 U	0.2 UJ	2
Nickel	20 U	20 U	101	1830	20 U	11.3	100^{Pr}
Potassium	400 U	400 U	400 U	4000 U	400 U	1070	—
Selenium	2.1 U	2 UJ	16.2 J	20 J	2 UJ	20 UJ	50
Silver	3 U	3 U	3 U	30 U	3 U	7.5 U	100^{S}
Sodium	43900	32300 J	177000	73400	29600 J	14700	—
Thallium	1 U	1 UJ	1 U	1 J	1 U	R	$2/1^{Pr}$
Vanadium	6.3 J	13.2 J	21.8 J	260 J	3.3 U	5 U	—
Zinc	18.3 U	3 UJ	19600	2110000	3380 J	4730	5000^{S}

MCL - Maximum Contaminant Level
S - Secondary (based on on aesthetic considerations)
P - Primary (health based)
Pr - Proposed MCL
D - Drinking Water Action Level (FR:56; June 7, 1991
R - Analysis was attempted; however, the data have been rejected.
U - Indicates the element was analyzed for but was undetected. The associated numerical value is the sample quantitation limit.
J - The element was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.
UJ - The element was analyzed for, but was not detected. The associated sample quantitation limit is an estimated value.

TABLE 4

DOMESTIC WELLS (CMDW)
DISSOLVED METALS, µg/L
June 1992

Sample #	CMDW-101	CMDW-102	CMDW-104	CMDW-107	CMDW-108	CMDW-109	CMDW-110	CMDW-111	CMDW-112	CMDW-113	CMDW-114	
Well #	DW-01 (Background)	DW-02	DW-04	DW-05	DW-06	DW-07	DW-08	DW-09	DW-09 (Duplicate)	DW-10	DW-11 (Background)	MCLs
Aluminum	45 U	45 U	45 U	45 U	45 U	45 U	45 U	45 U	45 U	45 U	45 U	$50\text{-}200^{S}$
Antimony	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	$10/5^{Pr}$
Arsenic	1 UJ	1.2 UJ	1.1 UJ	1.6 UJ	1.1 UJ	1.2 UJ	1 UJ	1 UJ	1.2 UJ	1.2 UJ	1.1 UJ	50
Barium	57 J	21.8 J	28.1 J	77 J	20.2 J	25.7 J	58.4 J	23.8 J	23.8 J	52.5 J	10.1 UJ	1000
Beryllium	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1^{Pr}
Cadmium	3 U	3 U	3 U	3 U	3 U	3 U	3 U	6 U	3 U	3 U	3 U	5^{Pr}
Calcium	93400	177000	59800	102000	144000	127000	114000	308000	310000	137000	172000	—
Chromium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50
Cobalt	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	—
Copper	14.6 J	6.7 J	4 U	4 U	35.9	4 U	4 U	4 U	4 U	4 U	7.9 J	1000^{S} $[1300]^{D}$
Iron	27 U	38.2 J	27 U	1090 J	27 U	267	27 U	69.7 J	93.3 J	439 J	27 U	300^{S}
Lead	6.5 J	2.6 U	1 UJ	1.1 UJ	4.1 J	1 UJ	1 UJ	1 UJ	1 UJ	1 U	1 UJ	50 $[15]^{D}$
Magnesium	37800	51500	35200	19700	79000	39200	24600	89500	87900	40800	48800	—
Manganese	3 U	6.5 J	3 U	139	3 U	61.3	149	69.8	69.8	50.4	3 U	50^{S}
Mercury	.20 U	.20 U	.20 U	0.20 U	.20 U	.20 U	.20 U	.20 U	.20 U	.20 U	.20 U	2
Nickel	53.7 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	8 U	100^{Pr}
Potassium	437 U	911 U	1120 J	1400 U	1130 J	2970 U	946 J	670 J	893 J	1220 U	959 J	—
Selenium	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	1 UJ	10 UJ	10 UJ	1 UJ	1 UJ	50
Silver	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	6 U	100^{S}
Sodium	23000	26900	25900	62700	61800	58500	31400	41900	41400	30200	58700	—
Thallium	1 UJ	1 U	1.1 UJ	1 U	1 UJ	1 U	1 U	1.1 U	1.1 U	1 U	1.1 U	$2/1^{PR}$
Vanadium	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	—
Zinc	710	2750	39.8	391	17.4 J	470	5.8 U	1380	1420	173	8.7 J	5000^{S}

TABLE 4 (Cont.)

MCL - Maximum Contaminant Level, all MCLs are primary unless otherwise noted
S - Secondary (based on on aesthetic considerations)
Pr - Proposed MCL
D - Drinking Water Action Level (FR:56; June 7, 1991)
U - Indicates the element was analyzed for but was undetected. The associated numerical value is the sample quantitation limit.
J - The element was analyzed for and was positively identified, but the associated numerical value is an estimated quantity.
UJ - The element was analyzed for, but was not detected. The associated sample quantitation limit is an estimated value.

airborne migration. Analysis of surface soil samples indicate that the majority of airborne deposition has occurred within 400 to 500 feet of the mill site. Soil samples collected at the nearest accessible downvalley residences did not contain elevated metals concentrations that could be attributed to airborne dispersal of contaminants from the Site.

F. Contaminant Fate and Transport Characterization

The transport and fate of contaminants from a source are dependent upon the physical and chemical properties of the contaminant and the characteristics of the environmental media through which the contaminants travel when released. Three mechanisms exist by which contaminants may be released from primary and secondary sources at the Site and become available for transport through the environmental media: wind entrainment; leaching with subsequent infiltration to groundwater and/or discharge of leachate or overland flow to surface water; and physical transport of tailings and sediment in surface water run-off.

Metals are persistent in the environment, but their mobility varies with environmental conditions. Metals may be present in soils in elemental form, sorbed or chelated by organic matter oxides, sorbed on exchange sites of soil colloids, or dissolved in acid leachate. Most metals are immobile in neutral or basic soils and become significantly leachable only if acidic solutions infiltrate through the soils. In the range of pHs commonly found in soils (pH = 6 to 8.4), metals usually do not leach appreciably; however, acids formed naturally by reactions of infiltrating rainwater, oxygen, and sulfide ores increase the mobility of metals. In the case of the Cleveland Mill Site, acid drainage at the toe of main tailings pile has a pH of 2 to 4, greatly increasing the mobility of Site contaminants.

Through the mining process which took place at the Cleveland Mill Superfund Site, sulfide-bearing ores were brought to the surface, exposing the ores to an oxygen-rich atmosphere. The milling process ground the ore into finer particles and increased the exposed surface area of the sulfides. These actions further enhanced the oxidation process and released many of the elements from their sulfide complexes. Atmospheric oxygen at the surface and vadose zone of the tailings reacted with the sulfide minerals (i.e., FeS, ZnS, PbS, $FeAsS$) causing an oxidation reaction releasing hydrogen, sulfate, and the accompanying metals to the environment. The sulfate generated by the reaction combined with available water, creating a concentrated sulfuric acid containing high concentrations of deleterious elemental metals. This water then migrated downward through the tailings into the subsurface and discharged as leachate seeps at the base of the tailings or flowed overland into the mill valley tributary and to Little Walnut Creek streambed. The fine-grained nature of the tailings also enhanced the potential for off-site migration of particulates, via the air pathway.

The potential for contaminant migration via the air route at the Cleveland Mill Superfund Site was evaluated through collection of site-specific meteorological data, air samples, and surface soil samples. Results of this data collection indicate that contaminant migration via air dispersal occurred at the Site during the air sampling portion of the RI field investigation. This air transport mechanism provides the potential for receptor exposure from contaminated tailings and sediment.

The potential for contaminant migration, due to the infiltration of water into contaminant sources and the subsequent leaching of contaminants into surface water, was evaluated through collection and analysis of tailings and sediment samples, tailings leachate samples, and surface and ground water samples. Results of these analyses indicate that leachate from contaminated tailings and soils is a mechanism for contaminant migration into surface water. Additionally, perched ground water in the immediate site vicinity appears to have been contaminated by the leachate. Long-term concerns include the potential for infiltration of surface water contaminants into downstream aquifers.

The potential for contaminant migration via physical transport by surface water run-off was evaluated through collection of streambed sediment and water samples, and by collection of reservoir sediment and water samples. The results of sample analysis indicated that contaminant migration via surface run-off has occurred at the Site.

VI. SUMMARY OF SITE RISKS

A. Risk Assessment Description

An evaluation of the potential risks to human health and the environment from Site contaminants was conducted as part of the baseline risk assessment. The baseline risk assessment was conducted as part of the RI. The baseline risk assessment is an analysis of the current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to air, leaching through soil, and bioaccumulating in the food chain. The results of the baseline risk assessment helped establish acceptable exposure levels for use in developing remedial alternatives in the FS. By definition, a baseline risk assessment evaluates risks that may exist under the no-action alternative (that is, in the absence of any remedial actions to control or mitigate releases). The baseline risk assessment indicates the exposure pathways that need to be addressed by the remedial action.

The baseline risk assessment presents a compilation and evaluation of data collected during the Site investigation in order to estimate the upper limit, or highest level, of potential health and environmental risk which may be present due to the release of contaminants from and at the Site. In the evaluation of potential human exposure scenarios, on-site sampling and analysis results were used in conjunction with current federal and state guidance documents, including the "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A" (HHEM) (EPA/540/1-89/002), "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part B" (OSWER Directive 9285.7-01B), "Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual" (EPA/540/1-89/001) and the companion manual "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference" (EPA/600/3-89/013), and professional judgement to estimate the potential human health risk attributable to contamination resulting from past Site-related operations.

The "risk" values generated within the human health risk assessment are designed to describe a plausible upper limit to the risk of cancer posed by releases of hazardous substances at and from the Site under the exposure scenarios evaluated. That is, the risk values arrived at in the Site Risk Assessment do not necessarily provide an actual description of the risk of cancer, but are instead constructed so as to give an estimate of the highest risk level that could plausibly be posed by the release of contamination at and from the Site.

Remedial Action Goals for the Site were established in a manner which provides acceptable exposure levels that are protective of human health and the environment, and by considering applicable or relevant and appropriate requirements (ARARs) set under federal environmental or state environmental laws, if available. Furthermore, certain risk factors were considered in the establishment of Remedial Action Goals.

One factor that was considered was that, for known or suspected carcinogens, acceptable exposure levels under the NCP, are generally concentrations that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6}, using information on the relationship between dose and response. The NCP also provides that, a risk level of 10^{-6} shall be used as the point of departure for determining Remedial Action Goals when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure, such as at the Cleveland Mill Superfund Site.

Another factor that was considered was that for non-carcinogenic systemic toxicants under the NCP, acceptable exposure levels represent concentrations to which the human population, including sensitive subgroups, may be exposed without adverse effect during a lifetime, or part of a lifetime, incorporating an adequate margin of safety. EPA has established criteria for interpreting non-carcinogenic risk for Superfund sites. These criteria are called the Hazard Index (HI). Non-carcinogenic risks are quantified by the HI which is the ratio of chronic daily intake (CDI) to the reference dose (RfD) that causes a non-carcinogenic impact. EPA's Remedial Action Goal for non-carcinogens is to reduce the HI at a site to less than 1.0, providing that the site background HI is less than 1. For non-carcinogenic systemic toxicants, an HI that exceeds 1 indicates that contaminants at the site may pose adverse health effects.

This section of the ROD, the Summary of Site Risks section, summarizes the results of the baseline risk assessment. Calculations and a more detailed analysis may be found in the Site Risk Assessment contained in the administrative record. All tables referenced in this section can be found in Appendix A of this ROD, Risk Assessment Tables.

B. Human Health Risks

The baseline risk assessment was divided into two parts: the human health evaluation and the ecological evaluation. The baseline risk assessment for the human health risks was based on Reasonable Maximum Exposure (RME). RME is an estimate of risk using exposure factors which are a reasonable maximum based on scenarios assumed for the Site. The human health evaluation considered all contaminated media, such as tailings, sediments, and surface water. The Risk Assessment evaluated the potential risk to the following populations which are most likely to be exposed to materials at the Cleveland Mill Site:

- o Current nearby residents (adults and children) using ground water as a drinking water source
- o Current on-site visitors (adolescents)
- o Future recreational users (adolescents)
- o Future on-site residents (adults and children)

The major components of the baseline risk assessment are: identification of chemicals of potential concern, exposure assessment, toxicity assessment, and risk characterization. Highlights of the findings for the major components of the human health portion of the Site Risk Assessment are summarized below.

C. Identification of Chemicals of Potential Concern and Contaminants of Concern

Analytical data from the tailings, sediment, air, surface water, and ground water were evaluated to identify contaminants of potential concern at the Site. Nine (9) chemicals were selected as chemicals of potential concern for the entire Site: arsenic, beryllium, cadmium, copper, lead, manganese (which is not a hazardous substance), mercury, silver, and zinc. Of these, arsenic, beryllium, cadmium, lead, and zinc, in tailings and sediment, were found to significantly contribute to the risk, and were therefore selected as contaminants of concern.

D. Exposure Assessment

The human populations which could potentially be exposed to hazardous substances from the Site are discussed below. The pathways which contaminants might travel to reach human populations are also discussed below. The discussions of populations and pathways include discussions of exposure under both current and projected future conditions. The Site Risk Assessment refers to the various combinations of populations and contaminant pathways, under current and projected future conditions, as "scenarios". Table 5 summarizes the various current and future scenarios which were considered in the Site Risk Assessment for the Site. That is, Table 5 summarizes and lists the various combinations of populations which could be exposed and the pathways that contaminants might travel to reach those populations under current and projected future conditions.

1. Exposure Pathways

An exposure pathway is the course that a chemical or physical agent takes from a source to an exposed organism. An exposure pathway describes a unique mechanism by which an individual or population is exposed to chemicals or physical agents at or originating from a site. Each exposure pathway includes a source or release from a source, and exposure point, and an exposure route. An exposure point is a location of potential contact between an organism and a chemical or physical agent. An exposure route is the way that a chemical or physical agent comes in contact with and organism (i.e. by ingestion, inhalation, dermal contact).

a) Exposure to Tailings and Sediment (The tailings and sediments exposure pathway may also be referred to as the soil exposure pathway in this ROD.) - All humans ingest small amounts of soil and other soil-like material each day through hand to mouth activity both indoors (e.g. intake of house dust) and outdoors (e.g while playing or gardening). Therefore, ingestion of contaminated surface tailings and sediment was selected for quantitative assessment as a probable exposure route for both adults and children. Likewise, dermal contact and inhalation of airborne particles from tailings and surface sediment are probable exposure routes for both adults and children. Exposure to subsurface tailings and sediment was not evaluated as a contaminant pathway for any population because exposure to

TABLE 5

SUMMARY OF EXPOSURE SCENARIOS AT THE CLEVELAND MILL SITE

Exposure Scenarios by Potentially Exposed Population	Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
On-Site Exposure			
Future Site Residents	Incidental ingestion of contaminated surface soils and dust.	Yes	Future residents may come into contact with contaminated soils.
	Direct dermal contact with contaminated surface soils.	Yes	Although COPCs are metals and dermal absorption of metals is negligible, default values were used to evaluate pathway.
	Inhalation of contaminated airborne particles.	Yes	Contaminants in site soils may become airborne.
	Incidental ingestion, dermal contact, and inhalation of airborne particulates of reservoir sediment.	Yes	Although the sediment samples are from the deepest (8 ft.) part of the lates reservoir and currently inaccessible, it is possible the reservoir will dry out in the future.
Current Site Visitors (Trespassers and Recreational Users)	Incidental ingestion of contaminated surface soils and dust.	Yes	Local residents are reported to use the site for a variety of recreational activities and may contact contaminated soils.
	Direct dermal contact with contaminated surface soils.	Yes	Although COPCs are metals and dermal absorption of metals is negligible, default values were used to evaluate pathway.
	Inhalation of contaminated airborne particles.	Yes	Contaminants in site soils may become airborne. Motor bikers would be a reasonable worst-case receptor.
	Incidental ingestion of contaminated surface water and sediment of the reservoir.	No	Trespassers are reported to swim in the reservoir, but concentrations of COPCs are quite low in surface water. Samples of sediment are from the deepest (8 ft.) and currently inaccessible.
	Direct dermal contact with contaminated surface water and sediment of the reservoir.	No	COPCs are metals and dermal absorption of metals is negligible. Samples of sediment are quite deep and currently inaccessible.

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TABLE 5 (Cont.)

Potentially Exposed Population	Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Off-Site Exposure			
Current Nearby Residents	Incidental ingestion, ingestion, direct dermal contact and inhalation of contaminated airborne particles of surface soil and dry sediment.	Yes	Site contaminants have migrated in sediment and accumulated behind the dam at the Hughes property.
	Ingestion of groundwater as drinking water, and dermal contact with groundwater used as a domestic water supply.	Yes	Although there is no evidence of communication between the on-site aquifer with the deep well used at the Hughes property, such groundwater migration could not be completely ruled out.
	Incidental ingestion and direct dermal contact with surface water of the stream.	Yes	Surface water samples from the stream near the Hughes home contain site-derived contaminants.
Future Recreational Users	Incidental ingestion, dermal contact, and inhalation of airborne particles of soil and sediment near the Hughes home.	Yes	If the area is developed, nearby adolescents may use the area and come in contact with site-derived contaminants.
	Incidental ingestion and direct dermal contact with the surface water of the stream.	Yes	Surface water samples from the stream on the Hughes property contain site-derived contaminants.

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Source: Ecology and Environment, Inc. 1992.

subsurface tailings and sediment is less likely than exposure to surface materials. Evaluation of risk due to exposure to tailings and sediment was carried out for both the mill area and for nearby residential areas where tailings have been deposited in Little Walnut Creek.

b) Exposure to Contaminants in Air - Air monitoring conducted during the Remedial Investigation for the Cleveland Mill Site indicated that a release of total suspended particulates at greater than three times background occurred during the sampling period in the mill area. However, respirable particulate sampling indicated that there were no chemicals of potential concern present at concentrations exceeding regulatory standards. The primary inhalation route for exposure to contaminants is through inhalation of particulates from tailings and contaminated sediment. Therefore, inhalation was not evaluated in the air pathway, but in the inhalation route of the soil exposure pathway.

c) Exposure to Contaminants in Ground water - Under reasonably anticipated future conditions, there are no known human populations who would employ the shallow perched aquifer in the mill area as a sole source of drinking water. Therefore, the ground water exposure pathway was not evaluated for the smaller perched aquifer in the mill area. Nearby residences obtain drinking water from aquifers which are not directly hydraulically connected with the shallow perched aquifer in the mill area, but which may be affected by contaminated stream water and sediment in Little Walnut Creek. Therefore, the ground water exposure pathway was evaluated in the risk assessment for the nearby areas located along Little Walnut Creek.

d) Exposure to Contaminants in Surface Water - Surface water bodies of concern at the Site include the mill valley tributary, Little Walnut Creek and the on-site reservoir. The mill valley tributary and Little Walnut Creek contain contaminated sediments which have been eroded from the main tailings piles and redeposited in these surface water bodies. Surface water within the mill valley tributary, Little Walnut Creek and the reservoir is a pathway through which contaminants might travel to reach Site visitors who use these waters for recreational use. Dermal contact with and incidental ingestion of surface water are probable exposure routes for both adults and children. Evaluation of risk due to exposure to surface water was carried out for visitors to the mill area reservoirs and for nearby residential areas along Little Walnut Creek. Evaluation of risk due to contaminated sediments was included in the soil exposure pathway.

The risk that humans would be exposed to Site contaminants was quantified using standard default values. Tables 7-5 to 7-16 in Appendix A summarize the assumptions used in the Site Risk Assessment for the Cleveland Mill Superfund Site.

2. Scenarios

a) Current Nearby Residents

Land nearby the mill area and along Little Walnut Creek currently includes residences. The nearest residence is located within one mile of the mill area. The closest major population center is Silver City, located about 5.5 miles south of the Site. Ground water is the primary source of drinking water for downstream residences which are concentrated along Little Walnut Creek. The regional and Site hydrogeology is discussed in detail in Section V of this ROD.

Current nearby residents may be exposed to contaminants from ingestion of ground water, incidental ingestion and dermal contact with tailings and sediment, and incidental ingestion and dermal contact with surface water. Risk was estimated for current nearby residents using the soil exposure pathway, ground water pathway, and surface water pathway.

b) Current and Future Site Visitors

The Site Risk Assessment also considered individuals who actually go on-site and the risk that they would be exposed to Site contaminants. Currently there are no people who live or work in the mill area. Therefore, a scenario based upon recreational users traversing the Site was selected as representative of the situation most likely to expose humans to the Site under current conditions. Under this scenario, the visitor was assumed to be an area resident who was first exposed to the contaminants while visiting the Site at age seven and who continued to visit the Site until age sixteen (a total of ten years). Adolescents are the most sensitive population at risk which would be likely to visit the Site. It was assumed that the visitor moved about the Site at random, coming into contact with all accessible contaminated media. Adolescent Site visitors may be exposed to contaminants from incidental ingestion and dermal contact with tailings and sediment, and incidental ingestion and dermal contact with surface water. Future adolescent Site visitors may have additional exposure to sediments in a potentially dry reservoir. Risk was estimated for adolescent Site visitors using the soil exposure pathway and surface water pathway.

c) Future Residents

In the future it is possible that the Site might be developed as a recreational area or as a residential area. Under the Site

Risk Assessment, development for residential use was considered the most likely future land use, since residences are being built in the surrounding area. Therefore, the persons who might use the Site as a residential area in the immediate future were selected as the population group most likely to be exposed to Site contaminants in the future. Future residents may be exposed to contaminants from incidental ingestion and dermal contact with tailings and sediment. Risk was estimated for future residents using the soil exposure pathway. Surface water of mill valley and the reservoir were not included as pathways of exposure for future residents because the mill valley tributary is intermittent and is not expected to pose a significant exposure compared to other sources and routes. Water in the reservoir did not exceed primary MCLs for chemicals of potential concern (COPCs).

E. Toxicity Assessment

The toxic effects of a chemical generally depend on the level of exposure (dose), the route of exposure (oral, inhalation, dermal), and the duration of exposure (acute, subchronic, chronic or lifetime). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause (carcinogenic and non-carcinogenic), and how the occurrence of these effects depends upon dose, route, and duration of exposure.

For the human population groups evaluated for this risk assessment (current and future adolescent recreational users, current nearby child and adult residents, and future on-site child and adult residents), Human Intake Factors (HIFs), also called Chronic Daily Intake Factors (CDIs), were calculated. These CDIs were calculated using the exposure point concentration factors for each medium. An exposure point concentration is the 90th percentile concentration for a particular chemical in the area being evaluated.

Slope factors (SFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of milligrams of contaminant intake per kilogram of body weight per day $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. By "excess lifetime cancer risk" EPA means the additional risk, over and above the average national risk of cancer (estimated to be slightly less than one in three), which is posed by contaminants from a site. By "upper-bound" EPA means that it has based its risk estimates using the 90th percentile of concentration of contaminants measured at a site for the area being evaluated. By using upper bounds, EPA ensures a conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (i.e., to account for the use of animal data to predict effects on humans).

EPA assigns a cancer weight-of-evidence category to each chemical in order to reflect the overall confidence EPA has that the chemical is likely to cause cancer in humans. These categories and their meanings are summarized in the following table.

Category	Meaning	Basis
A	Known human carcinogen	Sufficient evidence of increased cancer incidence in exposed humans.
B1	Probable human carcinogen	Sufficient evidence of increased cancer incidence in animals, with suggestive evidence from studies of exposed humans.
B2	Probable human carcinogen	Sufficient evidence of increased cancer incidence in animals, but lack of data or insufficient data from humans.
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals.
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans.
E	Noncarcinogen	Evidence of noncarcinogenicity for humans.

Toxicity information for each chemical of concern, including the slope factor, the weight of the evidence, and the source of the toxicity information, is summarized in Tables 7-18 and 7-20 in Appendix A.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting non-carcinogenic adverse health effects. RfDs, which are expressed in units of mg/kg-day, are estimates of daily (maximum) exposure levels for the human population, including sensitive subpopulations, that are likely to be without an appreciable risk of deleterious effects during a lifetime. Estimated intakes of contaminants of concern from environmental media (e.g., the amount of a contaminants of concern ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

F. Human Health Risk Characterization

The risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer by age 70. For carcinogens, risks are estimated as the incremental probability, over and above the national average risk of cancer, of an individual developing cancer over a life-time as a result of exposure to the chemical. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where:

Risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg-day); and

SF = slope-factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that are generally expressed in scientific notation (e.g., 1×10^{-6} or $1E^{-6}$). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a reasonable maximum estimate, an individual has a 1 in 1,000,000 chance of developing cancer as a result of Site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a Site.

Tables 7-18 and 7-20 in Appendix A provide a brief summary of the characteristic cancer effects of chemicals of potential concern at the Cleveland Mill Site and lists available inhalation SFs and cancer weight of evidence categories. Using the average lifetime daily intake values and the slope factors previously shown in Table 7-12, cancer risks were calculated for populations who may be chronically or sub-chronically exposed at the Cleveland Mill Superfund Site. Risk was calculated for several scenarios involving exposure to tailings and sediment, surface water, and ground water.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose derived for a similar exposure period. The ratio of exposure to toxicity is called the Hazard Quotient (HQ). By adding the hazard quotients for all chemicals of potential concern which affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. For an explanation of the HI, See Section IV.A. of this ROD.

The Hazard Quotient (HQ) is calculated as follows:

Non-cancer HQ = DI/RfD

where:

DI = Daily Intake (either chronic or sub-chronic)

RfD = reference dose

DI and RfD are expressed in the same units and represent the same exposure period (e.g., chronic, subchronic, or short-term).

1. Current Risk Characterization

Under the current Site visitor scenario, the estimated overall risk of carcinogenic effects is high as $3.1X10^{-4}$ for a current adolescent Site visitor who visits the Site 60 times per year and is exposed to contaminated tailings and sediment through ingestion and dermal contact, and inhalation of airborne particulates (See Appendix A, Table 7-21). This risk is greater than the EPA's acceptable risk levels of 10^{-4} to 10^{-6}. The main contaminants contributing to this risk are arsenic and beryllium. For the current Site visitor scenario, noncancer risk (hazard index or HI) is as high as 5.1 from contact with contaminated sediment and tailings (See Appendix A, Table 7-22). This exceeds the EPA target HI of 1. Arsenic, cadmium, and zinc are the contaminants contributing most to this HI for Site visitors.

Under the current nearby resident scenario, the excess cancer risk from inhalation, ingestion, and dermal contact with contaminated tailings and sediment, ingestion and dermal contact with surface water, and ingestion of ground water may be as high as $3.9x10^{-4}$ for adults and $2.7x10^{-4}$ for children (See Appendix A, Table 7-21 and Tables 6 and 7). These risks exceed the acceptable risk levels for carcinogenic compounds of 10^{-4} to 10^{-6}. The main contaminants contributing to this risk are arsenic and beryllium (See Appendix A, Table 7-27). The non-cancer risk (Hazard Index) from contact with contaminated tailings and sediment, contact with surface water, and ingestion of ground water may be as high as 2.0 for adults and 7.1 for children (See Appendix A, Table 7-22). These HIs exceed the target HI of 1 for non-carcinogenic compounds. Arsenic, cadmium, and copper are the contaminants contributing most to this HI (See Appendix A, Table 7-27). For drinking water alone, under the current nearby resident scenario, risk was calculated to be $4.6x10^{-5}$ for adults and $2.1x10^{-5}$ for children, with HIs of 0.008 for adults and 0.45 for children (See Appendix A, Table 7-21 and 7-22). Section VII

TABLE 6

CANCER RISK AND NONCANCER HAZARD INDEX ESTIMATES
Future On-site Residential Soil Exposure
Location: On Site
Receptor: Adult
Case: Reasonable Maximum Exposure

Chemical	Exposure Point Concentration (mg/kg)	Carcinogenic Effects: Intake (mg/kg/day)	Carcinogenic Effects: Cancer Risk	Non-Carcinogenic Effects: Intake (mg/kg/day)	Non-Carcinogenic Effects: Hazard Index
Exposure Route: Ingestion of Chemicals in Soil					
Arsenic	5.74E+02	4.80E-04	8.40E-04	1.12E-03	3.73E+00
Beryllium	7.04E+00	5.88E-06	2.53E-05	1.37E-05	2.74E-03
Cadmium	7.24E+01	—	—	1.41E-04	2.82E-01
Copper	1.96E+03	—	—	3.82E-03	1.03E-01
Manganese	1.62E+03	—	—	3.16E-03	3.16E-02
Mercury (inorganic)	7.89E-01	—	—	1.54E-06	5.13E-03
Silver	5.89E+01	—	—	1.15E-04	2.30E-02
Zinc	2.30E+04	—	—	4.49E-02	2.25E-01
Ingestion Route Subtotal:			8.65E-04		4.40E+00
Exposure Route: Dermal Contact with Contaminated Soil					
Arsenic	5.74E+02	6.60E-04	1.16E-03	1.54E-03	5.13E+00
Beryllium	7.04E+00	8.09E-06	3.48E-05	1.89E-05	3.78E-03
Cadmium	7.24E+01	—	—	6.47E-04	1.29E+00
Copper	1.96E+03	—	—	5.26E-03	1.42E-01
Manganese	1.62E+03	—	—	4.34E-03	4.34E-02
Mercury (inorganic)	7.89E-01	—	—	2.12E-06	7.07E-03
Silver	5.89E+01	—	—	1.58E-04	3.16E-02
Zinc	2.30E+04	—	—	6.17E-02	3.09E-01
Dermal Route Subtotal:			1.19E-03		6.95E+00
Exposure Route: Inhalation of Airborne Soil Particles					
Arsenic	5.74E+02	4.78E-07	7.17E-06	1.12E-06	3.73E-03
Beryllium	7.04E+00	5.86E-09	4.92E-08	1.37E-08	2.74E-06
Cadmium	7.24E+01	6.03E-08	3.68E-07	1.41E-07	2.82E-04
Copper	1.96E+03	—	—	—	—
Manganese	1.62E+03	—	—	3.15E-06	3.15E-02
Mercury (inorganic)	7.89E-01	—	—	1.53E-09	1.70E-05
Silver	5.89E+01	—	—	1.14E-07	2.28E-05
Zinc	2.30E+04	—	—	4.47E-05	2.24E-04
Inhalation Route Subtotal:			7.59E-06		3.57E-02
Receptor Total:			2.07E-03		1.14E+01

EN3015:D4028/2356/12

Source: Ecology and Environment, Inc. 1992.

TABLE 7

CANCER RISK AND NONCANCER HAZARD INDEX ESTIMATES
Future On-site Residential Soil Exposure
Location: On Site
Receptor: Child
Case: Reasonable Maximum Exposure

Chemical	Exposure Point Concentration (mg/kg)	Carcinogenic Effects: Intake (mg/kg/day)	Carcinogenic Effects: Cancer Risk	Non-Carcinogenic Effects: Intake (mg/kg/day)	Non-Carcinogenic Effects: Hazard Index
Exposure Route: Ingestion of Chemicals in Soil					
Arsenic	5.74E+02	6.29E-04	1.10E-03	7.34E-03	2.45E+01
Beryllium	7.04E+00	7.72E-06	3.32E-05	9.00E-05	1.80E-02
Cadmium	7.24E+01	—	—	9.26E-04	1.85E+00
Copper	1.96E+03	—	—	2.51E-02	6.77E-01
Manganese	1.62E+03	—	—	2.07E-02	2.07E-01
Mercury (inorganic)	7.89E-01	—	—	1.01E-05	3.37E-02
Silver	5.89E+01	—	—	7.53E-04	1.51E-01
Zinc	2.30E+04	—	—	2.94E-01	1.47E+00
Ingestion Route Subtotal:			1.13E-03		2.79E+01
Exposure Route: Dermal Contact with Contaminated Soil					
Arsenic	5.74E+02	1.87E-04	3.27E-04	2.18E-03	7.27E+00
Beryllium	7.04E+00	2.29E-06	9.85E-06	2.67E-05	5.34E-03
Cadmium	7.24E+01	—	—	9.16E-04	1.83E+00
Copper	1.96E+03	—	—	7.44E-03	2.01E-01
Manganese	1.62E+03	—	—	6.15E-03	6.15E-02
Mercury (inorganic)	7.89E-01	—	—	3.00E-06	1.00E-02
Silver	5.89E+01	—	—	2.24E-04	4.48E-02
Zinc	2.30E+04	—	—	8.73E-02	4.37E-01
Dermal Route Subtotal:			3.37E-04		9.86E+00
Exposure Route: Inhalation of Airborne Soil Particles					
Arsenic	5.74E+02	3.76E-07	5.64E-06	4.39E-06	1.46E-02
Beryllium	7.04E+00	4.61E-09	3.87E-08	5.38E-08	1.08E-05
Cadmium	7.24E+01	4.74E-08	2.89E-07	5.53E-07	1.11E-03
Copper	1.96E+03	—	—	—	—
Manganese	1.62E+03	—	—	1.24E-05	1.24E-01
Mercury (inorganic)	7.89E-01	—	—	6.03E-09	6.70E-05
Silver	5.89E+01	—	—	4.50E-07	9.00E-05
Zinc	2.30E+04	—	—	1.76E-04	8.80E-04
Inhalation Route Subtotal:			5.97E-06		1.41E-01
Receptor Total:			1.48E-03		3.78E+01

EN3015:D4028/2357/12

Source: Ecology and Environment, Inc. 1992.

of this ROD more fully describes ground water remediation.

2. Future Risk Characterization

Under the future Site resident scenario, the estimated excess cancer risks to a hypothetical future resident from inhalation, ingestion, and dermal contact with contaminated tailings and sediment in the mill area of the Site is as high as $2.1x10^{-3}$ for adults and $1.5x10^{-3}$ for children (See Appendix A, Table 7-21), which are greater than EPA's acceptable risk range of concern of $1x10^{-4}$ to $1x10^{-6}$. The contaminants contributing most to risk under the future Site resident scenario are arsenic and beryllium (See Appendix A, Table 7-26). The estimated HIs due to the non-carcinogenic effects from contact with contaminated tailings and sediment may be as high as 11 for adults and 38 for children (See Appendix A, Table 7-22), well above EPA's target HI of 1 for both children and adults. Arsenic, cadmium, and zinc are the contaminants contributing most to this HI (See Appendix A, Table 7-26.)

Under the future residential soil exposure scenario, carcinogenic and non-carcinogenic risk estimates were also calculated for the cobbed ore pile and the mine spoils area of the Site using surface soil data from these areas (See Appendix A, Table 7-25). Risks for these two areas were evaluated separately, from the risks calculated for the tailings, due to the possibility that a single residence could be located on either of the tailings piles, on the cobbed ore pile, or on the mine spoils pile but not on two of these piles at one time. For the cobbed ore pile, risk was calculated to be $7.4x10^{-4}$ for adults and $5.3x10^{-4}$ for children, with HIs of 7.4 for adults and 23 for children. For the mine spoils area, risk was calculated to be $3.6x10^{-4}$ for adults and $2.6x10^{-4}$ for children, with HIs of 6.6 for adults and 19 for children. All of these calculated risk estimates exceed both the EPA target risk range of 10^{-4} to 10^{-6} for carcinogenic risk and the target HI of 1 for non-carcinogens.

Under the future recreational user scenario, the estimated excess cancer risk to future adolescent recreational users due to contact with contaminated tailings, sediments, and surface water may be as high as $3.8x10^{-4}$ (See Appendix A, Table 7-21), primarily from arsenic and beryllium (See Appendix A, Table 7-28). The HI may be as high as 6.8 (See Appendix A, Table 7-22), primarily from arsenic, cadmium, and zinc (See Appendix A, Table 7-28). These risks exceed both the EPA target risk range of 10^{-4} to 10^{-6} for carcinogenic risk and the target HI of 1 for non-carcinogens.

3. Evaluation of Lead

Since there are no EPA-approved RfD values for lead, it is not possible to evaluate the noncancer risks of lead by calculation of a Hazard Index. An alternative approach is to estimate the likely effect of lead exposure on the concentration of lead in the blood using the EPA Uptake/Biokinetic (UBK) model. Input parameters are lead concentrations for all exposure pathways. The model produces a probability function that predicts the probability of blood-lead in child residents. Remedial Action Goals are established to provide no greater than a 5% probability that a child in the exposed population will have a blood-lead level greater than 10 ug/dl. That is, in an exposed population of 100 children, no more than 5 would have a blood-lead level greater than 10 ug/dl.

Model input parameters for the Cleveland Mill Superfund Site were site-specific concentrations of lead in the soil, water and air. Default values based on models were used when site-specific concentrations were unknown. Table 7-30 in Appendix A lists lead modelling results for various areas at the Cleveland Mill Superfund Site. In order to be protective, EPA has established there can exist no greater than a 5% probability that a child in the exposed population will have a blood-lead level above 10 ug/dl as calculated using the UBK model. At the Cleveland Mill Superfund Site, EPA determined, based on the UBK model, that the lead concentrations in the tailings and sediment would result in blood lead levels greater than 10 ug/dl with more than a 5% probability in the future child residents, which would exceed EPA recommendations and, therefore, pose an unacceptable health risk. Based on the UBK model, a soil lead concentration of 500 ppm is approximately the maximum allowable concentration that will result in a 95% probability that the children will have blood lead levels below 10 ug/dl. The concentration of 500 ppm is deemed adequately protective for direct human contact in residential settings (OSWER Directive #9355.4-02). Soil lead concentrations in the tailings and sediment and as a site-wide average are greater than 500 ppm. Therefore, a Remedial Action Goal for lead of 500 ppm was established.

G. Uncertainties Associated with Human Health Risk Calculations

Within the Superfund process, baseline quantitative risk assessments are performed in order to provide risk managers with a numerical representation of the severity of contamination present at the Site, as well as to provide an indication of the potential for adverse public health effects. There are many inherent and imposed uncertainties in the risk assessment methodologies. Uncertainties in the Human Health Risk Assessment include sampling data that may not fully characterize the contaminants at the Site, exposure factors that are extrapolated from animal or laboratory studies, and inhalation concentrations derived from a soil exposure model. Uncertainties in the Ecological Risk Assessment include sampling data that may not fully characterize the contaminants, estimations of the range and exposure factors for the affected species, the use of literature information and not site-specific ecological studies, the exclusion of bioaccumulation or bioavailability as factors, and extrapolation of toxicity values from literature or laboratory studies.

Note that the Reasonable Maximum Exposures calculated in the risk assessment are intended to represent the upper end of the distribution curve. Therefore, most people are likely to be exposed to lower doses than this calculated value.

H. Central Tendency Exposure

Based on a February 26, 1992, memorandum from Deputy Administrator F. Henry Habicht, EPA is required to evaluate both the "reasonable maximum exposure" (RME) to which humans may be subjected due to contamination at a Superfund site, and "central tendency" in the risk assessment at Superfund sites. Exposure assumptions discussed to this point in the ROD have been associated with the RME which was used to estimate the baseline risks and ultimately the Remedial Action Goals at sites. The "central tendency" scenario represents the risk expected for humans due to an estimated "average" exposure, instead of a "reasonable maximum" exposure. The Risk Assessment portion of the Remedial Investigation includes a central tendency risk assumption labeled as "Typical Exposure". (See Appendix A, Tables 7-5 to 7-15, and 7-23 and 7-24.)

I. Ecological Risks

The baseline ecological risk assessment provides a qualitative evaluation of the environmental risks at the Cleveland Mill Site. The Site ecology was evaluated to determine if contamination from the Site could be causing any significant adverse ecological impact. The two exposure media potentially presenting the greatest threat to biota were addressed: contaminated tailings and sediment, and surface water. Terrestrial biota may be exposed to contaminants in the soil through dermal contact, ingestion, inhalation, and absorption. Aquatic and terrestrial biota may be exposed to Site contaminants in the surface water and contaminated sediments of Little Walnut Creek.

The region surrounding the Cleveland Mill Site supports one proposed threatened species, the Mexican spotted owl, and two Category I species, the Mimbres figwort and the Southwestern willow flycatcher. Category I species are candidates for which there is substantial information to support listing as endangered or threatened. In addition, deer, small mammals, birds, amphibians, and reptiles are wildlife species that may be exposed at the Site, as well as aquatic invertebrates and fish in Little Walnut Creek. Animals may also be exposed through consumption of organisms that have accumulated site-related chemicals. Potential risk exists for vegetation growing in contaminated tailings and sediment of Little Walnut Creek.

Resident wildlife, which spend less than a lifetime on-site, are likely to receive low to moderate exposures to Site contaminants. Small mammals whose home range is contained entirely on-site are likely to receive a proportionately greater exposure than larger mammals and birds that may spend a fraction of their time on-site throughout the year or on a seasonal basis. It is assumed that organisms occurring near sample locations are likely to be exposed to measured contaminant concentrations.

Twelve metals present in soil, sediment and surface water associated with the Site were selected as contaminants of concern for the purposes of the ecological risk assessment. These are listed in Table 7-31 of Appendix A for the various media. Heavy metals can have toxic affects on wildlife. They may also act synergistically, antagonistically, or competitively in living systems and environments. The risk generated by contaminants can be qualitatively determined through comparison with benchmarks for aquatic environments, and through studies of their toxic affect on plants and animals in the terrestrial environment. Ecological risk for the Cleveland Mill Site was evaluated qualitatively so contaminant intake by animals was not measured. However, concentrations of metals in tailings and sediments and in the surface water are significantly elevated above background concentrations. Therefore, the Site poses a potential risk to flora and fauna.

A number of uncertainties are associated with the analysis of potential adverse ecological effects at this site. The use of regional species studies and toxicological studies presents uncertainties for Site-specific ecological risk assessment. These uncertainties include (1) extrapolating toxicity criteria and exposure parameters for home range and dietary estimates from literature studies to Site-specific assessment, (2) assumptions regarding dietary habits of the receptors assessed and (3) representativeness of species selected.

Bioavailability is a major uncertainty in interpreting the potential for adverse biological effects from exposure estimates based on measurements of bulk chemical concentrations in environmental media. Chemical and physical changes in environmental media that increase or decrease the solubility of metals also increase or decrease their bioavailability.

Synergisms among chemicals present at exposure points may increase the risk of adverse effects occurring in exposed organisms.

Imminent and Substantial Endangerment

Actual or threatened releases of hazardous substances from the Cleveland Mill Site, if not addressed by implementing the response action selected in this ROD, may be an imminent and substantial endangerment to public health or welfare or the environment. This determination that the release at and from the Site may present an imminent and substantial endangerment was made using EPA Risk Assessment guidance including, but not limited to, "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A" (HHEM) (EPA/540/1-89/002), "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part B" (OSWER Directive 9285.7-01B), "Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual" (EPA/540/1-89/001) and the companion manual "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (EPA/600/3-89/013).

VII. REMEDIAL ACTION GOALS

The reader should note that there are two terms used in this ROD which may sound similar, but which have distinct meanings. A Remedial Objective is a broad intent to address a type of risk to human health and the environment. A Remedial Action Goal is the allowable concentration of contaminants which may remain in a specific medium (such as soil, surface water or ground water) at the Site, after implementation of this ROD.

The contaminated tailings and sediment are considered to be principal threats at the Site. They are considered principal threats because of the risk they pose through direct contact, ingestion, and inhalation. The contaminated tailings and sediment are also considered principal threats because of the potential for migration of the contaminants in the tailings and sediment to the ground water and surface water. At the Site, ARARs are not available for certain contaminated media, or are not sufficiently protective because of the presence of multiple contaminants at the Site, or multiple pathways of exposure; therefore, for known or suspected carcinogens, the 10^{-6} risk level (or one in one million risk of getting cancer during a lifetime, or a part of a lifetime, of exposure to Site contaminants) was used as a point of departure in establishing Remedial Action Goals. For non-carcinogenic systemic toxicants, Remedial Action Goals were set based on a Hazard Index of 1 (See the Summary of Site Risks Section of this ROD, Section VI). Remediation of the tailings and sediment is necessary because the carcinogenic risk from these media is greater than 1×10^{-6} (one in one million) and the Hazard Index (HI) for three contaminants at the Site is greater than one. The risk posed by each individual contaminant
in the contaminated tailings and sediment is at least one order

of magnitude greater than the background risk for that individual contaminant.

Ground water is also a concern at the Site because the ground water in the shallow perched aquifer at the toe of the tailings pile is contaminated above federal and state standards called Maximum Contaminant Levels (MCLs) and New Mexico Water Quality Control Commission (NM WQCC) standards. Surface water is also contaminated above these federal and state standards. Safe Drinking Water Act (SWDA) Maximum Contaminant Levels (MCLs) represent the maximum permissible concentration of a contaminant in water that may be delivered to the free-flowing outlet of the ultimate user of a public water system under federal law (40 CFR §141.2). New Mexico Water Quality Control Commission (NM WCQQ) standards specify the maximum permissible concentration of a contaminant which may remain in ground water as a result of discharge onto or below the surface of the ground.

The Remedial Action Goals for the contaminated tailings and sediment are given in terms of a numerical value. Tailings and sediment shall be remediated until the contaminant concentrations in the remaining tailings and sediment, including, but not limited to, all Site soils does not exceed any of the values given in Table 8.

The methodology for determination of the Remedial Action Goals for lead, carcinogenic contaminants and non-carcinogenic contaminants follows:

Lead: The Remedial Action Goal for lead was calculated using EPA's Uptake/Biokinetic (UBK) model. The UBK model was used to predict a lead concentration in soils such that 95% of the exposed residential population of children would have resulting blood lead levels less than 10 ug/dl. The soil lead concentration corresponding to this percentage and this blood lead level is 500 ppm, which was chosen as the Remedial Action Goal.

Carcinogenic Contaminants: The major contributors to the carcinogenic risk at the Site are arsenic and beryllium. The calculated risk-based remediation concentrations which would bring the risk within EPA's acceptable risk range, for both arsenic and beryllium, are less than the background concentrations, so the background concentrations of 30 ppm for arsenic and 4 ppm for beryllium were chosen as the Remedial Action Goals.

Non-carcinogenic Contaminants: The major contributors to the non-carcinogenic risk at the Site are arsenic, cadmium and zinc. Non-carcinogenic risk is measured by the Hazard Index (HI) which is considered unacceptable for an individual contaminant if it is above 1. In other words, a contaminant is normally remediated if

TABLE 8 - FINAL REMEDIAL ACTION GOALS FOR THE CLEVELAND MILL SUPERFUND SITE

Final Remedial Action Goals					Corresponding Risk Levels	
					Chemical Specific RME Risk (a)	
Medium	Chemical	Remediation Level (ppm)	Point of Compliance	Basis of Goal	Cancer Risk	Non-Cancer Hazard Index
Tailings and Sediment	Arsenic	30	All Site Grounds	Background	1.1E-04	0.41
	Beryllium	4		Background	3.6E-05	3.4E-03
	Cadmium	140		Risk	7.1E-07	1
	Lead	500		UBK Model	N/A	N/A
	Zinc	82000		Risk	N/A	1

Footnote (a): Cancer risks are measured as individual incremental lifetime; non-cancer as Hazard Indices. RME = reasonable maximum exposure.

it has a Hazard Index greater than 1. If the background HI is higher than 1 for a certain contaminant, that contaminant is normally remediated to the background HI. The HI is also additive across a site which means that the HI of all contaminants can be added together to determine a cumulative HI for a site. At the Cleveland Mill Superfund Site, arsenic, cadmium and zinc all have an HI greater than 1. Therefore, the Site cumulative HI is greater than 3. The background cumulative HI at the Site is 2.3.

The Remedial Action Goals for the three major contaminants contributing to the non-carcinogenic risk at the Site are given individually and as a cumulative Site HI. Individually, arsenic has a background HI of 1.13 which is greater then 1. Therefore, the background value of 30 ppm was chosen as the individual non-carcinogenic Remedial Action Goal for arsenic. For the remaining major contaminants that contribute to the non-carcinogenic risk, the concentrations corresponding to an individual HI of 1, 140 ppm for cadmium and 82,000 ppm for zinc, were chosen as the individual non-carcinogenic Remedial Action Goals.

The Remedial Action Goal for the Cumulative Site HI must also be met in addition to the individual Remedial Action Goals for the three major non-carcinogenic contaminants. After excavation, the cumulative Site HI must be less than or equal to the Site background HI of 2.3. Again, the Site HI is additive and it is calculated by adding the HIs of all contaminants at the Site, not only the HIs of each of the three major contaminants that contribute to the non-carcinogenic risk. Therefore, if each major non-carcinogenic contaminant were brought to an HI of 1 and added with several minor contaminants with fractional HIs, the cumulative Site HI would be slightly more than 3, which would still be above the background HI. Because the contaminants may not be distributed homogeneously in a vertical direction, it is possible that during excavation, one or all of the contaminants may be reduced to an HI of much less than 1, causing the cumulative HI to be less than 2.3. Because of the numerous combinations of HIs and their corresponding concentrations that could result in a cumulative HI of less than background, the individual HIs are given in this ROD. This ROD requires that all individual non-carcinogenic Remedial Action Goals (HIs) be met. As far as the cumulative HI for the Site is concerned, EPA has no preference as to how this cumulative HI of 2.3 (Site background) is met. That is, clean-up of the Site could meet the Remedial Action Goals for the cumulative HI in any number of ways.

Note that the HI for zinc shown in the March 1993 Remedial Investigation Report has been changed. (The recalculation using a reference dose of .3 mg/kg-day, instead of .2 mg/kg-day, appears in Appendix A of this ROD and is further explained in Question #68 of the Responsiveness Summary, Appendix E of this ROD). The recalculation of the HI for zinc did not change the HI dramatically. For a child, the HI changed from 1.91 to 1.27 for the future residential scenario. The recalculated HI remained greater than 1 and must be remediated.

The approximate volume of the material which must be remediated is 70,900 cubic yards. The contaminated tailings and sediment are found in several areas of the Site. For a detailed breakdown of the areas of contamination and their corresponding volume, see Section V.E.

One of the Remedial Objectives for the Site is to return the shallow perched aquifer at the toe of the tailings to a condition where the concentration of contaminants is below MCLs and NM WQCC standards. Because ground water at the Site has been identified as a potential source of drinking water, MCLs and NM WQCC standards are applicable. The ground water at the Site and in the surrounding area was sampled and evaluated against these federal and state standards.

Sample results from a monitor well completed in the shallow perched aquifer showed that several dissolved metals and indicator parameters were found in the ground water in concentrations exceeding background levels, MCLs and NM WQCC standards. An indicator parameter is a substance which is not a contaminant, but which is frequently associated with contaminants. The indicator parameters detected in the ground water are substances which are found in the tailings and sediment at the Site. The substances do not normally occur in area waters in such high concentrations. These dissolved metals and indicator parameters were identified at a depth of 7 feet in near surface colluvium and weathered bedrock that comprise a shallow perched aquifer at the toe of the main tailings piles. A spring located immediately south of the western tailings pile also showed elevated levels of some contaminants and indicator parameters. No underlying bedrock aquifer was identified, though exploratory drilling was done to a depth of 110 feet. Ground water discharges from the shallow perched aquifer at the toe of the tailings in the form of seeps and springs which flow into the headwaters of Little Walnut Creek. In short, except for discharges to the surface through the springs and seeps, the ground water contamination appears to be limited in vertical and lateral extent within the shallow perched aquifer at the toe of the main tailings piles. Ground water from this aquifer is not currently used for human consumption.

The shallow, perched aquifer in the mill area is not directly hydraulically connected with the aquifers from which downstream residents obtain their drinking water. Therefore, contaminated ground water discharges from the perched aquifer and contributes to surface water contamination in the mill valley tributary and Little Walnut Creek. Therefore, the potential exists for contaminants to migrate downstream and into residential wells via infiltration of contaminated surface water from Little Walnut Creek which flows across the Colorado Formation and Quaternary alluvial aquifers that are used for drinking water. Ground water samples from residential wells and monitoring wells located 1.3 to 3.8 miles downstream in the Quaternary alluvium and Colorado Formation aquifers did not exceed regulatory standards. Therefore, EPA and NMED have determined that active treatment of the ground water is not warranted at this time. This determination is based upon EPA's and NMED's evaluation of site-specific data indicating that ground water contamination is currently limited to the shallow perched aquifer at the base of the main tailings piles which is not directly hydraulically connected with the aquifers from which downgradient residences obtain their drinking water. Under the selected alternative, removal of the contaminated tailings and sediment, the source of the ground water contamination, along with natural attenuation, should eliminate any potential threat to human health or the environment posed by contamination of ground water.

It is difficult to determine how long it will take for natural attenuation of contamination, in the shallow perched aquifer, to occur once the tailings and sediments are removed. Based on the nature of the aquifer and its contaminants, EPA and NMED estimate that natural attenuation will take 5 years. Contingency measures may be implemented in the event that contamination exceeding Remedial Action Goals persists after 5 years of monitoring.

Ground water contingency plans may be required by EPA, in consultation with NMED, in the following situations:

1) If, after five years of monitoring (5 years begins on the date that the contaminated tailings and sediments are removed), the shallow perched aquifer is still contaminated above remedial action goals; or

2) If any other aquifer at or near the site shows contamination above Remedial Action Goals.

If EPA requires contingency measures to be implemented, the ground water shall be remediated to MCLs or NM WQCC standards, whichever is more stringent, for each contaminant. For the contaminants of concern, these Remedial Action Goals (MCLs except as noted) under the ground water contingency measures are arsenic, .05 milligrams per liter (mg/l); beryllium, .004 mg/l; cadmium, .05 mg/l; lead (NM WQCC standards), .05 mg/l; copper, 1.0 mg/l; mercury, 0.002 mg/l; silver, 0.05 mg/l (NM WQCC standards); and zinc, 5 mg/l. For newly discovered contaminants of concern, without promulgated MCLs and NM WQCC standards, maximum concentrations left untreated will be those which produce a human health risk of 10^{-6} or less, unless the background concentration is higher than the concentration producing the 10^{-6} risk, in which case, the maximum concentration left untreated will be the background concentration. For newly discovered non-carcinogenic compounds without promulgated MCLs and NM WQCC standards, the maximum concentrations left untreated will be those that correspond to a Hazard Index less than or equal to 1 of the background HI for that contaminant, whichever is higher. The risk will be calculated using the assumptions in the Site Risk Assessment for the future resident scenario.

VIII. DESCRIPTION OF ALTERNATIVES

A feasibility study was conducted to ensure that appropriate remedial alternatives were developed and evaluated for the Site such that relevant information concerning the remedial alternatives could be reviewed and an appropriate remedy selected for the contamination at the Site. Remedial alternatives were assembled to address potential problems identified in source material (contaminated tailings and sediment) which has contaminated surface water and the shallow perched aquifer at the toe of the tailings and which may contaminate other media such as downstream ground water and surface water. Through remediation of the contaminated tailings and sediment, adverse effects on surface water are expected to be mitigated, and the potential for adverse effects on the ground water that supplies the residential wells downstream is expected to be significantly reduced. Each alternative includes ground water monitoring to assure that during and after the remediation, the ground water in the downstream aquifers remains safe for human consumption. In addition, the monitoring of surface water and ground water at the toe of the tailings will show if the remediation of the source of the contaminants and natural attenuation are causing a decrease in the levels of contaminants. In the event that control of the contaminated tailings and sediment does not provide for decreasing levels of contaminants in the ground water in the shallow perched aquifer at the toe of the tailings, contingency measures, as described later in this section, shall be implemented if EPA so requires.

The remedial action alternatives for this response action are presented below with a description of the common elements contained in each alternative. The costs of several of the alternatives differ from those costs described in the Proposed Plan because the estimates have been refined based on several factors. These factors include a revised estimate of transportation cost, both for those alternatives that involve taking the waste material off-site and for those alternatives that leave the waste material on-site. These factors also include refinements to the alternatives themselves based on public comments. The refined cost estimates are presented in Appendix B.

A. Tailings and Sediment

This section discusses remedial alternatives designed to address the contaminated tailings and sediment site-wide. Tailings and sediment is the principal contaminated media at the Site. The total amount of tailings and sediment that shall be addressed in the remediation of the Site is approximately 70,900 cubic yards. In addition to the health and environmental risks posed directly, the tailings and sediment are also the source of surface water contamination, and the source of the shallow perched ground water contamination in the mill area.

Certain contaminants at the Site are responsible for most of the risk to human health or the environment at the Site. In other words, these certain contaminants "drive the risk". The contaminants of concern driving the risk to human health, due to potential exposure to contaminated tailings and sediment, are arsenic, beryllium, cadmium, lead and zinc. The contaminants of concern are all inorganic chemicals.

Of the 89 surface and subsurface samples taken of tailings and sediment in the mine and mill area and from the roadbed sediment, 79 were analyzed using the Toxicity Characteristics Leaching Procedure (TCLP). TCLP is a type of leaching test described under the Resource and Recovery Act ("RCRA"), 42 U.S.C. 6901 et seq., that can be performed to determine whether or not metals will leach from a waste. Of the 79 samples, 8 samples exceeded the RCRA TCLP regulatory level set for cadmium in 40 CFR §261.24 Table 1 of 1.0 milligrams per liter, and 1 sample exceeded the regulatory level set for lead of 5.0 milligrams per liter. Fifty-two samples taken of tailings and sediment in the streambed of Little Walnut Creek and its tributary were analyzed using TCLP. Of the 52 samples, 1 exceeded the RCRA TCLP regulatory level set for lead of 5.0 milligrams per liter. Although some of the samples exceeded the RCRA regulatory limit for lead and cadmium, the contaminated tailings and sediment are not considered a "hazardous waste" as that term is defined in RCRA. (See Section IX. D.2. of this ROD.)

A brief description of the five detailed alternatives evaluated to address the contaminated tailings and sediment follows. For convenience, in this ROD, Alternatives 1a and 1b are referred to generally as one alternative, and sometimes called collectively "Alternative 1" or the "No Action Alternative", because neither requires remediation of the contamination. The alternatives are:

- **Alternative 1a;** No Action
- **Alternative 1b;** Institutional Controls
- **Alternative 2;** Excavation, On-Site Disposal and Multi-layer Capping
- **Alternative 3;** Excavation, On-Site Stabilization/ Solidification, On-Site Disposal and Capping

- **Alternative 4;** Excavation, On-Site Stabilization/ Solidification, Off-Site Disposal and Capping
- **Alternative 5;** Excavation, Off-Site Reprocessing, Reclamation and Disposal of Residuals (This is the remedy selected by EPA and NMED)

Common Elements:

The volume and locations of the various materials to be addressed under all of the remedial alternatives reviewed in the FS, except Alternative 1, are listed below. These volumes assume excavation of all tailings and sediment with concentrations of contaminants which exceed Remedial Action Goals. The actual volume of tailings and sediment to be excavated will be further refined during the remedial design phase of the remedy, based on additional sampling to determine the depth of contaminated tailings and sediment with contaminant concentrations above Remedial Action Goals.

Waste Area	**Volume (cubic yards)**
Main Tailings Piles	30,000
Cobbed Ore Pile	15,000
Mine Spoils	15,000
Creek Sediment	6,000
Western Hillside Waste Piles	2,500
Roadbed Soils	1,500
Dust Piles	900
Total Volume	70,900

Each of the alternatives listed above, other than Alternative 1, are intended to address the tailings and sediment, and have the following common elements: site preparation, restoration of the site surface upon completion of the remedial action, improvement of and repair of roads that are affected by the remedial action, and issuance of deed notices to advise future owners about the risks of disturbing the cover and/or the underlying material.

All of the alternatives, except the No Action Alternative, have a ground water monitoring element, which includes monitoring of the shallow perched aquifer in the mill area, monitoring of the springs in the mill and mine area, and monitoring of selected downgradient residential wells. Ground water monitoring shall be conducted to ensure that, under each of the alternatives, removal of the source of the contamination and natural attenuation of contaminants results in decreasing levels of contaminants in the shallow perched aquifer at the toe of the tailings and in the mill area springs, and to ensure that the residential wells do not become contaminated above MCLs or NM WQCC standards. The number and placement of the monitoring wells will be determined by EPA, in consultation with NMED, during the Remedial Design Phase. The wells and the springs which are part of the ground water monitoring program shall be analyzed for, at the minimum, the contaminants of concern, total dissolved solids, pH and major cations and anions.

One of the Remedial Objectives for the Site is to return the shallow perched aquifer at the toe of the tailings to a condition where the concentration of contaminants is below MCLs and NM WQCC standards. The length of time and the frequency of monitoring vary from one alternative to the other. Under Alternatives 2 and 3, which leave the waste material on-site, the ground water monitoring program would include institutional controls, installation of monitoring wells downgradient of the disposal and excavation area, quarterly sampling of new and existing monitoring wells for the first five years, and annual sampling for up to 30 years. Under Alternatives 4 and 5, which involve waste excavation and transport off-site, the ground water monitoring program would include institutional controls, installation of monitoring wells downgradient of the excavated mill tailings, and quarterly sampling of new and existing monitoring wells for the first five years. Under Alternatives 4 and 5, ground water monitoring would continue for up to 30 years if elimination of the source material (tailings and sediment) and natural attenuation did not bring the levels of contaminants in the monitoring wells below the regulatory levels discussed in the Remedial Action Goals section of this ROD.

An additional part of the monitoring program in each alternative, except in the No Action Alternative, would be monitoring of the surface water in the mill valley tributary and in Little Walnut Creek. The surface water monitoring would be conducted annually for at least 5 years as determined by EPA, in consultation with NMED.

All remedial alternatives were assessed as required under CERCLA to determine whether they attain applicable or relevant and appropriate requirements under federal and state environmental laws. These requirements are called ARARs. RCRA is not an ARAR for the remediation of the Site under any of the remedial alternatives. RCRA is not applicable to the contaminated tailings and sediment since the tailings and sediment are exempt from categorization as a hazardous waste, under 40 CFR §261.4. The Subtitle C requirements of RCRA were determined to be relevant in that certain samples did leach toxic materials at levels that failed RCRA standards when the Toxicity Characteristic Leaching Procedures (TCLP) was applied. However, EPA has completed an extensive national study of the type of contaminated material found at the Site-- solid waste from the extraction, benefication, and processing of ores and minerals, and determined that it should not be regulated under RCRA Subtitle C (see e.g. 54 Fed. Reg. 36614 (Sept. 1, 1989)); therefore, RCRA is not an appropriate requirement for any remedial alternative for the Site.

All of the remedial alternatives listed above will meet ARARs, which are the same for each of the alternatives. RCRA does not provide any chemical-specific ARARs which pertain to the remediation of the Site. There are location-specific ARARs, which do pertain to the remediation due to the fact that the Site is adjacent to a National Forest which contains endangered species, and due to the fact that the Site remediation may involve areas that have cultural and historical significance as defined in the National Historic Preservation Act. Any implementation of the off-site removal portion of the selected remedy, under this ROD, shall be carried out in compliance with EPA's Off-Site Policy, (CERCLA Section 121(d)(3) 42 U.S.C. Section 9621(d)(3)) along with all other applicable federal, state and local requirements. For a detailed list of ARARs see Sections IX and Section X of this ROD.

All of the alternatives, with the exception of Alternative 1, involve treating and/or containing tailings and sediment that have contaminant concentrations which exceed Remedial Action Goals. Alternative 1 will not meet the Remedial Action Goals for the Site. Alternatives 2, 3, 4 and 5 will meet the Remedial Action Goals because, under each alternative, the risk from exposure to contaminated tailings and sediment will be reduced or eliminated through excavation or treatment of the tailings and sediment.

All of the alternatives, with the exception of Alternative 1, include air monitoring during any excavation, during any on-site materials handling, and during any transport of contaminated materials. The air monitoring shall be on-site, at the Site boundary during excavation, and in the community during transportation.

All costs and implementation times are estimates. The costs have a degree of accuracy of +50% to -30% pursuant to the "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA - Interim Final" OSWER Directive 9355.3-01, October 1988. As noted previously, the costs for the alternatives have been revised since the Proposed Plan. (See Appendix B).

For each of the alternatives, the Site shall be re-evaluated five years after implementation of the remedy to determine if the remedy is providing the intended protection to human health and the environment.

1. **Alternative 1a: No Action**

Capital Cost: $0
Annual Operation and Maintenance: $5,000
Present Worth : $15,000
Implementation Time: 0 months

Major Components of the Remedial Action: EPA is required by the National Contingency Plan (40 CFR 300) to consider a No Action alternative as a basis of comparison when evaluating other alternatives. The No Action alternative would not involve any remedial actions. The Site would remain as it exists at the present time.

Treatment and Containment Components: No treatment or containment of the contaminated tailings and sediment would occur.

General Components: There are no costs associated with this alternative. Operation and maintenance (O&M) costs are estimated to be $5,000 every five years for the performance of a five-year review, required under CERCLA when contaminated material is left on-site. The present worth cost is estimated to be $15,000.

EPA and NMED do not favor this alternative because it would not decrease the toxicity, mobility, or volume of contaminants or address risks to public health or risks to the environment.

Alternative 1b: Limited Action

Capital Cost: $0
Annual Operation and Maintenance: $56,750
Present Worth : $246,878
Implementation Time: 2 months

Major Components of the Remedial Action: Under Alternative 1b, a limited action would be taken with respect to the tailings and sediment at the Site.

Under the limited action alternative provisions would be made for monitoring and institutional controls to limit use of the mill site and the ground water, but the limited action would not remediate the contamination. Warning signs would be posted to restrict access to the Site by unauthorized people. The institutional control used would be deed notices that would advise future owners of the potential health risks from exposures the tailings, soils, and surface water. These deed notices would only provide an alert, and it may be that they could not be used to restrict activities on the Site through legal action. The contaminated tailings and sediment would continue to be a source of leachate generation and this leachate would continue to contaminate shallow ground water at the base of the tailings, migrate into Little Walnut Creek, and potentially contaminate downstream aquifers.

As described in the Common Elements section of this ROD, a long-term ground water monitoring program would be established to monitor existing ground water contamination at the mill site and potential migration of contaminants to downstream aquifers. The ground water monitoring program in this alternative differs from the other alternatives in that this alternative, the Limited Action Alternative, would not include the installation of additional monitoring wells. The well network currently in place would be used.

Treatment Components: There is no treatment element in Alternative 1, because it will involve institutional controls only.

Containment Components: There is no containment element in this alternative because the contaminated material is left in place without placement of a cover.

General Components: The estimated time to implement this remedy is 2 months for set up of the institutional controls and 30 years for monitoring of wells. The estimated costs are: Capital Costs: $0; O&M Costs: $56,750 (annual); Present Worth: $246,878.

EPA and NMED do not favor this alternative because it would not decrease the toxicity, mobility, or volume of contaminants or address risks to public health or risks to the environment.

2. Alternative 2: Excavation, On-Site Disposal and Multi-Layer Capping

Capital Cost: $2,676,303
Annual Operation and Maintenance: $138,150
Present Worth : $3,324,701
Implementation Time: 6 months

Major Components of the Remedial Alternative: Under Alternative 2, approximately 70,900 cubic yards of contaminated tailings and sediment would be excavated, moved, and consolidated in an on-site disposal area. The consolidation would be followed by construction of a polyethylene and geo-textile cover that would be subsequently covered with soil and revegetated. Under Alternative 2, tailings and sediment would be moved out of the headwaters of Little Walnut Creek thereby reducing the potential for acid-leaching of the tailings and sediment by infiltration of surface and subsurface waters, and transport of the tailings and sediment into the creek. Under this alternative, surface water would be diverted away from the capped area and long-term operation and maintenance (O&M) would be conducted to monitor the ground water around the disposal area, to ensure the that the integrity of the cap is consistently maintained.

Treatment Components: There is no treatment element in Alternative 2, since it will only involve consolidation of the contaminated material.

Containment Components: Under Alternative 2, the tailings and sediment would be excavated and disposed of in an on-site disposal area located away from natural drainages areas and covered. The action would serve to consolidate the acid-producing material and keep water from contacting the surface of the disposal area. The disposal cell would be unlined, with the bottom at least 50 feet above the seasonal high ground water table.

Under Alternative 2, the polyethylene and geo-textile cover would be designed and constructed to promote drainage around the disposal cell, minimize erosion, and provide long-term minimization of migration of liquids through the underlying tailings, sediment and soil. The revegetated soil cover would offer added protection by further preventing rain water from migrating to the tailings and sediment and would require minimal maintenance.

General Components: The estimated time to implement this alternative is 6 months. Institutional controls, ground water monitoring, and, if necessary, repair and improvement of Little Walnut Road would be implemented, as part of the remedy under Alternative 2. The estimated costs of Alternative 2 are: Capital Costs $2,676,303; O&M Costs $138,150 (annual); Present Worth $3,324,701.

3. Alternative 3: Excavation, On-Site Stabilization/ Solidification, On-Site Disposal and Capping

Capital Cost: $5,980,216
Annual Operation and Maintenance: $136,150
Present Worth : $6,619,187
Implementation Time: 12 months

Major Components of the Remedial Alternative: Under Alternative 3, approximately 70,900 cubic yards of contaminated tailings and sediment would be treated on-site by stabilization and solidification, moved to an on-site disposal area, and covered with a soil cap. The soil cap would be subsequently revegetated with native plants. Like under Alternative 2, under Alternative 3, tailings and sediment would be moved out of the headwaters of Little Walnut Creek thereby reducing the potential for acid-leaching of the tailings and sediment by infiltration of surface and subsurface waters and transport of the tailings and sediment into the creek. Surface water would be diverted away from the capped area and long-term operation and maintenance (O&M) would be conducted to monitor the ground water around the disposal area, to ensure the that the integrity of the cap is consistently maintained.

Unlike Alternative 2, Alternative 3 contains a treatment element which reduces the mobility of the contaminants in the tailings and sediment. The purpose of the treatment is to immobilize the inorganic contaminants. Long-term operation and maintenance (O&M) would be conducted to monitor the ground water around the disposal area and to ensure the integrity of the soil cap.

Treatment Components: Alternative 3 does have a treatment element, since it would involve on-site stabilization and solidification. Stabilization and solidification are a combination of treatment technologies whereby a waste is mixed with various reagents such as cement or fly ash, which harden and transform the waste into a solid mass. The contaminants within the solid mass are held in place by strong chemical bonds which minimize the leaching of the contaminants. Stabilization limits the solubility or mobility of the contaminants by maintaining them in their least mobile or toxic form. The effectiveness of stabilization is generally measured through a series of tests that determine whether or not the contaminants will leach out of the stabilized mass and if they do, the concentration of the contaminants in the leachate. Solidification produces a solid block of material with high structural integrity, the effectiveness of which is measured through testing the material's compressive and tensile strength in order to prove that a physical bond exists.

Under Alternative 3, the inorganic contaminants would be chemically bonded, thus minimizing their leaching potential into the ground water. Stabilization is an established and effective means of treating most types of inorganic contamination in soils. Based on historical treatability studies conducted on similar tailings and sediment; however, the ability to stabilize high concentrations of arsenic is uncertain. In addition, the limited stabilization and solidification treatability study conducted on Cleveland Mill contaminated tailings and sediment was inconclusive regarding the effectiveness of stabilization of contaminants of concern besides the arsenic.

Although arsenic cannot be stabilized, the presence of arsenic as a contaminant in the tailings and sediment will not adversely affect the solidification process. Based on preliminary Site treatability studies, the tailings and sediment can be successfully solidified with a minimum of a 30% volume increase. Additional treatability studies would be necessary, under

Alternative 3, to further define the most effective means of stabilization and solidification.

Containment Components: Under Alternative 3, the tailings and sediment would be excavated, solidified and stabilized, disposed of in an on-site disposal area located away from natural surface drainage areas, covered and revegetated. The action would serve to consolidate the acid-producing material, reduce the mobility of the contaminants, and keep water from contacting the surface and subsurface of the disposal area. The disposal cell would be unlined, with the bottom at least 50 feet above the seasonal high ground water table.

Like under Alternative 2, under Alternative 3, the soil cap would be designed and constructed to promote drainage around the disposal cell, minimize erosion, and provide long-term minimization of migration of liquids through the underlying stabilized and solidified mass. The revegetated soil cover would offer added protection by preventing rain water from directly contacting the stabilized and solidified mass, but the soil cover would require maintenance.

General Components: The estimated time to implement Alternative 3 is 12 months. Institutional controls, ground water monitoring, and, if necessary, repair and improvement of Site access roads, including Little Walnut Road, would be implemented, as part of the remedy under Alternative 3. The estimated costs are: Capital Costs $5,980,216, O&M Costs $136,150 (annual); Present Worth $6,619,187.

4. Alternative 4: On-Site Stabilization/Solidification, Off-Site Disposal and Capping

Capital Cost: $11,101,596
Annual Operation and Maintenance: $51,250
Present Worth : $11,479,046
Implementation Time: 12 months

Major Components of the Remedial Alternative: Implementation of Alternative 4 would involve the same activities as Alternative 3 with respect to excavation, solidification and stabilization of the contaminated tailings and sediment. However, the stabilized and solidified tailings and sediment would be disposed of in an off-site landfill permitted to accept these materials. The contaminated tailings and sediment is not defined as a hazardous waste under RCRA; however, the stabilization and solidification would be performed in order to provide added protection to human health and the environment. Once the material was stabilized, it would be less hazardous to transport because the chance of a release of contaminated material would be greatly reduced. However, a large volume increase would occur as a result of the stabilization and solidification prior to transportation off-site. The large number of trucks that would be required to transport this increased volume of tailings and sediment could pose some short-term transportation risks. (See the Transportation Appendix, Appendix C of this ROD.)

Treatment Components: The treatment element in Alternative 4 is the on-site stabilization and solidification of tailings and sediment prior to transportation to an off-site disposal facility. After stabilization and solidification, the inorganic material would be chemically bonded, thus reducing its leaching potential. Stabilization is an established and effective means of treating most inorganic contamination in soils. Based on historical treatability studies conducted on similar wastes, the ability to stabilize high concentrations of arsenic is uncertain, but the presence of arsenic in the tailings and sediment will not adversely affect the solidification process.

Under Alternative 4, the solidified and stabilized tailings and sediment would be sent off-site for disposal; consequently, it would no longer pose a risk at the site. Under Alternative 4, additional treatability studies would be necessary to further define the most effective means of Stabilization and Solidification.

Containment Components: Under Alternative 4, the stabilized tailings and sediment would be disposed of in a manner consistent with the state and federal requirements for the off-site landfill. No contaminated material would be stored or contained at the Cleveland Mill Superfund Site.

General Components: The estimated time to implement this remedy is 12 months. Institutional controls, ground water monitoring, and, if necessary, repair and improvement of Site access roads, including Little Walnut Road, would be implemented, as part of the remedy under Alternative 4. The estimated costs are Capital Costs $11,101,596; O&M Costs $51,250; Present Worth $11,479,046.

5. Alternative 5: Excavation, Off-Site Reprocessing, Reclamation and Disposal of Residuals

EPA and NMED's preferred Alternative

Capital Cost: $5,836,586
Annual Operation and Maintenance: $51,250
Present Worth : $6,214,036
Implementation Time: 12 months

Major Components of the Remedial Alternative: Implementation of Alternative 5 would involve the same activities as Alternative 4 with respect to excavation, and off-site transport of the contaminated tailings and sediment. Under Alternative 5, the contaminated tailings and sediment would be transported to an off-site facility where they would be reprocessed using the reprocessing method chosen by the off-site facility. The purpose of the reprocessing would be to reclaim valuable metals and to render the residual material less toxic and the contaminants in the residual material less mobile. The residual material would be disposed of at the reprocessing facility.

Treatment Components: Under Alternative 5, the contaminated tailings and sediment would be reprocessed at an ore-processing facility. Reprocessing shall remove both contaminants and metals that can be beneficially reused. The determination of the metals that would be removed from the tailings and sediment would depend upon the process employed by the reprocessing facility.

Containment Components: The residual would be disposed of in a disposal area at the reprocessing facility with other tailings and residuals from ore-processing. The disposal activities would be required to be conducted in accordance with applicable state and federal laws, as determined by EPA and the state in which the disposal facility is located. The reprocessing activity would have to meet and all federal and state laws.

General Components: The estimated time to implement the selected remedy is 2 months for site preparation, 8 months for excavation of and transport of the contaminated tailings and sediment, and 2 months for site restoration. The contaminated tailings and sediment must be reprocessed within one year of delivery to the reprocessing facility. Institutional controls, ground water monitoring, and, if necessary, repair and improvement of Site access roads, including Little Walnut Road, would be implemented, as part of Alternative 5. The estimated costs are Capital Costs $5,836,586; O&M Costs $51,250; Present Worth $6,214,036.

The cost of Alternative 5, is based, in part, upon EPA and NMED's projection that some valuable metals would be recovered and kept by the reprocessing facility. The recovery of valuable metals would help lower the cost of the remedy. Costs may go up, if the reprocessing facility cannot keep the valuable metal.

Ground Water Contingency Measures:

If the selected remedy, Alternative 5, cannot meet the specified Remedial Action Goals at any or all of the monitoring points, including those in the perched aquifer, after 5 years, the contingency measures and objectives described in this section of the ROD may be implemented. These measures are considered to protect human health and the environment, and are technically practical under the corresponding circumstances. Under the selected remedy, Alternative 5, EPA, in consultation with NMED, may require one or more of the following contingency measures to be put into effect if EPA, in consultation with NMED, later determines that there is contamination in ground water above

Remedial Action Goals. EPA may make such a determination if MCLs or NM WQCC standards are exceeded in any ground water monitoring well, including, but not limited to, those wells completed in the perched aquifer.

Ground water contingency plans may be required by EPA, in consultation with NMED, in the following situations:

1) If, after five years of monitoring (5 years begins on the date that the contaminated tailings and sediments are removed), the shallow perched aquifer is still contaminated above remedial action goals; or

2) If any other aquifer at or near the site shows contamination above Remedial Action Goals.

EPA may also make such a determination if EPA has any other reason to believe that ground water contamination above Remedial Action Goals exists 5 years from completion of removal of the contaminated tailings and sediment. The ground water contingency measures will be one or more of the following as determined by EPA in consultation with NMED:

- Installation of additional monitoring wells to confirm and better define the changing conditions in ground water contaminant concentrations.

- Development of a Remedial Action Plan which provides for the extraction, treatment, and reinjection or discharge or disposal of contaminated ground water in order to achieve ARARs.

- Implementation of a Remedial Action Plan subject to EPA disapproval of the plan, after NMED has had an opportunity to review and comment upon the plan.

- Waiving the ground water ARAR for the aquifer based on the technical impracticability of achieving contaminant reduction.

- Establishment of an Alternative Concentration Limit "(ACL") for the detected contaminants provided compliance with CERCLA 121 (d)(2)(B)(ii) can be demonstrated.

The ground water monitoring which is required under the selected remedy, provides for quarterly monitoring of ground water wells at the Site. Wells established as part of the ground water monitoring program during remedy design shall be used to determine 1) whether natural attenuation of the ground water contamination is taking place, and 2) whether the extent of ground water contamination has spread or diminished.

If contingency measures are implemented, EPA, in consultation with NMED, may require modification of the existing network of wells, changes in the type of analyses performed, or changes in frequency of sampling, in order to identify changes in ground water quality. The selected remedy is expected to prevent continued ground water contamination. However, as explained in Section VII, Remedial Action Goals, if monitoring wells detect contaminant concentrations which exceed MCLs or NM WQCC standards, site background or a concentration producing a risk greater than 10^{-6} or, if EPA determines, for any other reason, that ground water has become contaminated and requires remediation, EPA may require that the contingency measures listed be implemented.

IX. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The EPA uses nine criteria to evaluate alternatives for addressing a Superfund site. These nine criteria are categorized into three groups: threshold, balancing, and modifying. The threshold criteria must be met in order for an alternative to be eligible for selection. The threshold criteria are overall protection of human health and the environment and compliance with ARARs. The balancing criteria are used to weigh major tradeoffs among alternatives. The five primary balancing criteria are long-term effectiveness and permanence; reduction of toxicity, mobility or volume through treatment; short-term effectiveness; implementability; and cost. The modifying criteria are state acceptance; and community acceptance.

A. Threshold Criteria

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

This criterion addresses whether or not the alternative in question can adequately protect human health and the environment, in both the short- and long-term, from unacceptable risks posed by hazardous substances, pollutants, or contaminants present at a site by eliminating, reducing, or controlling exposures to levels established during development of remediation goals. Overall protection of human health and the environment draws on the assessments of other evaluation criteria, especially long-term effectiveness, and compliance with the Applicable or Relevant and Appropriate Requirements (ARARs) under federal and state environmental laws.

COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

This criterion addresses whether or not the alternative attains applicable or relevant and appropriate requirements under federal environmental laws and state environmental or facility siting laws or provides grounds for invoking one of the waivers of these requirements. There are three types of ARARs. Chemical-specific ARARs are usually health- or risk-based numerical values of methodologies used to determine acceptable concentrations of chemicals that may be found in or discharged to the environment, e.g. MCLs that establish safe levels in drinking water. Location-specific ARARs restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include flood plains, wetlands, and location where endangered species or historically significant cultural resources are present. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions or conditions involving specific substances.

B. Balancing Criteria

LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion assesses the alternative for the long-term effectiveness and permanence that it affords, along with the degree of certainty that the alternative will prove successful. Factors that are considered, include the following: (1) 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 volume, toxicity, mobility, and propensity to bioaccumulate. (2) Adequacy and reliability of controls such as containment systems and institutional controls that are necessary to manage treatment residuals and untreated waste. This factor addresses in particular the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cap, a slurry wall, or a treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

This criterion addresses the degree to which alternatives employ recycling or treatment that reduces toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by a site. Factors that are considered include the following: (1) The treatment or recycling processes the alternatives employ and materials they will treat; (2) The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled; (3) The degree of expected reduction in toxicity, mobility, or volume of the waste due to treatment or recycling and the specification of which reduction(s) are occurring; (4) The degree to which the treatment is irreversible; (5) The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents; and (6) The degree to which treatment reduces the inherent hazards posed by principal threats at a site.

SHORT TERM EFFECTIVENESS

This criterion assesses the short-term impacts of alternatives considering the following: (1) Short-term risks that might be posed to the community during implementation of an alternative; (2) Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures; (3) Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation; and (4) Time until protection is achieved.

IMPLEMENTABILITY

This criterion addresses the ease or difficulty of implementing the alternatives by considering the following types of factors as appropriate; (1) Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy (2) Administrative feasibility, including 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 off-site actions); (3) Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and availability of prospective technologies.

COST

This criterion addresses the types of costs that shall be assessed including the following: (1) Capital costs, including both direct and indirect costs; (2) Annual operation and maintenance (O&M) costs; and (3) Net present values of capital and O&M costs.

C. Modifying Criteria

STATE ACCEPTANCE

Assessment of state concerns may not be completed until comments on the RI/FS are received but may be discussed, to the extent possible, in the proposed plan issued for public comment. The state concerns that are assessed under this criterion include the following: (1) The state's position and key concerns related to the preferred alternative and other alternatives; and (2) state comments on ARARs or the proposed use of waivers.

COMMUNITY ACCEPTANCE

Assessment of community acceptance includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. Community Acceptance allows for a public comment period for interested persons or organizations to comment on the proposed remedy. EPA considers these comments in making its final remedy selection. The comments are addressed in the Responsiveness Summary which is included as Appendix E of this ROD.

D. Comparative Analysis of Alternatives

1. Overall Protection of Human Health and the Environment

The discussion regarding whether the alternatives can adequately protect human health and the environment in both the short- and long-term from unacceptable risks, posed by the hazardous substances at the Site, follows immediately below, and also appears under the short-term effectiveness and long term effectiveness sections. Likewise, the discussion regarding whether the various alternatives meet ARARs, in the sections which follow, incorporates some discussion as to whether the alternatives examined can protect human health and the environment. EPA and NMED's overall view as to whether the alternatives are protective appears immediately below.

All of the remedial alternatives considered for the Site, except No Action, will provide some degree of overall protection of human health and the environment. The degree to which each alternative provides this protection is discussed below.

Alternatives 1a and 1b, the No Action and Limited Action alternatives, provide no increase or an insignificant increase in the overall protection to human health and the environment. Under these alternatives, all of the potential risks to human health and the environment associated with the Cleveland Mill Site would remain. Institutional controls would only minimally address the risk because the controls are only temporary and do nothing to address the contamination. The long-term risk associated with potential exposure would not be reduced, nor would these alternatives address the potential short-term risk to future on-site workers or residents. ARARs would not be met under these alternatives. Alternatives 1a and 1b do not provide overall protection of human health and the environment and were, therefore, eliminated from further consideration.

Alternative 2, On-Site Disposal without Treatment, would reduce, to a moderate degree, the risk from direct contact with the tailings and sediment on-site by consolidating the Site tailings and sediment and covering the consolidated material with a multi-layered geo-textile and soil cap. The cap would also minimize the potential for air emissions from the Site as long as it is undisturbed. Under Alternative 2, exposure to levels of Site contaminants above the Remedial Action Goals would be controlled. Human health and the environment would be protected to the extent that the cap was maintained, and did not allow humans or animals to access the disposal area, and to the extent that the cap kept water from coming in contact with the contaminated tailings and sediment.

Alternative 2 would pose some short-term risks such as risk to workers and residents from the heavy equipment and risk from inhalation of dust from the excavation. These short term risks are controllable by employing engineering controls such as transportation controls, limiting Site access and using dust suppression techniques. Alternative 2 would also meet ARARs. Because Alternative 2 would not reduce the mobility, or toxicity of the contaminated material through treatment and would not be permanent, the possibility of contaminant leaching would still remain and, therefore, this alternative would be only moderately protective of human health and the environment. It would not be protective of human health and the environment in the long term because it is not permanent.

Alternative 3, Stabilization/Solidification and On-Site Disposal, would be significantly more protective than Alternative 2 because it would do more to prevent humans and animals from having direct contact with contaminated tailings and sediment, and it would do more to prevent humans from ingesting contaminated sediment and tailings by encapsulating and immobilizing many of the contaminants, solidifying the tailings and sediment, and covering the solidified mass. Under Alternative 3, the inorganic contaminants would remain, but it is expected that all the contaminants except possibly arsenic would be stabilized, and all the contaminants would be consolidated and capped. Because the inorganic contaminants except possibly arsenic would be chemically bonded, their leaching potential into the ground water would be reduced. In addition, water would be kept from contacting the surface and subsurface of the disposal area, further reducing the potential for contaminant migration to the ground water, surface water, or soil. Because humans and ground water and surface water would be kept from directly contacting the contaminants, the potential for exposure to the Site contaminants would be greatly reduced and controlled.

Alternative 3 can adequately protect human health and the environment in the short term, but because of uncertainties in stabilizing arsenic, it is not known whether it could adequately protect human health and the environment in the long term from the unacceptable risk posed by hazardous substances at the Site. Alternative 3 would pose the same short term risks as Alternative 2 and these risks are controllable using the same engineering controls as Alternative 2. Alternative 3 would also meet ARARs.

Alternative 3 would have a high long term effectiveness for all Site contaminants except arsenic. As previously mentioned, the ability to permanently stabilize arsenic is uncertain, so some risk of adverse human health and environmental effects from direct contact with the arsenic, and some risk of adverse effects to the environment from contaminant migration to Site soils, sediment, and surface water and infiltration into the ground water would remain.

Alternative 4, On-Site Solidification and Off-Site Disposal and Alternative 5, Off-Site Reprocessing and Off-Site Disposal, provide the maximum site-specific protection of human health and the environment by the removal of the contaminated material from the Site. Alternative 4 and 5 can adequately protect human health and the environment, in both the short and long term, from unacceptable risk posed by hazardous substances at the Site. Both alternatives eliminate exposure to Site contaminants consistent with Remedial Action Goals and both meet ARARs. Both have a high degree of long term effectiveness and permanence with respect to the Site. Due to the fact that the contaminated material would be removed, the potential for future contaminant migration to the Site soils, surface water and ground water, and the potential for air emissions at the Site would be eliminated. Short term risks, such as transportation risks, would pose a temporary risk that would be mitigated through engineering controls. See the Transportation Appendix, Appendix C of this ROD, for examples of transportation risks and their appropriate engineering controls. Alternatives 4 and 5 both use an off-site facility for disposal of the contaminated tailings and sediment; however, under Alternative 5, reprocessing would be employed to reduce the toxicity of the tailings and sediment.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARS)

ARARs are federal and state environmental requirements that the selected remedy must meet. All of the alternatives would comply with ARARs. Because the contaminated material is a type of mining waste which is exempt from categorization as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) Subtitle C, RCRA regulations are not applicable. The Subtitle C requirements of RCRA were determined to be relevant in that certain samples did leach toxic materials at levels that failed RCRA standards when the Toxicity Characteristic Leaching Procedures (TCLP) test was applied. However, EPA has completed an extensive national study of the type of contaminated material found at the site-- solid waste from the extraction, benefication, and processing of ores and minerals, and determined that it should not be regulated under RCRA Subtitle C (See e.g. 54 Fed. Reg. 36592, 36621 (September 1, 1989); therefore, RCRA is not an appropriate requirement for any remedial alternative.

Under the selected remedy, Alternative 5, residuals from the reprocessing of the contaminated material are expected to contain elevated concentrations of contaminants, but none are anticipated to be at levels that fail TCLP. However, even if residuals fail TCLP, the residuals remain solid waste from the extraction, benefication, and processing of ores and minerals and, consequently, as previously explained, RCRA Subtitle C, is not an appropriate requirement for the residuals. The residuals are also exempt from NMED Solid Waste Management Regulations (See NM SWMR-3 at Part I Section 105 (FFF)), so those regulations are not applicable. Moreover, since the purpose of the mining waste exemption from the NMED Solid Waste Management Regulations is to exempt the type of waste that exists at the Site, those regulations are not an appropriate requirement for the contaminated tailings and sediment. In order to be as protective as possible during the transport of the contaminated tailings and sediment, however, uniform hazardous waste manifests will be utilized for all contaminated materials that are transported off-site.

A list of ARARs for the Site is provided in Appendix D.

Because the tailings and sediment are not a hazardous waste, chemical-specific ARARs that are listed in RCRA, do not apply to the alternatives at the Cleveland Mill Site. However, the alternatives are designed to eliminate the source of contamination of the shallow perched aquifer and the surface water in Little Walnut Creek and its tributary, so that both the ground water and surface water meet federal and state environmental standards. The alternatives are also designed to ensure that air emissions above state and federal established levels do not occur. Therefore, chemical-specific ARARs for ground water, surface water and air do exist. These chemical-specific ARARs include provisions of the Clean Water Act, 33 U.S.C. §1251 <u>et</u> <u>seq</u>.; the Safe Drinking Water Act, 33 U.S.C. §300 f <u>et</u> <u>seq</u>.; the New Mexico Water Quality Act, NM Stat. Ann. §74-6-1 <u>et</u> <u>seq</u>.; NM WQCC Regulations 82-1, Sections 3-101 and 3-103; NM WQCC Regulations 91-1, Sections 1-102, 2-205, and 3-101; the Clean Air Act, 42 U.S.C. §7401 <u>et</u> <u>seq</u>.; New Mexico Ambient Air Quality Control Act, NM Stat. Ann. §72-2-1 <u>et</u> <u>seq</u>.; and OSHA requirements for worker safety, 29 CFR §1910.120.

For those alternatives that involve off-site disposal of the contaminated Site material, action-specific ARARs include the CERCLA Off-Site Response Policy.

Location-specific ARARs such as those laws and regulations protecting endangered species that have been found in the region surrounding the Site including the Endangered Species Act, 16 U.S.C. §1531 et seq., will be met by all alternatives. Additionally other location-specific ARARs are applicable and must be met due to the historic significance of the Site. These ARARs include the National Historic Preservation Act 16 U.S.C. §470 et seq. and its implementing regulations, 36 CFR Part 800; the Archaeological and Historic Preservation Act 16 U.S.C. §469a-1; and the New Mexico Cultural Properties Act. New Mexico Solid Waste Management regulations protecting fault areas, archaeologically sensitive areas and public water supply areas, would have to be considered under any of the alternatives which require the contaminated tailings and sediment to be placed in an on-site disposal area.

All ARARs can be met for all alternatives and a detailed discussion of ARARs for the selected remedy is presented in the Selected Remedy Section of this ROD.

3. Long-term Effectiveness and Permanence

Alternative 2 would provide long-term effectiveness only to the extent that the geo-textile cover is not compromised and is maintained. Since all such covers have a finite design life, the cover would have to be replaced on a regular basis. This alternative, therefore, is not considered permanent and the magnitude of residual risk would remain unchanged.

Alternative 3 involves treatment of the contaminated materials by stabilization and solidification which is a proven technology for all of the contaminants of concern at the Site except arsenic, based on historical studies at other sites. Because of the previously mentioned difficulties in stabilizing arsenic and the inconclusiveness of the stabilization and solidification treatability study at the Cleveland Mill Superfund Site, both the adequacy and reliability of these controls is believed to be moderate. Assuming that the stabilization and solidification would be effective for all contaminants, including arsenic, the magnitude of residual risk would be reduced so that a moderate risk remained under Alternative 3. Although exposure to the inorganic contaminants at the Cleveland Mill property would be expected to be significantly reduced by the stabilization and capping of the contaminated material under Alternative 3, management of the stabilized and solidified mass on-site does not fully eliminate the potential for exposure to arsenic, beryllium, cadmium, lead, and zinc.

For both Alternatives 2 and 3, the containment system of stabilization and solidification with a cap would be adequate to provide long-term protection, though it would not be reliable and over time would fail. The cap would have to be maintained and would eventually need replacement at the end of its design life.

Releases to the air could occur if the cap failed as could releases to the ground water if cap failure allowed rainwater to come in contact with the waste material. The risks posed by this failure could range from a minimal level to the same level of risk posed at the Site were the material to remain in place at the Site.

Alternatives 4 and 5 both involve moving the waste off-site which provides for a permanent solution for the Cleveland Mill Site. The residual risk at the Site would be completely eliminated. Some risk would be relocated to the off-site landfill in Alternative 4. Some risk would also be relocated to the receiving facility's disposal area in Alternative 5. The adequacy of controls in both these alternatives would be high because the contaminated tailings and sediment in Alternative 4 and the residual material in Alternative 5 would be disposed of in disposal areas which are subject to state regulation. Alternative 4 and 5 would be the most effective long-term and permanent alternatives for the Site.

The adequacy and reliability of the controls in Alternatives 4 and 5 would be the same as those of Alternatives 2 and 3, for the waste material that is taken off-site; however, the risks would be lower since, in Alternative 4, the waste would be handled in a lined landfill and in Alternative 5, the waste would be treated to remove some of the contaminants and precious metals. In addition, the sites to which the waste material would be taken in Alternatives 4 and 5 would be in commercial areas where contact by residents, children, would be much less probable.

4. Reduction of Toxicity, Mobility or Volume Through Treatment

Because Alternative 2, does not contain a treatment element, it does not provide a reduction in the waste's mobility, toxicity or volume (See 55 Fed. Reg 8666, 8721 (March 8, 1990)). Alternatives 3 and 4 are expected to reduce the mobility of the contaminants in the contaminated tailings and sediment through stabilization and solidification. Alternative 5 reduces the toxicity and slightly reduces the volume of the contaminated tailings and sediment through reprocessing. Alternative 5 will may also reduce the mobility depending upon the reprocessing technology selected during the Remedial Design.

Alternative 3 uses stabilization and solidification to treat all the contaminated tailings and sediment. Although EPA believes that mobility of each of the contaminants would be significantly reduced, based on historical treatability studies, it is uncertain whether arsenic can be permanently stabilized, low concentrations may still leach. As mentioned previously, the Site treatability study on stabilization and solidification was inconclusive in the determination of whether or not the stabilization was effective in reducing the mobility of the contaminants in the tailings and sediment. The solidification portion of the treatment is essentially irreversible because the monolith produced through solidification should retain its structural integrity based on both historical and site-specific studies. However, in practice, it is not known how long stabilization and solidification of contaminants will remain effective. The volume of the contaminated tailings and soil would increase by at least 30% and up to 100% with this treatment due to the addition of stabilizing and solidifying agents. The residue that would remain after treatment would be a monolithic structure on-site; however, the inherent hazards posed by the waste would be reduced since it would be stabilized, solidified and covered. Under Alternative 3, the direct exposure pathway would be almost totally eliminated because as long as the cap remained intact, humans could not contact the contaminants. The potential for the contaminants to leach into the surface and subsurface water and be ingested by humans would also be reduced, providing the stabilization was effective. The possibility of human exposure through the air pathway would be eliminated.

Like Alternative 3, Alternative 4 utilizes the chemical bonding and structural integrity of the stabilization and solidification process to reduce the mobility of the waste and the inherent dangers associated with the waste. Under Alternative 4, disposal is carried out off-site. This is an important distinction insofar as the significance of low level leaching is considered less of a risk in a regulated commercial area than it is in a residential area.

Alternative 5 also uses reprocessing to alter the principal threat wastes at the Site to reduce the toxicity and volume of the waste. The percentage change in concentration of the contaminants that was demonstrated in the Site treatability study ranged from a low of 1% to 9% for arsenic to a maximum of 38% to 61% for copper. These percentages were calculated by comparing assays of the original tailings and sediments to assays of the residual from the reprocessing. The reason that these percentages are given as a range is because the reductions in contaminant concentration also varied depending upon the type of site material (tailings or dust piles, for example) that was evaluated. The reprocessing will reduce the toxicity of the waste because these metals will be permanently removed and sold for beneficial reuse. The residuals that will remain, after reprocessing, will still contain a percentage of the original contaminants; however, the degree to which the treatment will reduce the inherent hazards posed by the waste may be increased because the acid-producing potential which was high in the initial tailings and sediment may be lowered depending upon the reprocessing method that is utilized. Sulfide minerals such as pyrite may be concentrated and removed from the tailings and sediment at the reprocessing facility which would result in a reduction in acid-producing potential in the residual material, reducing the chance that the contaminants present in the residuals will leach from these residuals.

Depending upon the reprocessing technology selected, Alternative 5 may reduce the mobility of the contaminants in the tailings and sediment by reducing the potential to generate acidic leachate. In EPA's view; however, it is more important to employ a reprocessing technology on the basis of the percentage of contaminants removed. Therefore, a reprocessing technology which does not reduce the mobility, but which will remove a higher percentage of contaminants, may be selected, thereby making mobility less of a concern.

Unlike the other alternatives, Alternative 5 is expected to slightly reduce the volume of contaminated materials by reprocessing and reclaiming the usable metals. The reprocessing, under Alternative 5, will be wholly irreversible.

EPA has established, as a guideline, that treatment as part of CERCLA remedies should generally achieve reductions of 90 to 99 percent in concentrations or mobility of the contaminants of concern, although there will be situations where reductions outside the 90 to 99 percent range that achieve health-based or other site-specific remediation goals are appropriate. (See 55 Fed. Reg 8666, 8721 (March 8, 1990)). The Cleveland Mill Superfund Site is a situation in which reductions outside the 90 to 99 percent range are appropriate because the contaminants of concern at the Site are inorganic constituents which cannot be destroyed, so a 90 percent reduction in concentration of contaminants through destruction cannot be achieved. According to the Site Froth Flotation Treatability Study and historical data on ore reprocessing using other treatment technologies, a 90 percent removal rate for the contaminants present at the Site cannot be achieved. In addition, due to the uncertainty associated with the stabilization of arsenic, a 90 percent or greater reduction in mobility through stabilization cannot be achieved for the Cleveland Mill Superfund Site wastes. Rather than specifying a percentage reduction that the reprocessing must achieve, EPA and NMED have instead chosen to rely upon excavation of the tailings and sediment to the Remedial Action Goals. Excavation to the Remedial Action Goals for the carcinogenic contaminants assures that carcinogenic risk at the Cleveland Mill Superfund Site is brought to, at the maximum, the risk that is currently posed by background values of these contaminants. Excavation to the health-based levels for the non-carcinogenic contaminants assures that, in the excavated areas, non-carcinogenic risk at the Cleveland Mill Superfund site falls below a Hazard Index of 1 individually for beryllium and cadmium and below a Hazard Index of the background value of 1.13 for arsenic.

All the metals identified in the Cleveland Mill tailings and sediment have a tendency to bioaccumulate. None of the alternatives destroy or chemically reduce the toxicity of the main contaminants of concern. Alternative 5, however, will remove a percentage of these contaminants and treat the contaminated material so that it is rendered less likely to leach, and is rendered less toxic, and, consequently, is rendered less hazardous.

5. Short-Term Effectivenesss

There would be potential short-term risks to Site workers during implementation of all the alternatives, since all alternatives will require some excavation of the contaminated material. Some increase in air emissions that could adversely affect human health and the environment might occur during excavation activities, which are required under all of the alternatives, and might also occur during the stabilization/solidification process in Alternatives 3 and 4. However, engineering controls, including dust control and air monitoring, during excavation or treatment will reduce the potential for any adverse impacts due to air emissions during implementation of any of the remedial alternatives. A contingency plan would be developed, under any of the alternatives which require excavation, to address any potential air emissions during remedial activities.

There is also a potential risk for accidental release of contaminants from transportation of excavated material to an off-site facility under Alternatives 4 and 5. Each of the alternatives evaluated would involve an increase in trucking and its associated risks, either in taking the contaminated material away from the Site or in bringing material and equipment to the Site to implement on-site disposal. Therefore, each of the alternatives evaluated, except the No Action alternative, would cause additional transportation risks including those risks associated with trucking, in general, such as traffic accidents, additional noise, and risk to automobiles or pedestrians traveling the same roads as trucks. These risks do not necessarily involve the release of contaminants.

Under Alternative 2, trucks bringing liner material and earthmoving equipment would travel to the Site. This would increase the truck traffic to approximately 8 trucks per day over the period of time that the excavation and capping would be implemented, approximately 6 months. Under Alternative 3, on average, a total of approximately 24 trucks per day (12 going to the Site loaded with materials necessary for stabilization and solidification and 12 leaving the Site empty) would travel to and from the Site over an 8-month period. Under Alternative 5, on average, approximately 48 trucks per day (24 going to the Site empty and 24 leaving the Site full of contaminated tailings and sediment enroute to the off-site reprocessing facility) would travel to and from the Site over an 8 month period. Because Alternative 4 would involve the same stabilization and solidification steps as Alternative 3 and the same off-site transport as Alternative 5, Alternative 4 would require the most truck trips, 74 per day (37 going to the Site, some carrying stabilization raw materials and 37 leaving the Site full of stabilized contaminated tailings and sediment). The number of truck trips, when compared to the number of trucks already using the roads for mining activities in the area is low, so the corresponding increase in overall risk from implementation of any of the alternatives is low. There is also a potential for accidental release of contaminants during transportation of waste material to an off-site facility under Alternatives 4 and 5. The short term risk due to truck traffic can be greatly reduced through the use of strict transportation controls. (See Appendix C for trucking calculations.)

Alternative 2 would take approximately 6 months to implement. The other alternatives each would take approximately 12 months to implement. This is not a significantly different amount of time.

6. Implementability

Alternative 2, On-Site Excavation and Disposal, could be implemented using readily available equipment and materials. Implementation of Alternative 2, however, would be hindered by the steep slopes on the Site, the lack of ready access to the areas of the streambed that would be excavated, and the limited amount of space available on-site for disposal of the excavated material. Nonetheless, generally speaking, the technical feasibility of Alternative 2 is high.

Implementation of Alternative 3 would face the same problems as those of Alternative 2. Although technically feasible, the on-site disposal of the material in Alternative 3 would necessitate strict engineering controls to ensure that the stabilized and solidified material did not come into contact with Site water, and to ensure that the slope of the disposal area would provide permanent structural soundness. Historical treatability studies conducted on materials similar to those found at the Cleveland Mill Superfund Site indicate that stabilization and solidification could effectively immobilize and eliminate the hazardous characteristics of the contaminants of concern found at the Site for all the contaminants except arsenic. However, the solidification and stabilization treatability study conducted on the actual Cleveland Mill contaminated tailings and sediment was inconclusive in its determination of the effectiveness of the stabilization of the contaminants and additional treatability studies would have to be conducted to verify the effectiveness and implementability of this process.

As previously noted, the ability to permanently stabilize high concentrations of arsenic is uncertain, but the presence of arsenic in a waste does not adversely affect the solidification process. The Cleveland Mill stabilization and solidification treatability study showed that effective solidification of the contaminated tailings and sediment was possible and implementable. The technical feasibility of Alternative 3 is slightly lower than that of Alternative 2, but generally speaking, it is still considered high.

It is expected that Alternatives 4 and 5, Off-Site Disposal and Off-Site Treatment and Reclamation could be more easily implemented technically than Alternatives 2 and 3. Alternative 4 and 5 are more easily implemented partly because an on-site disposal area would not have to be constructed under Alternative 4 or 5. Like the previous alternatives, the excavation of contaminated material for these two alternatives would be hindered by the steep slopes at the Site, and by the difficult access to the streambed.

All of the alternatives are implementable with respect to the availability of services and materials, specialists and equipment, and with respect to the availability of technology. Services to construct disposal areas and to stabilize and solidify materials are easily obtained locally, and there are several disposal and reprocessing facilities, within a 150-mile radius of the Site, with the capacity to handle the contaminated tailings and sediment from the Site.

EPA was concerned that there might not be an off-site facility which could reprocess and dispose of the contaminated tailings and sediment, as required under Alternative 5. EPA expressed its concern in the Proposed Plan for the Site. Since the release of the Proposed Plan, the business community has expressed interest, to both EPA and NMED, in implementing the remedy proposed under Alternative 5, which is now the selected remedy. The two agencies believe that several facilities with the ability and capacity to reprocess this waste will bid on the selected remedy. Without the formal solicitation of contractual bids, however, business interest in Alternative 5's off-site reprocessing and disposal cannot be fully substantiated. The uncertainty in determining the availability of off-site reprocessing facilities is one factor that slightly lessens the implementability of Alternative 5.

All of the alternatives have a high administrative feasibility because coordination with other agencies will be easily achieved, and the time required to obtain necessary approvals and permits will be short. One reason that administrative feasibility is high for all alternatives is that EPA and NMED have worked together closely on the Site and each agency has coordinated with associated agencies throughout the RI/FS process.

The effectiveness and reliability of all the alternatives can be easily evaluated by monitoring the ground water.

7. **Cost**

The approach that the NCP takes requires that alternatives must be determined to be adequately protective and ARAR-compliant before cost effectiveness is considered in remedy selection (See 55 Fed. Reg 8666, 8727 (March 8, 1990)). The selected remedy, Alternative 5, provides greater long term effectiveness and permanence than any other alternative other than Alternative 4 which is comparable in its long term effectiveness and permanence, but which is more expensive. Alternative 5 removes the contaminated tailings and sediment from the Site and eliminates the residual risk at the Site. In addition, depending upon the reprocessing technology selected, Alternative 5 may reduce the mobility of the contaminants in the contaminated tailings and sediment. Alternative 5 performs better than any of the other alternatives when it comes to reduction of toxicity since it removes contaminants. Alternative 5 also reduces volume more than any other alternative by removing recoverable metals. The short-term effectiveness of Alternative 5 is approximately the same as the other alternatives. Alternative 5, the selected remedy for Cleveland Mill Superfund Site contaminated tailings and sediment, is adequately protective and cost-effective. The cost of the preferred alternative, Alternatives 5, is $6,214,036 (present worth). No Action and On-Site Disposal without Treatment (Alternatives 1 and 2) have lower present worth costs than Alternative 5, $246,878 and $3,324,701, respectively, but they not protective of human health and the environment and they are not as effective. Alternative 3 also has a lower present worth cost than Alternative 5, $6,619,187, but it is not as protective of human health and the environment as Alternative 5. Alternative 4, Off-Site disposal is less protective of human health and the environment than Alternative 5, because, unlike Alternative 5, it does not decrease the toxicity of the contaminants in the tailings and sediment or reduce the volume of the tailings and sediment. Moreover, Alternative 4 does not recover valuable metals that can be beneficially reused. At $11,479,046, Alternative 4 would also be more costly to implement than Alternative 5.

8. **State Acceptance**

Under the Superfund law, EPA is required to ensure that States have a meaningful and continuing role in remedy selection and execution. EPA and NMED worked closely in the development of the alternatives for remediation of the Cleveland Mill Site and in the identification development of ARARs. NMED was the lead agency for the RI/FS process through preparation of the final RI/FS report. EPA selected the remedy presented in this ROD, Alternative 5, Excavation, Off-Site Reprocessing, Reclamation, and Disposal of Residuals, to address the contaminated tailings and sediment at the Site and to prevent future ground water and surface water contamination. The State's concurrence with the selected remedy is set forth in a letter from Judith Espinosa, Secretary of NMED dated June 29, 1993, included in the Administrative Record for this Site.

9. Community Acceptance

EPA recognizes that the community in which a Superfund Site is located is the principal beneficiary of all remedial actions undertaken. EPA also recognizes that it is its responsibility to inform interested citizens of the nature of Superfund environmental problems and solutions, and to learn from the community what its desires are regarding these sites.

EPA and NMED solicited input from the public on the remedial alternatives proposed to address the contamination at the Site. The comments from the residents are mixed and indicate that some residents would like to see the tailings and sediment permanently removed from the Site and some would like to see the tailings and sediment remain at the Site. Of the residents who indicated that they would like the contaminated tailings and sediment to remain at the Site, some did not feel that any action at all was necessary and some supported variations on Alternatives 2 and 3. The primary reason that many residents are opposed to the off-site alternatives is that they feel that these alternatives would greatly increase truck traffic on local unpaved road which could pose an uncontrollable risk from the trucks themselves and not necessarily from the contaminated tailings and sediment. They feel that the traffic could destroy roads that are already in poor condition and have an adverse effect on the amount of tourism and business in the area.

Several members of the residential and industrial community and representatives of several federal and state agencies indicated support for the reprocessing of the mining wastes and the beneficial reuse of the recovered metals. However, the limited rate of metal recovery and the perception that the contamination might threaten an off-site area, once it was removed were considered, by some commenters, to be negative aspects of the reprocessing option.

EPA believes and NMED agrees that community concerns can be addressed through strict transportation controls and through repair and improvement of access roads where needed. In addition, the receiving facility will be regulated through State authority. The transportation controls and other responses to specific residential and business community concerns are discussed in the Responsiveness Summary in Appendix E. Calculations showing the increase in the amount of truck traffic under each alternative are included in Appendix C.

X. THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives using the nine criteria, and public comments, EPA has determined that Alternative 5, Excavation, Off-Site Reprocessing, Reclamation and Beneficial Reuse and Disposal of Residual, is the most appropriate remedy for the Cleveland Mill Superfund Site in Grant County, New Mexico. NMED concurs with the selection of this remedy.

The Remedial Objectives for the Site are the following:

1. Prevent dermal contact, ingestion of, and inhalation of contaminated tailings and sediment.
2. Prevent direct contact with and ingestion of contaminated ground water and surface water.
3. Prevent the downstream aquifers from becoming contaminated with hazardous substances from the tailings and sediments, at concentrations which exceed MCLs and NM WQCC standards.
4. Return the shallow perched aquifer at the toe of the tailings to a condition where the concentration of contaminants is below MCLs and NM WQCC standards.

These Remedial Objectives shall be met under this ROD.

The ROD requires removal of the contaminated tailings and sediment that contain concentrations of hazardous substances at levels which exceed Remedial Action Goals. Removal of the contaminated tailings and sediment under the selected remedy is intended to remove the source of the on-site soil and ground water contamination, and the source of the surface water contamination. An additional benefit of the selected remedy is that the toxicity of the contaminated tailings and sediment will be reduced through reprocessing and beneficial reuse of the valuable metals that are recovered as a result of the reprocessing. The ROD requires that the contaminated tailings and sediment, which are removed from the Site, shall be taken to a reprocessing facility. The reprocessing facility shall remove all or some of the recoverable metals and dispose of the reprocessed material at the facility's disposal area. The length of time the reprocessing facility shall be given to reprocess the contaminated tailings and sediment will be determined during the Remedial Design phase of the project. The facility's disposal area shall be in physical compliance with all applicable state, and federal environmental requirements. It is the intent of this ROD that recoverable metals shall become the property of the reprocessor, thereby lowering the cost of the reprocessing. If, for any reason, the reprocessor cannot or will not take possession of the recovered metals, the cost of this selected remedy may increase.

Approximately 70,900 cubic yards of contaminated tailings and sediment shall be removed from the Site, including but not limited to, the roadbed, the mill area, the mine spoils area, the streambed of the mill valley tributary to Little Walnut Creek, and the streambed of Little Walnut Creek itself, and taken to an off-site reprocessing facility. A percentage of some of the contaminants of concern, along with several other valuable metals such as copper, shall be recovered from the contaminated tailings and sediment. One of several available processes such as froth flotation, acid heap leaching, or other effective reprocessing technologies shall be used to treat the contaminated tailings and sediment. The process used to reprocess the tailings and sediment, the facility selected to reprocess the tailings and sediment, and the disposal method used for the residual material, which is material that remains after reprocessing, shall all be subject to disapproval by EPA, in consultation with NMED. One consideration in the selection of the reprocessing facility shall be the outcome of additional treatability studies which shall be undertaken during the design phase of the project to determine recovery rates for the contaminants of concern and the other valuable metals.

The residuals which remain after the contaminated tailings and sediment are processed shall be disposed of at the off-site reprocessing facility which is subject to state regulation.

During the design and implementation phases of the remedial action, air monitoring shall be conducted at the Site to ensure that airborne particulates or other air emissions from the removal of Site materials or transportation of these materials do not pose a risk to the workers or inhabitants of the area.

A transportation plan shall be designed and implemented to assure that risks incurred from the increase in truck traffic are mitigated as much as possible. Transportation controls shall be implemented as a part of this plan and they shall include, but shall not be limited to, engineering controls such as dust suppression and control of transportation routes. Road repairs or improvements shall be performed, if necessary as determined by EPA in consultation with NMED, after state and local governmental agencies have had an opportunity to provide information to EPA regarding road repairs. The road repairs shall be performed at the completion of the remedial action in order to return the road to the condition it was in at the time this ROD was signed, unless the road, in EPA's opinion, is badly damaged during the remedial action, in which case repairs shall be made upon EPA's determination, in consultation with NMED, that the road is badly damaged. EPA, in consultation with NMED, will provide to the Town of Silver City and the Grant County Commission an opportunity to comment on the development of the transportation plan for the remedial action.

Ground water at the Site shall be monitored on a quarterly basis, beginning immediately and for a minimum of the first five years after removal of the contaminated tailings and sediment. If monitoring results indicate, in EPA's opinion, that additional monitoring for a longer period of time is required, EPA may require such monitoring, after NMED has had an opportunity to review and comment. The ground water monitoring program shall include, but shall not be limited to, monitoring of the existing wells, the installation of and monitoring of additional wells, and sampling of the springs in the mill area. EPA may require implementation of the contingency measures for the remediation of ground water as described in the Description of Alternatives Section, Section VIII of this ROD, if ground water contamination concentrations at the Site remain above Remedial Action Goals five years after the tailings and sediment with concentrations of contaminants above Remedial Action Goals have been removed from the Site.

Surface water at the Site shall be monitored on a quarterly basis, beginning immediately and continuing for a minimum of the first five years after removal of the contaminated tailings and sediment. If monitoring results indicate, in EPA's opinion, that additional monitoring for a longer period of time is required, EPA may require such monitoring. The surface water monitoring program shall include, but shall not be limited to, sampling locations in the mill valley tributary, Little Walnut Creek and Picnic Creek.

The Site shall be replanted with native vegetation in disturbed areas. The estimated costs for the entire remedy including stabilization and solidification of residuals at the off-site facility are: Capital costs: $5,836,586, Annual Operation and Maintenance: $51,250, and Present Worth: $6,214,036.

A. Remedial Action Goals for the Contaminated Tailings and Sediment

The Remedial Objectives for the Site are the following:

- Prevent dermal contact, ingestion of, and inhalation of contaminated tailings and sediment.
- Prevent direct contact with and ingestion of contaminated ground water and surface water.
- Prevent the downstream aquifers from becoming contaminated with hazardous substances from the tailings and sediments, at concentrations which exceed MCLs and NM WQCC standards.

- Return the shallow perched aquifer at the toe of the tailings to a condition where the concentration of contaminants is below MCLs and NM WQCC standards.

The Remedial Action Goals at the Site are designed so that the Remedial Objectives will be met.

The results of the baseline risk assessment indicate that risk to human health under a projected future scenario in which there are residences on Site indicate that contamination at the Site could pose an excess lifetime cancer risk as high as 2.1×10^{-3} for adults and 1.5×10^{-3} for children from direct contact with the contaminated tailings and sediment. This cancer risk is mainly due to the arsenic concentrations in the tailings and the sediment, and to the predisposition of the tailings and sediment to leach arsenic and other hazardous metals because of the acid-producing conditions at the Site. The acid-producing conditions are caused by numerous water sources including springs and rainfall that react with the high sulfide tailings to produce sulfuric acid. Non-carcinogenic risk to human health due to contamination from the Site is mainly due to arsenic, cadmium, lead and zinc.

The Remedial Action Goals for arsenic, beryllium, cadmium, lead and zinc are stated in this section of the ROD. Remedial Action Goals are the maximum concentration of contaminants that may be left on the Site. Under this ROD, all tailings and sediment with concentrations of any contaminants which exceed Remedial Action Goals shall be excavated, manifested and transported away from the Site, and taken to a facility for reprocessing. Manifests shall meet RCRA Subtitle C requirements. Remedial Action Goals are consistent with either a risk to human health that is within EPA's acceptable risk range or background, whichever is higher. For additional explanation of Remedial Action Goals and the Risk Assessment, See Sections VI and VII.

Tailings and sediment that contain concentrations of contaminants above any of the following Remedial Action Goals shall be excavated and removed from the Site:

<u>Carcinogenic</u>

Arsenic-------------------------------30 parts per million

Beryllium-----------------------------4 part per million

Non-carcinogenic

Individual

Arsenic--------------------------------30 parts per million

Cadmium-------------------------------140 parts per million

Zinc-------------------------------82,000 parts per million

Cumulative (Site Wide)

Hazard Index less then 2.3 once individual goals have been met

Lead

Lead-----------------------------------500 parts per million

Ground Water Contingency Measures

If the selected remedy, Alternative 5, cannot meet the specified Remedial Action Goals at any or all of the monitoring points, including those in the perched aquifer, after 5 years, EPA may require the contingency measures and objectives described in this section of the ROD to be implemented. In the event that EPA requires active ground water contingency measures to be implemented, the ground water shall be remediated to MCLs or NM WQCC standards, whichever is more stringent, for each contaminant. For the contaminants of concern, these Remedial Action Goals (MCLs except as noted) under the ground water contingency measures are arsenic, .05 milligrams per liter (mg/l); beryllium, .004 mg/l; cadmium, .05 mg/l; lead (NM WQCC standards), .05 mg/l; copper, 1.0 mg/l; mercury, 0.002 mg/l; silver, 0.05 mg/l (NM WQCC standards); and zinc, 5 mg/l. For newly discovered contaminants, without promulgated MCLs and NM WQCC standards, maximum concentrations left untreated will be those which produce a human health risk of 10^{-6} or less, unless background is higher than the concentration producing the 10^{-6} risk, in which case, the maximum concentration left untreated will be the background concentration. The risk will be calculated using the assumptions in the Site Risk Assessment for a future resident child. For newly discovered non-carcinogenic compounds without promulgated MCLs and NM WQCC standards, the maximum concentrations left untreated will be those that correspond to a Hazard Index less than or equal to 1.

The contingency measures are considered protective of human health and the environment, and are technically practical under the corresponding circumstances. Under the selected remedy, Alternative 5, EPA, in consultation with NMED, may require one or more of the following contingency measures to be put into effect if EPA, in consultation with NMED, later determines that there is contamination in ground water above Remedial Action Goals. EPA may make such a determination if MCLs or NM WQCC standards are exceeded in any ground water monitoring well, including, but not limited to, those wells completed in the perched aquifer. EPA may also make such a determination if EPA has any other reason to believe that ground water contamination above Remedial Action Goals exists 5 years from completion of removal of the contaminated tailings and sediment. The ground water contingency measures will be one or more of the following as determined by EPA in consultation with NMED:

- Installation of additional monitoring wells to confirm and better define the changing conditions in ground water contaminant concentrations.

- Development of a Remedial Action Plan which provides for the extraction, treatment, and reinjection or discharge or disposal of contaminated ground water in order to achieve ARARs.

- Implementation of a Remedial Action Plan subject to EPA disapproval of the plan, after NMED has had an opportunity to review and comment upon the plan.

- Waiving the ground water ARAR for the aquifer based on the technical impracticability of achieving contaminant reduction.

- Establishment of an Alternative Concentration Limit "(ACL") for the detected contaminants, provided compliance with CERCLA 121 (d)(2)(B)(ii) can be demonstrated.

The ground water monitoring which is required under the selected remedy, provides for quarterly monitoring of ground water wells at the Site. Wells established as part of the ground water monitoring program during remedy design shall be used to determine 1) whether natural attenuation of the ground water contamination is taking place, and 2) whether the extent of ground water contamination has spread or diminished.

If contingency measures are implemented, EPA, in consultation with NMED, may require modification of the existing network of wells, changes in the type of analyses performed, or changes in frequency of sampling, in order to identify changes in ground water quality. The selected remedy is expected to prevent continued ground water contamination. However, as explained in Section VII, Remedial Action Goals, if monitoring wells detect contaminant concentrations which exceed MCLs or NM WQCC standards, site background or a concentration producing a risk greater than 10^{-6} or, if EPA determines, for any other reason, that ground water has become contaminated and requires remediation, EPA may require that the contingency measures listed be implemented.

Upon completion of the tailings and sediment remedy implementation, overall Site risk is expected to be less than or equal to the risk posed by Site background.

B. SENSITIVITY ANALYSIS FOR SELECTED REMEDY

In an effort to more accurately assess the viability of this remedial action in light of potential waste volume increases during actual remediation, a sensitivity analysis was conducted. The intent of this analysis was to determine if unexpected volume increases would adversely impact the selection of this particular alternative because waste volume was determined to be the most critical factor affecting cost.

The evaluation revealed that if the volume of contaminated tailings and sediment to be excavated and transported off-site were to double, the cost for the selected remedy would approximately double. Likewise, the cost estimates for each of the other alternatives, except the No Action alternative, would approximately double if the volume of tailings and sediment doubled. An unanticipated increase in volume of tailings and sediments that had to be remediated, therefore, would not change the remedy selection decision.

Because the majority of the remedial action involves excavation of material that was deposited surficially and not subsequently buried, the extent of the area needing treatment is fairly well-defined and large volume increases are not expected to impact this aspect of the remediation.

XI. THE STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to select remedial actions that are protective of human health and the environment. Section 121 of CERCLA also requires that the selected remedial action for a site comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws, unless a waiver is granted. The selected remedy must be cost-effective and utilize treatment or resource recovery technologies to the maximum extent practicable. The statute also contains a preference for remedies that include treatment as a principal element. The following sections discuss how the selected remedies for tailings and soils at the Cleveland Mill Site meet the statutory requirements.

A. Protection of Human Health and the Environment

In order to protect human health and the environment, the tailings and soils that exceed Remedial Action Goals will be removed from the Site. They will be transported to a reprocessing facility where they will undergo a treatment through reprocessing and off-site disposal of residual. The metals reclaimed from the reprocessing of the tailings and soils will be beneficially reused. The residuals will be contained at the disposal site. These Remedial Action Goals will assure that Site risks due to carcinogens are less than or equal to those risks posed by site background. The Remedial Action Goals will also assure that the non-carcinogenic hazard index will be reduced to less than one (1) for each of the contaminants of concern.

The selected remedy protects human health and the environment by reducing concentrations of contaminants through treatment, reclamation and containment of residuals. Of all the alternatives evaluated for the tailings and soils, the selected alternative provides the best overall protection to human health and the environment. No unacceptable short-term risks will be caused by implementing this remedy. ROD Section IX, Summary of Comparative Analysis of Alternatives, and ROD Section X, The Selected Remedy, provide an analysis of the ways in which the selected remedy provides the best overall protection of human health and the environment, and explains that the selected remedy causes no unacceptable short-term risk.

B. Compliance With ARARs

The selected remedy which addresses the tailings and sediment by off-site reprocessing and disposal of residuals will attain all applicable or relevant and appropriate requirements (ARARs). Appendix D lists ARARs developed for the Cleveland Mill Superfund Site. The ARARs are as follows:

1. Chemical-Specific ARARs for Tailings and Sediment

a. National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61) (NESHAPS).

Relevant and appropriate during removal of tailings and soils and transportation.

b. New Mexico Ambient Air Standards, Air Quality Control Regulations, Section 201A. (NM Stat. Ann. § 72-2-1 _et seq_.)

Relevant and appropriate during removal of tailings and soils and transportation.

2. Action-Specific ARARs for Tailings and Sediment

a. RCRA 40 CFR 262, Manifesting Requirements for Transport of Hazardous Waste

Relevant and appropriate because manifesting method to be used to keep track of Superfund wastes which will be transported. The material involved is not a RCRA hazardous waste, but the manifesting method is helpful and protective.

b. New Mexico Mining Act of 1993

Remediation on-site falls under the definition of "mining" in the "New Mexico Mining Act (effective July 1, 1993)", and so is subject to the Act. However, since regulations have not, yet, been promulgated under the Act, remediation need only comply with the Act to the extent that it clearly defines procedures to be used. Once regulations are promulgated, application of the Act and its regulations to the remediation of the site may be re-evaluated by EPA. Under CERCLA, ARARs do not apply to off-site activity.

3. Location-Specific ARARs for Tailings and Sediment

a. Endangered Species Act, 50 CFR 17, 402

Although no endangered species have been observed at the Site, there are two endangered species in the Gila Wilderness which is located about 10 miles northwest of the Site. Federal activities must not jeopardize the continued existence of endangered or threatened species or adversely modify their critical habitat.

b. Fish and Wildlife Coordination Act, 40 CFR 6.302 (g)

Consultation between federal agencies is required when a water body is modified and it could affect wildlife which may be the case during excavation of tailings from the stream.

c. New Mexico Wildlife Conservation Act

Consultation with State agencies is required to avoid or mitigate adverse impacts to endangered species listed by the New Mexico Departments of Natural Resources and Game and Fish.

d. National Historic Preservation Act, 40 CFR 6301 (b)

Coordination with State agencies is required in order to ensure that properties, the impact on them, and the effects on them are identified, and that the alternatives to avoid or mitigate an adverse effect on property eligible for the National Register of Historic Places are adequately considered in the planning process.

e. Archaeological and Historical Preservation Act, 16 U.S.C. 469, et. seq.

Any federally-funded or licensed construction project is covered by this act that provides a mechanism for funding the protection of historical and archaeological data.

f. New Mexico Cultural Properties Act.

Relevant and Appropriate because State agencies shall conduct all plans necessary to preserve, protect and enhance significant historical cultural properties under this act.

4. ARARs for Ground Water and Surface Water

EPA and NMED will evaluate, at the least, the following regulations before contingency measure selection, should the implementation of contingency measures become necessary:

a. Chemical-Specific ARARs for Ground Water

The regulations that will be evaluated will include National Primary Drinking Water Regulations (40 CFR Part 141); New Mexico Water Quality Act, NM Stat. Ann. § 74-6-1 et seq.; NM WQCC Regulations 82-1, Sections 3-101, and 103; and NM WQCC Regulations 91-1, Section 1-102, 2-105, and 3-101.

b. Action-Specific ARARs for Ground Water

The regulations that will be evaluated will include Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities should it become necessary to construct a pumping and treating operation on-site for any treatment of any contaminated ground water resulting in residuals (for instance filter cake) that contained a hazardous waste.

C. Cost-Effectiveness

EPA and NMED believe that the selected remedy is cost-effective in mitigating the threat of direct contact with Site wastes and in reducing the potential for ground water contamination from the Site wastes. Section 300.430 (f) (ii) (D) of the NCP requires EPA to determine cost-effectiveness by evaluating the following three of the five balancing criteria to determine overall effectiveness: long-term effectiveness and permanence, reduction of toxicity, mobility or volume through treatment, and short-term effectiveness. Overall effectiveness is then compared to cost to ensure that the remedy is cost effective. EPA and NMED believe the selected remedy meets these criteria.

The estimated cost of the selected remedy (present worth) for the tailings and soils is $6,214,036. Note that this cost includes a fee paid to the reprocessing facility to account for the fact that the reprocessing of the old, oxidized tailings and soils from this facility will be an expensive process that will not be fully offset by the sale of the usable metals.

The selected remedy, Alternative 5, costs less than Alternative 3, On-Site Stabilization/Solidification, and Alternative 5 is much more effective. Alternative 5 also uses resource recovery. Alternative 5 is significantly more protective than Alternative 3 because the waste is removed from the mountain drainage minimizing the potential for acid leachate generation at the Site. In addition, Alternative 5, in keeping with SARA preferences, reduces the volume and reduces the toxicity of the waste because it separates some of the metals from the tailings and soil so that they can be beneficially reused. Remedies which recover resources are preferred by SARA. In that Alternative 5 provides greater effectiveness for a slightly lower cost than Alternative 3, with a greater overall effectiveness than Alternative 3. The cost is proportional to the overall effectiveness. The reprocessing will be wholly irreversible. The selected remedy is the most protective of human health and the environment because it eliminates risk at the Site.

Alternative 2, which is less expensive than Alternative 5 was not included in the final cost comparison because it does not provide overall protection of human health and the environment (see Section IX).

All of the alternatives meet ARARs and all of the alternatives had similar, controllable short term effects, so these criteria were not a part of the overall effectiveness and cost effectiveness evaluation.

D. Utilization of Permanent Solutions and Treatment or Resource Recovery Technologies to the Maximum Extent Practicable

EPA and NMED believe the selected remedies represent the maximum extent to which permanent solutions and treatment/resource recovery technologies can be utilized in a cost-effective manner for the Cleveland Mill Superfund Site. Alternative 5 is the only alternative that involves a resource recovery technique to permanently separate metals from the tailings and soils so that they may be sold and beneficially reused. Remedies which involve resource recovery are preferred under SARA.

Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and NMED have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost. The selected remedy takes into consideration State and community concerns. The selected remedy is the most effective in the long-term. In comparison to the other alternatives, Alternative 5 clearly produces the greatest reduction in toxicity, mobility and volume; therefore, Alternative 5 meets the statutory preferences set forth in SARA better than any other alternative. The selected remedy has nearly identical high short-term effectiveness and implementability compared with the other alternatives and is a reasonable value for the money.

The selected remedy complies with the statutory requirement to utilize permanent solutions (separation of metals) and treatment technologies (reprocessing) to the maximum extent practicable.

E. Preference for Treatment as a Principal Element:

The statutory preference for remedies that employ treatment as a principal element will be satisfied through implementation of the reprocessing of the contaminated tailings and sediment and the reclamation of usable metals as explained in the Description of Alternatives Section, Section VIII of this ROD, and in the Selected Remedy Section, Section X of this ROD. Through reprocessing, a percentage of the valuable metals will be recovered and the contaminated tailings and sediment will be rendered less toxic. The selected remedy meets the statutory preference for treatment as a principal element.

XII. DOCUMENTATION OF SIGNIFICANT CHANGES:

The Proposed Plan for the Cleveland Mill Site was released for public comment on April 8, 1993. The Proposed Plan identified Alternative 5, Off-Site Reprocessing, Reclamation and Disposal of Residuals, as the preferred alternative to address the tailings and soils and the potential threat to surface water and ground water. EPA and NMED reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary. Since the publication of the Proposed Plan, the name of the remedy has been changed to Reprocessing and Reclamation to more accurately reflect the processing the waste will undergo.

One minor difference between the ROD and the Proposed Plan are the revision of costs for Alternatives 2 through 5, based on public comment on the transportation costs associated with the remedies. (See Appendix B of this ROD). These costs did not significantly affect the relative comparison between alternatives, since the cost of the alternatives increased by about the same amount. The costs of the Selected Remedy as set forth in this ROD are within +50% to -30% of the costs estimated for the preferred alternative in the Proposed Plan. These cost differences did not affect selection of the final alternative.

The risk from beryllium and the associated Remedial Action Goal were inadvertently left out of the Proposed Plan. Beryllium contributes to the carcinogenic risk and therefore, is a contaminant that must be remediated. The Remedial Action Goal for beryllium in the contaminated tailings and soils is 4 ppm which is the background level. In ground water, the Remedial Action Goal for beryllium is .004 mg/l. The Hazard Index for zinc was recalculated using a new reference dose. The Hazard Index changed from 1.91 to 1.27 for a future resident child. This change did not change the decision to remediate zinc. The recalculation is shown at the end of Appendix A.

Stabilization and solidification of residuals had been included in the Proposed Plan as part of Alternative 5, the proposed remedy, if necessary to reach commercial treatment standards. In that the reprocessing residuals is subject to state regulation, stabilization and solidification was deleted from Alternative 5, the selected remedy. The deletion of the stabilization and solidification of the residuals under Alternative 5 caused a decrease in cost of approximately 2 million dollars. This decrease in costs is detailed in the cost calculations in Appendix B. The Selected Remedy costs are within +50% to -30% of the cost estimated for the preferred alternative described in the Proposed Plan. These cost differences did not affect selection of the final alternative.

The implementation time was changed for several of the remedies. based upon new calculations regarding the length of time that it will take to excavate the tailings, and the number of trucks that could travel to and from the Site during a 6 day work week. The implementation time for Alternative 2 was recalculated and changed from 4 months to 6 months to account for the time it would take to bring material to the Site to construct the disposal cell, excavate and dispose of the contaminated tailings and sediment, and construct a cap. The implementation time for Alternative 3 was recalculated and changed from 4 months to 12 months to account for the time it would take to bring material to the Site for construction of the disposal cell and waste treatment, excavate the contaminated tailings and sediment, stabilize and solidify this material and construct a cap. The implementation times for Alternative 4 and 5 were recalculated and changed from 4 months to 12 months to account for the time it will take to excavate the contaminated tailings and sediment and transport them off-site. For Alternatives 3 through 5, the implementation time includes 2 months for site preparation, 8 months for excavation of and transport of the contaminated tailings and sediment, and 2 months for site restoration.

Appendix A Risk Assessment Tables

Table 7-5

RESIDENTIAL EXPOSURE SCENARIO: PATHWAY 1A - INGESTION OF CHEMICALS IN SOIL BY ADULTS/CHILDREN 0 TO 6 YEARS OLD

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

where:

CS = Chemical Concentration in Soil (mg/kg)
IR = Ingestion Rate (mg soil/day)
CF = Conversion Factor (10^{-6} kg/mg)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CS	Adult/ Child	Typical	Average concentrations in surface soils and/or sediments
		RME	UCL or maximum concentrations in surface soils and/or sediments
IR	Adult	Typical/ RME	200 mg/day (6 years) and 100 mg/day (24 years) (EPA 1992a)
	Child	Typical/ RME	200 mg/day (EPA 1992a)
EF	Adult/ Child	Typical/ RME	350 days/year (EPA 1992a)
ED	Adult	Typical	9 years [50th percentile time at one residence (EPA 1989b)]
		RME	30 years [90th percentile time at one residence (EPA 1991c and 1992a)]
	Child	Typical/ RME	6 years (entire duration of age group)
BW	Adult	Typical/ RME	15 kg (6 years) and 70 kg (24 years) (EPA 1992a)
	Child	Typical/ RME	15 kg [average for 0- to 6-year-old age group (EPA 1989b and 1992a)]
AT	Adult/ Child	Typical/ RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2292/16

Key:

RME = Reasonable Maximum Exposure.
UCL = Upper 95% confidence limit on the arithmetic average.

Source: Ecology and Environment, Inc. 1992.

Table 7-6

**RESIDENTIAL EXPOSURE SCENARIO:
PATHWAY 1B - DERMAL CONTACT WITH CHEMICALS IN SOIL BY
ADULTS/CHILDREN 0 TO 6 YEARS OLD**

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times ABS \times CF \times SA \times AF \times EF \times ED}{BW \times AT}$$

where:

CS = Chemical Concentration in Soil (mg/kg)
ABS = Absorption Factor (unitless)
CF = Conversion Factor (10^{-6} kg/mg)
SA = Skin Surface Area Available for Contact (cm^2/event)
AF = Soil to Skin Adherence Factor (mg/cm^2)
EF = Exposure Frequency (events/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CS	Adult/ Child	Typical	Average concentrations in surface soils and/or sediments
		RME	UCL or maximum concentrations in surface soils and/or sediments
ABS	Adult/ Child	Typical/RME	0.01 default value for metals (EPA 1992a) and cadmium (EPA 1992b)
SA	Adult	Typical/RME	5,000 cm^2 (EPA 1992a)
	Child	Typical/RME	1,800 cm^2 (EPA 1992a)
AF	Adult/ Child	Typical/RME	1.0 mg/cm^2 (EPA 1992a)
EF	Adult/ Child	Typical/RME	350 days/year (EPA 1992a)
ED	Adult	Typical	9 years [50th percentile time at one residence (EPA 1989b)
		RME	30 years [90th percentile time at one residence (EPA 1991c and 1992a)]
	Child	Typical/RME	6 years (entire duration of age group)
BW	Adult	Typical/RME	15 kg (6 years) and 70 kg (24 years) (EPA 1992a)
	Child	Typical/RME	15 kg [average for 0- to 6-year-old age group (EPA 1989b and EPA 1992a)]
AT	Adult/ Child	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2293/18

Key:

RME = Reasonable maximum exposure.
UCL = Upper 95% confidence limit on the arithmetic average.

Source: Ecology and Environment, Inc. 1992.

Table 7-7

RESIDENTIAL EXPOSURE SCENARIO:
PATHWAY 1C - INHALATION OF AIRBORNE SOIL PARTICLES
ADULTS/CHILDREN 0 TO 6 YEARS OLD

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA = Contaminant Concentration in Air (mg/m3)
IR = Inhalation Rate (m^3/hour)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CA	Adult/ Child	Typical	Modeled value based on average concentration in site-wide surface soils
		RME	Modeled value based on UCL surface soil concentrations (EPA 1989a)
IR	Adult	Typical/ RME	0.83 m^3/hour (EPA 1989a)
	Child	Typical/ RME	0.83 m^3/hour (EPA 1989a)
ET	Adult/ Child	Typical/ RME	24 hours/day (EPA 1992a)
EF	Adult/ Child	Typical/ RME	350 days/year (EPA 1992a)
ED	Adult	Typical	9 years [50th percentile time at one residence (EPA 1989b)]
		RME	30 years [90th percentile time at one residence (EPA 1991c and 1992a)]
	Child	Typical/ RME	6 years (entire duration of age group)
BW	Adult	Typical/ RME	15 kg (6 years) and 70 kg (24 years) (EPA 1992a)
	Child	Typical/ RME	15 kg [average for 0- to 6-year-old age group (EPA 1989b and 1992a)]
AT	Adult/ Child	Typical/ RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2294/16

Key:

RME = Reasonable maximum exposure.
UCL = Upper 95% confidence limit on the arithmetic average.

Source: Ecology and Environment, Inc. 1992.

Table 7-8

RECREATIONAL EXPOSURE SCENARIO:
PATHWAY 2A - INCIDENTAL INGESTION OF CHEMICALS IN SOIL AND/OR SEDIMENT
(ADOLESCENT RESIDENTS 7-16 YEARS OLD)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times EF \times ED}{BW \times AT}$$

where:

CS = Chemical Concentration in Sediment (mg/kg)
IR = Ingestion Rate (mg soil)
CF = Conversion Factor (10^{-6} kg/mg)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CS	Adolescent	Typical	Average concentration in sediments and/or surface soil
		RME	UCL or maximum observed concentrations in sediments and/or surface soil
IR	Adolescent	Typical/RME	100 mg/day (EPA 1992a)
EF	Adolescent	Typical/RME	60 days/year (EPA 1992a)
ED	Adolescent	Typical/RME	10 years (entire duration of age group)
BW	Adolescent	Typical/RME	43 kg (EPA 1992a)
AT	Adolescent	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2296/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-9

RECREATIONAL EXPOSURE SCENARIO:
PATHWAY 2B - DIRECT DERMAL CONTACT WITH CHEMICALS IN SOIL AND/OR SEDIMENT
(ADOLESCENT RESIDENTS 7-16 YEARS OLD)

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times ABS \times CF \times SA \times AF \times EF \times ED}{BW \times AT}$$

where:

CS = Chemical Concentration in Sediment (mg/kg)
ABS = Fraction Absorbed (unitless)
CF = Conversion Factor (10^{-6} kg/mg)
SA = Skin Surface Area Available for Contact (cm^2/event)
AF = Soil-to-Skin Adherence Factor (mg/cm^2)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CS	Adolescent	Typical	Average concentration in sediments and/or surface soil
	Adolescent	RME	UCL or maximum observed concentrations in sediments and/or surface soil
ABS	Adolescent	Typical/RME	Chemical-specific values
SA	Adolescent	Typical/RME	5,000 cm^2 (EPA 1992a)
AF	Adolescent	Typical/RME	1.0 mg/cm^2 (EPA 1992a)
EF	Adolescent	Typical/RME	60 days/year (EPA 1992a)
ED	Adolescent	Typical/RME	10 years (entire duration of age group)
BW	Adolescent	Typical/RME	43 kg (EPA 1992a)
AT	Adolescent	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2295/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-10

RECREATIONAL EXPOSURE SCENARIO:
PATHWAY 2C - INHALATION OF AIRBORNE DRY SEDIMENT AND/OR SOIL PARTICLES
(ADOLESCENT RESIDENTS 7 TO 16 YEARS OLD)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times ET \times EF \times ED}{BW \times AT}$$

where:

CA = Contaminant Concentration in Air (mg/m3)
IR = Inhalation Rate (m^3/hour)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CA	Adolescent	Typical	Modeled value based on average concentration in surface soils and/or sediments
		RME	Modeled value based on maximum or UCL dry sediment and/or surface soil concentrations (EPA 1989a)
IR	Adolescent	Typical	0.83 m^3/hour (EPA 1989a)
		RME	0.83 m^3/hour most activities; 2.5 m^3/hour motor-bikers (moderate activity, EPA 1989b)
ET	Adolescent	Typical/ RME	2 hours/day (professional judgment)
EF	Adolescent	Typical/ RME	60 days/year (EPA 1992a)
ED	Adolescent	Typical/ RME	10 years [entire duration of age group (EPA 1992a)]
BW	Adolescent	Typical/ RME	43 kg (EPA 1992a)
AT	Adolescent	Typical RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2297/16

Key:

RME = Reasonable maximum exposure.
UCL = Upper 95% confidence limit on the arithmetic average.

Source: Ecology and Environment, Inc. 1992.

Table 7-11

CURRENT RESIDENTIAL EXPOSURE:
PATHWAY 3A – INGESTION OF CHEMICALS IN DRINKING WATER
(ADULT AND CHILD RESIDENTS)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/L)
IR = Ingestion Rate (L/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adult/Child	Typical	Average concentration in groundwater
	Adult/Child	RME	Maximum observed concentration in groundwater
IR	Adult	Typical/RME	2.0 L/day (EPA 1992a, percentile; EPA 1989b)
	Child	Typical/RME	1.0 L/day (EPA 1992a)
EF	Adult/Child	Typical/RME	350 days/year (EPA 1992a)
ED	Adult	Typical	9 years (national median time (50th percentile) at one residence (EPA 1989b)
	Adult	RME	30 years (EPA 1992a)
	Child	Typical/RME	6 years (entire duration of age group)
BW	Adult	Typical/RME	70 kg (EPA 1992a)
	Child	Typical/RME	15 kg (EPA 1992a)
AT	Adult/Child	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02(EH)EN3015:D4028/2298/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-12

CURRENT RESIDENTIAL EXPOSURE:
PATHWAY 3B - DERMAL CONTACT WITH CHEMICALS DURING SHOWERING
(ADULT AND CHILD RESIDENTS)

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times PC \times SA \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/liter)
PC = Chemical-Specific Dermal Permeability Constant (cm/hr)
SA = Skin Surface area Available for Contact (cm^2)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
CF = Volumetric Conversion Factor for Water (1 liter/1,000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adult/Child	Typical	Average concentrations in groundwater
	Adult/Child	RME	Maximum detected concentrations in groundwater
PC	Adult/Child	Typical/RME	0.001 cm/hr default value for inorganics (EPA 1992b)
SA	Adult	Typical/RME	20,000 cm^2 (total body SA for adults; EPA 1992a; EPA, 1989b)
	Child	Typical/RME	7,200 cm^2 (average total body SA, 3- to 6-year old child; EPA 1992a; EPA 1989b)
ET	Adult/Child	Typical/RME	0.2 hour/day (EPA 1992a; EPA 1989b)
EF	Adult/Child	Typical/RME	350 days/year (1991b)
ED	Adult	Typical	9 years (national median time (50th percentile) at one residence, EPA 1989b)
	Adult	RME	30 years (EPA 1992a)
	Child	Typical/RME	6 years (entire duration of age group)
BW	Adult	Typical/RME	70 kg (EPA 1991b)
	Child	Typical/RME	15 kg (EPA 1992a)
AT	Adult/Child	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02(EH)EN3015:D4028/2299/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-13

CURRENT RESIDENTIAL EXPOSURE:
PATHWAY 4A - INCIDENTAL INGESTION OF CHEMICALS IN SURFACE WATER
(ADULT AND CHILD RESIDENTS)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/L)
IR = Ingestion Rate (L/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adult/Child	Typical	Average concentration in surface water
	Adult/Child	RME	Maximum observed concentration in surface water
IR	Adult/Child	Typical/RME	0.01 L/day (professional judgment)
EF	Adult	Typical/RME	12 days/year (professional judgment)
	Child	Typical/RME	60 days/year (EPA 1992a)
ED	Adult	Typical	9 years (national median time [50th percentile] at one residence, EPA 1989b)
	Adult	RME	30 years (90th percentile time at one residence; EPA 1992a, EPA 1989b)
	Child	Typical/RME	6 years (entire duration of age group)
BW	Adult	Typical/RME	70 kg (EPA 1989b)
	Child	Typical/RME	15 kg (EPA 1992a)
AT	Adult/Child	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2300/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-14

CURRENT RESIDENTIAL EXPOSURE:
PATHWAY 4B – DERMAL CONTACT WITH CHEMICALS IN SURFACE WATER
(ADULT AND CHILD RESIDENTS)

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times PC \times SA \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

- CW = Chemical Concentration in Water (mg/liter)
- PC = Chemical-Specific Dermal Permeability Constant (cm/hr)
- SA = Skin Surface area Available for Contact (cm^2)
- ET = Exposure Time (hours/day)
- EF = Exposure Frequency (days/year)
- ED = Exposure Duration (years)
- CF = Volumetric Conversion Factor for Water (1 liter/1,000 cm^3)
- BW = Body Weight (kg)
- AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adult/Child	Typical	Average concentrations in surface water
	Adult/Child	RME	Maximum detected concentrations in surface water
PC	Adult/Child	Typical/RME	0.001 cm/hr default value for inorganics (EPA 1992b)
SA	Adult	Typical/RME	5,000 cm^2 [area of hands, arms, and 1/2 legs (EPA 1989b)]
	Child	Typical/RME	3,000 cm^2 [area of hands, arms, legs, and feet (EPA 1989b)]
ET	Adult	Typical/RME	1 hour/day (professional judgment)
	Child	Typical/RME	2.6 hours/day (EPA 1992a)
EF	Adult	Typical/RME	12 days/year (professional judgment)
	Child	Typical/RME	60 days/year (EPA 1992a)
ED	Adult	Typical	9 years (national median time [50th percentile] at one residence, EPA 1989f)
	Adult	RME	30 years (90th percentile time at one residence; EPA 1992a, EPA 1989b)
	Child	Typical/RME	6 years (entire duration of age group)
BW	Adult	Typical/RME	70 kg (EPA 1989b)
	Child	Typical/RME	15 kg (EPA 1992a)
AT	Adult/Child	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2301/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-15

RECREATIONAL EXPOSURE SCENARIO:
PATHWAY 5A - INGESTION OF CHEMICALS IN SURFACE WATER
(ADOLESCENTS 7-16 YEARS OLD)

Equation:

$$\text{Intake (mg/kg-day)} = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/L)
IR = Ingestion Rate (L/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
BW = Body Weight (kg)
AT = Averaging Time (days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adolescent	Typical	Average concentration in surface water
	Adolescent	RME	Maximum observed concentration in surface water
IR	Adolescent	Typical/RME	0.01 L/day
EF	Adolescent	Typical/RME	60 days/year (EPA 1992a)
ED	Adolescent	Typical/RME	10 years (entire duration of age group)
BW	Adolescent	Typical/RME	43 kg (EPA 1992a)
AT	Adolescent	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2302/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-16

RECREATIONAL EXPOSURE SCENARIO:
PATHWAY 5B – DERMAL CONTACT WITH CHEMICALS IN SURFACE WATER
(ADOLESCENTS 7-16 YEARS OLD)

Equation:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CW \times PC \times SA \times ET \times EF \times ED \times CF}{BW \times AT}$$

where:

CW = Chemical Concentration in Water (mg/liter)
PC = Chemical-Specific Dermal Permeability Constant (cm/hr)
SA = Skin Surface area Available for Contact (cm^2)
ET = Exposure Time (hours/day)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
CF = Volumetric Conversion Factor for Water (1 liter/1,000 cm^3)
BW = Body Weight (kg)
AT = Averaging Time (period over which exposure is averaged, in days)

Variable	Receptor	Case	Value (Rationale/Source)
CW	Adolescent	Typical	Average concentrations in surface water
	Adolescent	RME	Maximum detected concentrations in surface water
PC	Adolescent	Typical/RME	Chemical-specific values used (EPA 1992b)
SA	Adolescent	Typical/RME	5,000 cm^2 (EPA 1992a)
ET	Adolescent	Typical/RME	2 hours/day (EPA 1992a)
EF	Adolescent	Typical/RME	60 days/year (EPA 1992a)
ED	Adolescent	Typical/RME	10 years (entire duration of age group)
BW	Adolescent	Typical/RME	43 kg (EPA 1989b)
AT	Adolescent	Typical/RME	Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED x 365 days/year), and 70-year lifetime for carcinogenic effects (i.e., 70 years x 365 days/year)

02[EH]EN3015:D4028/2303/16

Key:

RME = Reasonable Maximum Exposure.

Source: Ecology and Environment, Inc. 1992.

Table 7-18

TOXICITY VALUES FOR POTENTIAL CARCINOGENIC EFFECTS

Chemical	Route	Slope Factor (SF) $(mg/kg/day)^{-1}$	Weight-of-Evidence Classification	Type of Cancer	SF Basis/ SF Source
Inorganics					
Arsenic	Oral	1.75	A	Skin	Drinking water/ IRIS
	Inhalation	15	A	Lung	Inhalation occupational/IRIS
Beryllium	Oral	4.3	B2	Total tumors	Drinking water/ IRIS
	Inhalation	8.4	B2	Lung	Inhalation occupational/IRIS
Cadmium	Oral	NA	ND	NA	NA/IRIS
	Inhalation	6.3	B1	Lung	Occupational/IRIS
Copper	Oral	NA	D	NA	NA/IRIS
	Inhalation	NA	D	NA	NA/IRIS
Lead	Oral	NA	B2	NA	NA/IRIS
	Inhalation	NA	B2	NA	NA/IRIS
Manganese	Oral	NA	D	NA	NA/IRIS
	Inhalation	NA	D	NA	NA/IRIS
Mercury	Oral	NA	D	NA	NA/IRIS
	Inhalation	NA	D	NA	NA/IRIS
Silver	Oral	NA	D	NA	NA/IRIS
	Inhalation	NA	D	NA	NA/IRIS
Zinc	Oral	NA	D	NA	NA/IRIS
	Inhalation	NA	D	NA	NA/IRIS

02(EH)EN3015:D4028/2270/16

Key:

HEAST = EPA's Health Effects Assessment Summary Tables.
IRIS = EPA's Integrated Risk Information System.
NA = Not applicable.
ND = Not determined.

Compiled by Ecology and Environment, Inc. 1992.

Table 7-20

TOXICITY VALUES FOR POTENTIAL NONCARCINOGENIC EFFECTS

Chemical	Route	Type	Reference Dose (RfD) Value (mg/kg/day)	Confidence Level	Critical Effects	RFD Basis/ Source	Uncertainty (UF) and Modifying (MF) Factors
Inorganics							
Arsenic	Oral	Chronic	3×10^{-4}	Medium	Hyperpigmentation, keratosis, and possible vascular complications	Human Oral/IRIS	UF=3 MF=1
		Subchronic	3×10^{-4}	NS	Keratosis and hyperpigmentation	Human Oral/HEAST	UF=1
	Inhalation	Chronic	3×10^{-4}	--	NA	Extrapolated from oral	
		Subchronic	3×10^{-4}	--	NA	Extrapolated from oral	
Beryllium	Oral	Chronic	5×10^{-3}	Low	None observed	Drinking water/IRIS	
		Subchronic	5×10^{-3}	NS	None observed	Drinking water/HEAST	
	Inhalation	Chronic	5×10^{-3}	--	NA	Extrapolated from oral	
		Subchronic	5×10^{-3}	--	NA	Extrapolated from oral	
Cadmium	Oral	Chronic	5×10^{-4}	High	Significant proteinuria	Drinking water/IRIS	UF=10 MF=1
		Subchronic	5×10^{-4}	NS	NA	Extrapolated from chronic	
	Inhalation	Chronic	5×10^{-4}	--	NA	Extrapolated from oral	
		Subchronic	5×10^{-4}	--	NA	Extrapolated from oral	

02(EH)EN3015:D4028/2271/6

Key at end of table.

Table 7-20 (Cont.)

Chemical	Route	Type	Reference Dose (RfD) Value (mg/kg/day)	Confidence Level	Critical Effects	RFD Basis/ Source	Uncertainty (UF) and Modifying (MF) Factors
Copper	Oral	Chronic	(3.7×10^{-2})[D]	NS	Local GI irritation	Oral/HEAST	NA
		Subchronic	(3.7×10^{-2})[D]	NS	Local GI irritation	Oral/HEAST	NA
	Inhalation	Chronic	ND	--	NA	NA/IRIS & HEAST	
		Subchronic	ND	--	NA	NA/HEAST	
Lead	Oral	Chronic	ND	NS	CNS effects	NA/IRIS & HEAST	
		Subchronic	ND	NS	CNS effects	NA/HEAST	
	Inhalation	Chronic	ND	--	CNS effects	NA/IRIS & HEAST	
		Subchronic	ND	--	NA	NA/HEAST	
Manganese	Oral	Chronic	1×10^{-1}	Medium	CNS effects	Diet/IRIS	UF=1 MF=1
		Subchronic	1×10^{-1}	NS	CNS effects	Diet/HEAST	UF=1
	Inhalation	Chronic	1×10^{-4}	Medium	Increased prevalence of respiratory symptoms and psychomotor disturbances	Occupational Inhalation/ IRIS	UF=300 MF=3
		Subchronic	1×10^{-4}	NS	Respiratory effects, psychomotor disturbances	Occupational Inhalation/ HEAST	UF=900

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Key at end of table.

Table 7-20 (Cont.)

Chemical	Route	Type	Reference Dose (RfD) Value (mg/kg/day)	Confidence Level	Critical Effects	RfD Basis/ Source	Uncertainty (UF) and Modifying (MF) Factors
Mercury	Oral	Chronic	3 x 10-4	NS	Kidney effects	Oral rat/HEAST	UF=1000
		Subchronic	3×10^{-4}	NS	Kidney effects	Oral rat/HEAST	UF=1000
	Inhalation	Chronic	9×10^{-5}	NS	Neurotoxicity	Human Occupational/HEAST	UF=30
		Subchronic	9×10^{-5}	NS	Neurotoxicity	Human Occupational/HEAST	UF=30
Silver	Oral	Chronic	5×10^{-3}	Low	Argyria	Oral/IRIS	UF=3 MF=1
		Subchronic	5×10^{-3}	NS	Argyria	Oral/HEAST	UF=3
	Inhalation	Chronic	5×10^{-3}	--	NA	Extrapolated from Oral	
		Subchronic	5×10^{-3}	--	NA	Extrapolated from Oral	
Zinc	Oral	Chronic	2×10^{-1}	NS	Anemia	Therapeutic Dosage/ HEAST	UF=10
		Subchronic	2×10^{-1}	NS	Anemia	Therapeutic Dosage/ HEAST	UF=10
	Inhalation	Chronic	2×10^{-1}	--	NA	Extrapolated from Oral	
		Subchronic	2×10^{-1}	--	NA	Extrapolated from Oral	

02[EH]EN3015:D4028/2272/6

Key at end of table.

Table 7-20 (Cont.)

Key:

D = Implied value calculated from current drinking-water action level of 1.3 mg/L.
HEAST = EPA's Health Effects Assessment Summary Tables.
IRIS = EPA's Integrated Risk Information System.
NA = Not available.
ND = Not determined.
NS = Not specified.
UF = Uncertainty factor.
MF = Modifying factor.

Source: Ecology and Environment, Inc. 1992.

Table 7-21

CLEVELAND MILL SITE
SUMMARY OF ESTIMATED EXCESS CANCER RISKS –
RME CASE

Exposure Scenario and Pathway	Background		Nearest Accessible Downstream Residence		Mill Area	
	Adult	Child	Adult	Child	Adult	Child
Residential						
Soil Exposure	1.2×10^{-4}	8.9×10^{-5}	3.4×10^{-4}	2.5×10^{-4}	2.1×10^{-3}	1.5×10^{-3}
Drinking Water	7.1×10^{-5}	3.3×10^{-5}	4.6×10^{-5}	2.1×10^{-5}	--	--
Surface Water	--	--	7.6×10^{-8}	8.0×10^{-7}	--	--
Total	1.9×10^{-4}	1.2×10^{-4}	3.9×10^{-4}	2.7×10^{-4}	2.1×10^{-3}	1.5×10^{-3}
Recreational	Adolescent		Adolescent		Adolescent	
Soil Exposure – Motorbikers	9.6×10^{-6}		--		1.6×10^{-4}	
– Other Activities (hiking, target shooting, etc.)	9.0×10^{-6}		2.5×10^{-5}		1.5×10^{-4} (Future at Dry Reservoir) 6.5×10^{-5}	
Surface Water	--		4.1×10^{-7}		--	
Total	1.9×10^{-5}		2.5×10^{-5}		3.1×10^{-4} (Current) 3.8×10^{-4} (Future)	

02(EH)EN3015:D4028/2304/20

Table 7-22

CLEVELAND MILL SITE
SUMMARY OF ESTIMATED EXCESS NONCANCER HAZARD INDICES -
RME CASE

Exposure Scenario and Pathway	Background		Nearest Accessible Downstream Residence		Mill Area	
	Adult	Child	Adult	Child	Adult	Child
Residential						
Soil Exposure	0.66	2.3	1.8	6.1	11	38
Drinking Water	0.37	0.87	0.23	0.53	--	--
Surface Water	--	--	0.008	0.45	--	--
Total	1.03	3.17	2.04	7.08	11	38

Recreational	**Adolescent**	**Adolescent**	**Adolescent**
Soil Exposure - Motorbikers	0.30	--	2.6
- Other Activities (hiking, target shooting, etc.)	0.14	0.39	2.5 (Future at Dry Reservoir) 1.7
Surface Water	--	0.14	--
Total	0.44	0.53	5.1 (Current) 6.8 (Future)

(EH)EN3015:D4028/2305/19

Table 7-23

CLEVELAND MILL SITE
SUMMARY OF ESTIMATED EXCESS CANCER RISKS –
TYPICAL EXPOSURE CASE

Exposure Scenario and Pathway	Background		Nearest Accessible Downstream Residence		Mill Area	
	Adult	Child	Adult	Child	Adult	Child
Residential						
Soil Exposure	1.8×10^{-5}	4.2×10^{-5}	7.1×10^{-5}	7.1×10^{-4}	4.4×10^{-4}	1.0×10^{-3}
Drinking Water	0.00	0.00	4.6×10^{-6}	7.2×10^{-6}	—	—
Surface Water	—	—	0.00	0.00	—	—
Total	1.8×10^{-5}	4.2×10^{-5}	7.6×10^{-5}	1.8×10^{-4}	4.4×10^{-4}	1.0×10^{-3}
Recreational	Adolescent		Adolescent		Adolescent	
Soil Exposure – Motorbikers	4.4×10^{-6}		—		1.1×10^{-4}	
– Other Activities (hiking, target shooting, etc.)	4.3×10^{-6}		1.7×10^{-5}		1.1×10^{-4} (Future at Dry Reservoir) 3.4×10^{-5}	
Surface Water	—		0.00		—	
Total	8.7×10^{-6}		1.7×10^{-5}		2.2×10^{-4} (Current) 2.5×10^{-4} (Future)	

02(EH)EN3015:D4028/2313/20

Table 7-24

CLEVELAND MILL SITE
SUMMARY OF ESTIMATED EXCESS NONCANCER HAZARD INDICES -
TYPICAL EXPOSURE CASE

Exposure Scenario and Pathway	Background		Nearest Accessible Downstream Residence		Mill Area	
	Adult	Child	Adult	Child	Adult	Child
<u>Residential</u>						
Soil Exposure	0.29	1.0	1.2	4.1	8.0	27
Drinking Water	0.08	0.18	0.09	0.22	—	—
Surface Water	—	—	0.006	0.32	—	—
Total	0.37	1.2	1.3	4.6	8.0	27
<u>Recreational</u>	<u>Adolescent</u>		<u>Adolescent</u>		<u>Adolescent</u>	
Soil Exposure - Motorbikers	0.09		—		1.8	
- Other Activities (hiking, target shooting, etc.)	0.06		0.26		0.61 (Future at Dry Reservoir) 0.89	
Surface Water	—		0.10		—	
Total	0.15		0.36		2.4 (Current) 6.8 (Future)	

02[EH]EH3015:D4028/2314/19

Table 7-25

SUPPLEMENTAL RISK ESTIMATES
RESIDENTIAL SOIL EXPOSURE
RME CASE[a]

Location	Cancer Risks		Noncancer Hazard Indices	
	Adust	Child	Adult	Child
Background	1.2×10^{-4}	8.9×10^{-5}	0.66	2.3
Cobbed Ore	7.4×10^{-4}	5.3×10^{-4}	7.4	23
Mine Spoils	3.6×10^{-4}	2.6×10^{-4}	6.6	19

02{EH}EN3015:D4028/2316/25

[a]Based on maximum concentrations found in these areas.

Table 7-26

SUMMARY OF ESTIMATED EXCESS CANCER RISKS
AND NONCANCER HAZARD INDICES
ASSOCIATED WITH THE CLEVELAND MILL AREA
(Future Residential Exposure in Mill Area)
(Reasonable Maximum Exposure)

Exposure Scenario	Total Risk Per Receptor: Adult	Total Risk Per Receptor: Child 0 to 6 years	Risk Contributions by Exposure Route[a]	Risk Contributions by Chemical[a]
Cancer Risks				
Future residential scenario	2.1×10^{-3}	1.5×10^{-3}	Ingestion - 42%, 76% Dermal - 57%, 23% Inhalation - <1%, <1%	Arsenic - 97%, 97% Beryllium - 3%, 3%
Noncancer Risks				
Future residential scenario	11	38	Ingestion - 39%, 74% Dermal - 61%, 26% Inhalation - <1%, <1%	Arsenic - 78%, 84% Cadmium - 14%, 10% Zinc - 5%, 5% Copper - 2%, 2% Manganese - 1%, 1%

02[EH]EN3015:D4028/2286/19

[a]The percentages given are for the adult and the child, respectively.

Source: Ecology and Environment, Inc. 1992.

Table 7-27

SUMMARY OF ESTIMATED EXCESS CANCER RISKS AND NONCANCER HAZARD INDICES ASSOCIATED WITH THE NEAREST ACCESSIBLE DOWNSTREAM RESIDENCE (Current Offsite Residential Exposure Scenario) (Reasonable Maximum Exposure)

	Total Risk Per Receptor			
Exposure Scenario	Adult	Child 0 to 6 years	Risk Contributions by Exposure Route[a]	Risk Contributions by Chemical[a]
Cancer Risks				
Current offsite residential scenario	3.9×10^{-4}	2.7×10^{-4}	Ingestion - 49%, 78% Dermal - 51%, 21% Inhalation - <1%, <1%	Arsenic - 90%, 91% Beryllium - 10%, 8% Cadmium - <1%, 1%
Noncancer Risks				
Current offsite residential scenario	2.04	7.08	Ingestion - 46%, 77% Dermal - 52%, 23% Inhalation - <2%, <1%	Arsenic - 76%, 77% Cadmium - 11%, 10% Zinc - 1%, <1% Copper - 4%, 5% Manganese - 2%, 3% Beryllium - 1%, <1% Mercury - <1%, <1% Silver - 2%, 2%

02[EH]EN3015:D4028/2286/19

[a]The percentages given are for the adult and the child, respectively.

Source: Ecology and Environment, Inc. 1992.

Table 7-28

SUMMARY OF ESTIMATED EXCESS CANCER RISKS
AND NONCANCER HAZARD INDICES
ASSOCIATED WITH THE CLEVELAND MILL AREA
(Current and Future Site Visitor Residential Exposure in Mill Area)
(Reasonable Maximum Exposure)

Exposure Scenario	Total Risk For Receptor: Adolescent	Risk Contributions by Exposure Route[a]	Risk Contributions by Chemical[a]
Cancer Risks			
Current site visitor scenario	3.1×10^{-4} (current) 3.8×10^{-4} (future)	Ingestion - 36%, 36% Dermal - 60%, 60% Inhalation - 4%, 4%	Arsenic - 97%, 97% Beryllium - 2%, 2% Cadmium - <1%, <1%
Noncancer Risks			
Current site visitor scenario	5.1 (current) 6.8 (future)	Ingestion - 34%, 33% Dermal - 64%, 65% Inhalation - 2%, 2%	Arsenic - 76%, 70% Cadmium - 14%, 18% Zinc - 5%, 6% Copper - 2%, 3% Manganese - 3%, 3%

02[EH]EN3015:D4028/2286/19

[a]The percentages given are for the current and future cases, respectively.

Source: Ecology and Environment, Inc. 1992.

Table 7-29

SUMMARY OF ESTIMATED EXCESS CANCER RISKS
AND NONCANCER HAZARD INDICES
ASSOCIATED WITH THE CLEVELAND MILL AREA
(Recreational Exposure in Off-site Area)
(Reasonable Maximum Exposure)

Exposure Scenario	Total Risk For Receptor: Adolescent	Risk Contributions by Exposure Route	Risk Contributions by Chemical
Cancer Risks			
Future recreational scenario	2.5×10^{-5}	Ingestion - 38% Dermal - 61% Inhalation - <1%	Arsenic - 96% Beryllium - 4%
Noncancer Risks			
Future recreational scenario	0.53	Ingestion - 56% Dermal - 43% Inhalation - <1%	Arsenic - 60% Cadmium - 18% Zinc - 8% Copper - 7% Manganese - 5% Others - <2%

02[EH]EN3015:D4028/2286/19

Source: Ecology and Environment, Inc. 1992.

Table 7-30

PREDICTED BLOOD LEAD LEVELS FROM EXPOSURE TO LEAD IN SOIL AND AIR
RECEPTOR: CHILD, 0 TO 6 YEARS OLD

Area	Number of Soil and/or Sediment Samples	Range of Soil Lead Concentration (mg/kg)	Geometric Mean Soil Lead Concentration (mg/kg)	Estimated Lead Uptake From Soil and Dust (µg/day)	Estimated Lead Uptake From All Sources (µg/day)	Predicted Geometric Mean Blood Lead Concentration (µg/dL)	Percent of Blood Lead Levels Predicted to exceed 10 µg/dL (%)
Current Off-Site Residential Exposure							
Natural Background	5	35.7 - 61.6	44.6	1.34	5.72	1.91	0.00
Nearest Accessible Residence	9	17.1 - 1,390	146	4.38	8.63	2.74	0.01
Future On-Site Residential Exposure							
Site-wide	45	46.8 - 13,500	819	24.6	28.8	8.48	30.8
East Pile	15	278 - 1,860	791	23.7	27.9	8.24	27.4
West Pile and Center	15	438 - 11,500	1,340	40.2	44.4	12.9	73.2
West Hill	7	348 - 13,500	1,280	38.4	42.6	12.4	70.6
Dust Pile	3	46.8 - 444	195	5.85	10.0	3.16	0.05
Cobbed Ore	5	98.8 - 512	262	7.86	12.1	3.73	0.23

02[EH]EN3015:D4028/2289/10

Note: The EPA recommended cutoff probability for excessive exposure is 95% of the most sensitive population having blood levels below 10 µg/dL.

Source: Ecology and Environment, Inc. 1992.

Table 7-31

SELECTED CONTAMINANTS OF POTENTIAL ECOLOGICAL CONCERN

Element/Compound	Surface Water	Sediments	Soils
Aluminum	X		
Antimony			
Arsenic	X	X	X
Barium			
Beryllium			
Cadmium	X	X	X
Calcium			
Chromium			
Cobalt	X		
Copper	X	X	X
Iron			
Lead	X	X	X
Magnesium	X		
Manganese	X		
Mercury			X
Nickel	X		
Potassium			
Selenium			
Silver		X	X
Sodium			
Thallium			
Vanadium			
Zinc	X	X	X
Cyanide			

02[EH]EN3015:D4028/2318/34

Source: Ecology and Environment, Inc. 1993

CALCULATIONS OF HAZARD INDICES (HI) FOR ZINC USING ALTERNATIVE REFERENCE DOSE (RfD), CLEVELAND MILL SITE

ALL CALCULATIONS ARE FOR RME RESIDENTIAL SCENARIO, SOIL EXPOSURE PATHWAY (Ingestion, Dermal and Inhalation Routes).

Basic equation: HI = CDI/RfD   CDI is chronic daily intake.

CDIs are taken from Tables 6-B-2 and 6-B-2 in the Risk Assessment (Section 7 of the Remedial Investigation for the Cleveland Mill Site, March 1993), and are the same for either RfD.

---

for RfD = 0.2,   HI = CDI/0.2

Route	Adult CDI	Adult HI	Child CDI	Child HI
Ingest	4.49E-02	2.25E-01	2.94E-01	1.47
Dermal	6.17E-02	3.09E-01	8.73E-02	4.37E-01
Inhal	4.47E-05	2.24E-01	1.76E-04	8.80E-01
TOTAL		5.34E-01		1.91

NOTE: The HIs for zinc calculated using RfD = 0.2 are those that appear in the Risk Assessment.

---

for RfD = 0.3,   HI = CDI/0.3

Route	Adult CDI	Adult HI	Child CDI	Child HI
Ingest	4.49E-02	1.50E-01	2.94E-01	9.80E-01
Dermal	6.17E-02	2.06E-01	8.73E-02	2.91E-01
Inhal	4.47E-05	1.49E-04	1.76E-04	5.87E-04
TOTAL		3.56E-01		1.27

Appendix B Refined Cost Estimates for Alternatives

Estimated Cost Recalculations

Road Improvement/Repair Estimate

Road improvements or repairs shall be performed, if necessary, as determined by EPA, after state and local governmental agencies have had an opportunity to provide information to EPA regarding road repairs. Although EPA does not know if road repairs or road improvements will be necessary, costs for each of these items have been included in the Site cost estimates. Actual costs for the selected remedy will be determined during the Remedial Design Phase of the Site clean-up.

Repair: $5,000 per mile, 4 times in 8 months

a) 4 mile stretch of Little Walnut Road from Highway 180 to site turn-off

$5,000/mile x 4 times x 4 miles = $80,000

b) 2 mile stretch to site

$5,000/mile x 4 times x 2 miles = $40,000

Improvement:

Pavement Base for 2 mile stretch to site
(12" deep, bank run gravel, spread and compacted)

(2 miles)(5,280 ft/mile)(1 ft deep)(15 ft wide)($15/yd^3)
(1 yd^3/27 ft^3) = $88,000

Turnouts

(50 ft long)(15 ft wide)(8 ft deep/turnout)(2 turnouts)($15/yd^3)
(1 yd^3/27 ft^3) = $6,666

Grand Total Transportation = $214,666

Individual Alternative Cost Recalculations

Alternative 5, The Selected Remedy

	$7,999,370	original Proposed Plan estimate
-	$3,000,000	stabilization/solidification removed
+	$1,000,000	reprocessing fee paid (15% profit)
+	$ 214,666	transportation costs
	$6,214,036	**TOTAL**

$5,621,920 + $214,666 = **$5,836,586** **TOTAL (capital cost)**

Alternative 2

	$3,110,035	
+	$ 214,666	
	$3,324,701	**TOTAL (present worth)**

$2,461,637 + 214,666 = **$2,676,303** **TOTAL (capital cost)**

Alternative 3

	$6,404,521	
+	$ 214,666	
	$6,619,187	**TOTAL (present worth)**

$5,765,550 + 214,666 = **$5,980,216** **TOTAL (capital cost)**

Alternative 4

	$11,264,380	
+	$ 214,666	
	$11,479,046	**TOTAL (present worth)**

$10,886,930 + $214,666 = **$11,101,596** **TOTAL (capital cost)**

Appendix C Transportation Calculations and Considerations

Transportation Calculations and Considerations

Community concerns exist with regard to potentially heavy truck traffic through the community during implementation of the remedy at the Cleveland Mill Superfund Site. Implementation of either Alternative 3, On-site Solidification and Stabilization and Disposal; Alternative 4, On-site Solidification and Stabilization with Off-site Disposal; or Alternative 5, Off-site Reprocessing will cause an increase in truck traffic in the short-term. EPA and NMED believe that short-term risks from the increase in traffic could be mitigated by using engineering controls and consulting closely with the City and the County to develop transportation routes.

Based on EPA's calculations included in this appendix, approximately 4700 truck loads or 24 trucks a day each way (or 4 trucks per hour) would travel on Little Walnut Road to move the 70,900 cubic yards of contaminated materials to a reprocessing facility as specified in Alternative 5. All calculations assume an eight-month transportation period which has been expanded since the publication of the Proposed Plan to more accurately reflect the time the work will require. The calculations also assume a 6-day work week, 12 hour days and 24 ton trucks. The assumptions made in these calculations were checked with mining companies in the area and with the contacts at both the County and State Highway departments to be sure that they accurately reflect realistic and local conditions.

Alternative 3 would require a lower number of truck trips, 1300 truckloads, about 7 trucks per day each way (or about 1-2 trucks per hour) in order to bring stabilizing and solidifying material and water to the site. This calculation assumes the minimum amount of cement and water necessary to adequately stabilize and solidify the waste material and assure protection from leaching. The amount of cement and water may increase as a result of design phase treatability studies, resulting in an increase in truck traffic for this alternative.

The volume of the waste material would be greatly increased under Alternative 4, due to on-site stabilization and solidification of the contaminated tailings and sediment prior to transportation. Therefore, a greater number of trucks than under any other alternative would be employed if Alternative 4 were implemented. Alternative 4 would take 7400 truckloads, 39 trucks per day each way (or about 7 trucks per hour).

To further facilitate truck traffic the City and County will be invited to help design trucking routes and suggest possible safety considerations for use in any transportation plan. For instance, the trucks traveling to the site could follow a reduced speed limit, be rerouted around school zones, and have flashing lights. The assumptions used in the traffic calculations are not firm and may be modified to address additional City and County concerns during the design phase. EPA and NMED would like to point out that the increase in truck traffic through Silver City is not a very high percentage increase when compared to the number of trucks already traveling between other local mines, mills and smelters. Both the EPA and the NMED believe that this level of truck traffic over a short time period is very manageable.

The concerns with the truck traffic fall into the short-term effectiveness and community acceptance criteria which are explained in detail in the Record of Decision for this Site. All of the alternatives have some short-term impacts. Alternatives 3, 4 and 5 would all involve an increase in truck traffic and some short-term risks. EPA believes that these risks can be addressed through engineering controls such as road improvements, dust suppression and air monitoring and also through consulting with the City and County on transportation routing.

TRUCK LOAD CALCULATION
ALTERNATIVE 5, OFF-SITE REPROCESSING
CLEVELAND MILL SUPERFUND SITE, GRANT COUNTY, NEW MEXICO

1) volume/weight calculation

$(16.875\ ft^3/ton)(yd^3/27\ ft^3) = 1.6\ tons/yd^3$ sand, gravel, rock

2) truckload calculations (one way)

For a 24 ton truck:

$(24\ ton/truck)/(1.6\ tons/yd^3) = 15\ yd^3/truck$

$(70{,}900\ yd^3)/(15\ yd^3/truck) = 4727$ trucks

For 8 months of work, 6 days/week, 12 hours/day (32 weeks, 192 days):

4727 trucks/192 days ≈ 24 trucks/day (each way)

((24 trucks/day one direction)/(12 hours/day))(2*) ≈ 4 trucks/hour (one way trip)

* 2 directions, going to the Site and coming from the Site

TRUCKLOAD CALCULATION
ALTERNATIVE 3, ON-SITE SOLIDIFICATION/STABILIZATION AND ON-SITE DISPOSAL
CLEVELAND MILL SUPERFUND SITE, GRANT COUNTY, NEW MEXICO

1) Weight of cement that must be added (assumes 10% by volume cement)

(1 ton/2000 lbs)(2700 lbs/yd^3)((.10)(70,900 yd^3)) = 9571.5 tons

2) Number of trucks of cement

(9571.5 tons)/(15 ton/truck) = 638 trucks

3) Number of truckloads to bring portable cement mixing plant, equipment and other supplies (electrical hook-up): 60 truckloads

TOTAL for Cement and Supplies: 638 trucks + 60 trucks ≈ **700 trucks**

4) Water Calculation: Assume that about 1 million gallons is the maximum that can be taken from the site reservoir in an average year without destroying its use. This entire quantity of water would be necessary for decontamination and revegetation.

The following calculation is for the actual water needed to make the cement.

a) conversion

1 gal = ((231 in^3)/(12^3 in^3))(ft^3)/(27 ft^3/yd^3) = .00495 yd^3

b) Number of Gallons of water needed for cement (assumes 20% by volume water):

(.20)(70,900 yd^3)/(.00495 yd^3/gal) = 2.86 million gallons
≈ 3 million gallons

c) Using a 5000 gallon tanker (about 20 tons of water):

3,000,000 gal water/(5000 gal/tanker) = 600 tankers

5) **Total:** 700 + 600 = 1300 tanker truck loads

6) Truckload calculation (one-way):

1300 truckloads/192 days ≈ 7 trucks/day (each way) ≈ 1-2 trucks/hour (one way)

TRUCKLOAD CALCULATION
ALTERNATIVE 4, ON-SITE SOLIDIFICATION/STABILIZATION AND OFF-SITE DISPOSAL
CLEVELAND MILL SUPERFUND SITE, GRANT COUNTY, NEW MEXICO

Alternative 4 would require the same number of trucks as Alternative 3 to stabilize and solidify the waste plus 1.3 times the number of trucks as Alternative 5 (because the volume will increase by at least 30% due to water and cement that is added during stabilization and solidification) to take the increased volume of waste off-site:

1.3(4727) + 1300 = 7445 trucks/day ≈ 7 trucks/hour
(each way) (one way)

Appendix D Applicable, Relevant or Appropriate Requirements

APPENDIX D - CLEVELAND MILL ARARS

1. Chemical-Specific ARARs for Tailings and Sediment

1. National Emission Standards for Hazardous Air Pollutants (40 CFR Part 61) (NESHAPS).

Relevant and appropriate during removal of tailings and soils and transportation.

2. New Mexico Ambient Air Standards, Air Quality Control Regulations, Section 201A. (NM Stat. Ann. § 72-2-1 et seq.)

Relevant and appropriate during removal of tailings and soils and transportation.

2. Action-Specific ARARs for Tailings and Sediment

a. RCRA 40 CFR 262, Manifesting Requirements for Transport of Hazardous Waste

Relevant and appropriate because manifesting method to be used to keep track of Superfund wastes which will be transported. The material involved is not a RCRA hazardous waste, but the manifesting method is helpful and protective.

b. New Mexico Mining Act of 1993

Remediation on-site falls under the definition of "mining" in the "New Mexico Mining Act (effective July 1, 1993)", and so is subject to the Act. However, since regulations have not, yet, been promulgated under the Act, remediation need only comply with the Act to the extent that it clearly defines procedures to be used. Once regulations are promulgated, application of the Act and its regulations to the remediation of the site may be re-evaluated by EPA. Under CERCLA, ARARs do not apply to off-site activity.

3. Location-Specific ARARs for Tailings and Sediment

a. Endangered Species Act, 50 CFR 17, 402

Although no endangered species have been observed at the Site, there are two endangered species in the Gila Wilderness which is located about 10 miles northwest of the Site. Federal activities must not jeopardize the continued existence of endangered or threatened species or adversely modify their critical habitat.

b. Fish and Wildlife Coordination Act, 40 CFR 6.302 (g)

Consultation between federal agencies is required when a water body is modified and it could affect wildlife which may be the case during excavation of tailings from the stream.

c. New Mexico Wildlife Conservation Act

Consultation with State agencies is required to avoid or mitigate adverse impacts to endangered species listed by the New Mexico Departments of Natural Resources and Game and Fish.

d. National Historic Preservation Act, 40 CFR 6301 (b)

Coordination with State agencies is required in order to ensure that properties, the impact on them, and the effects on them are identified, and that the alternatives to avoid or mitigate an adverse effect on property eligible for the National Register of Historic Places are adequately considered in the planning process.

e. Archaeological and Historical Preservation Act, 16 U.S.C. 469, et. seq.

Any federally-funded or licensed construction project is covered by this act that provides a mechanism for funding the protection of historical and archaeological data.

f. New Mexico Cultural Properties Act.

Relevant and Appropriate because State agencies shall conduct all plans necessary to preserve, protect and enhance significant historical cultural properties under this act.

4. ARARs for Ground Water and Surface Water

EPA and NMED will evaluate, at the least, the following regulations before contingency measure selection, should the implementation of contingency measures become necessary:

a. Chemical-Specific ARARs for Ground Water

The regulations that will be evaluated will include National Primary Drinking Water Regulations (40 CFR Part 141); New Mexico Water Quality Act, NM Stat. Ann. § 74-6-1 et seq.; NM WQCC Regulations 82-1, Sections 3-101, and 103; and NM WQCC Regulations 91-1, Section 1-102, 2-105, and 3-101.

b. Action-Specific ARARs for Ground Water

The regulations that will be evaluated will include Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities should it become necessary to construct a pumping and treating operation on-site for any treatment of any contaminated ground water resulting in residuals (for instance filter cake) that contained a hazardous waste.