Public Health Assessment for

MOLYCORP, INCORPORATED
QUESTA, TAOS COUNTY, NEW MEXICO
EPA FACILITY ID: NMD002899094
SEPTEMBER 1, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

Comment Period Ends:

OCTOBER 22, 2004

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced.
(The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E60), Atlanta, GA 30333.

Table of Contents

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List of Acronyms

ADHD	Attention Deficit Hyperactivity Disorder
AL	Action Level
ATV	All-Terrain Vehicle
ATSDR	Agency for Toxic Substances and Disease Registry
COC	Contaminant of Concern
COPD	Chronic Obstructive Pulmonary Disease
CREG	Cancer Risk Evaluation Guide
CSF	Cancer Slope Factor
CV	Comparison Value
EMEG	Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
ESI	Expanded Site Inspection
HOD	Health Outcome Data
LOAEL	Lowest Observed Adverse Effect Level
MCL	Maximum Contaminant Level
mg/kg/day	milligram per kilogram per day
MMD	Mining and Mineral Division
MRL	Minimal Risk Level
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
PM_{10}	Particulate Matter less than 10 microns in diameter
ppm	part per million
RBC	Risk-based Concentration
RCRC	Rio Colorado Reclamation Committee
PRG	Preliminary Remediation Goal
RfD	Reference Dose
RI	Remedial Investigation
RMEG	Reference Media Evaluation Guide
SSL	Soil Screening Level
TAG	Technical Assistance Grant
TCDD	Tetrachlorodibenzodioxin
TEF	Toxicity Equivalency Factor
TEQ	Toxicity Equivalency Quotient

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TSP	Total Suspended Particulates
TUI	Tolerable Upper Intake
μg/L	microgram per liter
$\mu g/m^3$	microgram per cubic meter

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Summary

The Molycorp site is a molybdenum mining operation located in and around Questa, New Mexico. The site comprises mining operations east of town, a pipeline used to transport waste tailings, and a tailings impoundment facility west of town. Waste rock and tailings have contributed heavy metals to surface water in the Red River and groundwater downgradient from the mine facilities. Metals-contaminated dust has also been released from the tailings facility, and many spills and other releases of tailings from the pipeline have occurred over the years, potentially spreading metals contamination into the water and land around the Red River and acequias (irrigation ditches).

On the basis of available information, the Agency for Toxic Substances and Disease Registry (ATSDR) has made the following conclusions about the Molycorp site:

- Information about use of private wells and their levels of contamination in the past was limited. Some of the wells potentially used for private consumption in the past have levels of arsenic, cadmium, iron, magnesium, manganese, molybdenum, zinc, fluoride, or sulfate high enough to have increased the risk of adverse health effects, to varying degrees, if people drank water from the affected wells regularly. No adverse health effects are likely today as long as people avoid drinking contaminated well water.

- Information about levels of dust blowing from tailings piles toward Questa was also limited. Using available data and professional judgment, rough “worst case” estimates of past exposures indicated that exposures to metals contaminants from breathing in tailings dust were too low to result in short- or long-term health effects. However, intermittently high dust levels in the 1970s, 1980s, and (to a lesser extent) the 1990s could have resulted in short-term eye and respiratory irritation and an increased risk of respiratory problems in sensitive groups (people with asthma or other respiratory disease, the elderly, and children). Recent studies indicate that adverse health effects are unlikely today.

- Contaminants in Questa municipal water meet applicable water quality standards and are not expected to cause adverse health effects. Although there is no evidence of it occurring, even if people occasionally drank tap water with tailings particles or contaminants in it, estimated contaminant exposures would be too low to result in adverse health effects.

ATSDR has made the following recommendations about the Molycorp site:

- People should avoid drinking water from wells shown to be contaminated. The most highly contaminated wells should be decommissioned to prevent people from drinking the water. People who drink water from private wells are encouraged to have the well water quality tested regularly.

- Continue dust mitigation/suppression at the tailings facility as long as suspendable tailings are present. People in sensitive groups (people with asthma or other respiratory disease, the

elderly, and children) should limit outdoor activity on dry, windy days or if dust levels appear to be high.

- To improve the community's acceptance of Questa's water supply, ATSDR supports the planned upgrading of the municipal water system to remove water lines from tailings.

I. Purpose and Health Issues

The Molycorp site was proposed for the National Priorities List (NPL) on May 11, 2000. The Agency for Toxic Substances and Disease Registry (ATSDR) is required by Congress to conduct public health activities on all sites proposed for the NPL. In this public health assessment, ATSDR evaluates the public health significance of the Molycorp site. ATSDR reviewed available environmental data, potential exposure scenarios, and community health concerns to determine whether adverse health effects are possible. In addition, this public health assessment recommends actions to prevent, reduce, or further identify the possibility for site-related adverse health effects.

II. Background

A. Site Description

This description comes from the New Mexico Environment Department (NMED) Expanded Site Inspection report and other site documents [1,2].The Molycorp NPL site is located in Taos County, New Mexico, near the town of Questa. It includes a molybdenum mining and processing area east of town, a tailings disposal area containing wastes from the mining process west of town, and a pipeline which transports the tailings from the mine to the tailings facility. As shown in Figure 1, the mine area, approximately 3 square miles in area, is located about 5 miles east of Questa. The tailings disposal facility covers about 1 square mile and is located less than 2 miles west of Questa. The tailings pipeline follows the Red River most of the way to the tailings facility. It also crosses and parallels the acequias, ditches that provide irrigation and other water to the community.

Molybdenum has been, and is still, mined from the mountains east of Questa since the 1920s. The rock is mined, crushed and processed to obtain the molybdenum. Waste rock (rock with no commercial value) is piled in several areas around the site. Tailings (fine remains of crushed rock after product removal) are mixed with water and pumped through a pipeline into large ponds at the tailings facility. The solid tailings settle out of the water, and are covered after drying. Waste rock and tailings have contributed heavy metals to surface water in the Red River and groundwater downgradient from mine facilities [2]. Metals-contaminated dust has also been released from drying tailings west of town. Many spills and other releases of tailings from the pipeline have occurred over the years, potentially spreading metals contamination into the water and land around the Red River and acequias [5,6]. Concerns have also surfaced about the physical stability of some of the waste rock piles, especially at Goat Hill Gulch.

The Molycorp mine includes underground workings, an open pit, the mill site, and waste rock dumps at Capulin Canyon, Spring Gulch, Sulphur Gulch, Blind Gulch, Goat Hill Gulch, and the Sugar Shack area adjacent to the Red River. The Molycorp tailings impoundment includes two large ponds and two smaller ponds [3].

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B. Site Operational History

Molycorp began underground molybdenum mining operations at the site in 1920, constructing a mill in 1923. In 1965, Molycorp began open pit operations, which required the construction of tailings impoundments to dispose of the large quantities of waste. Open pit mining continued until 1983, when the operation returned to underground mining. Pipelines located above the ground surface along the Red River transport the tailings from the mill site to the tailings impoundments. The water left over after the tailings settle out is channeled to Pope Lake before being discharged to the Red River [4]. The company installed surface water diversion ditches in 1974 to divert surface water runoff around the tailings impoundments [1]. It built seepage barriers below the dams in 1975 to allow collection of leachate from the tailings impoundments in groundwater recovery wells. All the groundwater and surface water collected is diverted around residences below the dams to a designated National Pollutant Discharge Elimination System (NPDES) permitted outfall [3]. In 1983, Molycorp built an ion exchange plant near Pope Lake to treat water from the tailings impoundments before discharge to the Red River [3]. Market conditions forced the mine to halt operations from 1991–1994 and for other periods; however, Molycorp continues to mine from underground operations today.

In the 1980s citizens began protesting the problem of dust blowing from the tailings impoundments into Questa [5]. This was reported in local newspapers to be a particular problem at the Questa Junior/Senior High School (now Alta Vista Elementary), with the extremely high levels of dust prompting a student walkout. In response to protests, complaints, and media attention, Molycorp changed the procedure for drying tailings at the impoundments. The mine reduced the acreage of tailings drying before they were covered to 100 acres. Although no record of exactly when this change was implemented could be located, it reportedly reduced the amount of tailings dust that blows into Questa.

C. Demographics

The town of Questa has approximately 1,864 residents [7]. Figure 1 shows demographic information for the population within a 1-mile radius of the site (including the mine property, tailings impoundment area, and pipeline). According to the 2000 US Census, 1,786 people, including 166 children younger than 6 years of age, live within a 1-mile radius of the site [7]. This population is approximately 80% Hispanic. The racial makeup of the population is 52% White; 42% some other race alone; 5% two or more races; and less than 1% each Black, American Indian or Alaska Native, Asian, or Native Hawaiian or other Pacific Islander [7].

In the 2001-2002 school year, 202 children attended the Alta Vista Elementary/Intermediate School (grades K-6), and 276 children attended Questa Junior/Senior High School [8]. Junior and senior high school age children from surrounding communities are bused to Questa to attend school. From its construction in the late 1960s until a new school was built in the 1990s, the junior/senior high school was located where the Alta Vista school is now.

D. Land and Natural Resource Use

Questa lies at an elevation of about 7,500 feet in north central New Mexico, about 20 miles south of the Colorado border and 20 miles north of Taos. The surrounding land is mountainous, with some peaks reaching more than 10,000 feet in elevation. Questa is located at and around the intersection of state highways 522 and 38 [1].

The soils in the area have a naturally high mineral content. Some areas of natural erosion (known as hydrothermal scars) present in the vicinity of Questa may contribute to metals levels in area soil and waters [9].

Land in the area around the Molycorp property is used primarily for farming, recreation, and residential use. Although ATSDR did not tour the entire perimeter of the mine property, the boundaries observed were either fenced or posted with “private property” signs. Reportedly, the site is not completely fenced; however, ATSDR received no reports of frequent trespassing on Molycorp property itself. One citizen reported that it was possible to access the tailings impoundment property and that all-terrain vehicle (ATV) riders used that area as a cut-through (personal communication, private citizen, September 30, 2003). The tailings pipeline is not completely fenced off from the public and runs through residential and recreational areas. Releases from the pipeline have been reported in areas that are easily accessible to the public.

The Red River runs in a westerly direction on the south side of the mine, Questa, and tailings impoundments on its way to the Rio Grande River approximately 5 miles downstream of Questa [1]. Two tributaries enter the Red River around Questa: Columbine Creek, which enters the river from the south directly across from the mine, and Cabresto Creek, which enters from the north close to town. Eagle Rock Lake is also located on the course of the Red River, about ½ mile east of town. The Red River, Columbine Creek, Cabresto Creek, and Eagle Rock Lake are all listed as trout fishing waters by the New Mexico Department of Game and Fish [10]. The Red River below Questa is stocked with rainbow trout grown in a fish hatchery run by the New Mexico Department of Game and Fish, located 2 miles downstream from the tailings impoundments [11]. Fishing is common along the Red River, and hunting in the land around the Molycorp property is reported to occur regularly. The native fishery has reportedly declined significantly since the 1970s [1].

The Village of Questa maintains a municipal water supply drawn from two wells and stored in two tanks with a combined capacity of 130,000 gallons [12]. In 2000, the system served 768 connections and approximately 1800 people. Tailings from Molycorp were apparently used to backfill water lines when the municipal system was added in 1968 [13]. In addition to the municipal supply, there are several private wells registered for domestic use in Questa and in surrounding areas that could potentially be affected by contaminants from the mining process. The usage rates and contaminant levels of many of these wells remains unknown.

III. Discussion

A. Data Used

The environmental sampling data evaluated in this document came from the following sources:

- Data collected during the remedial investigation. The U.S. Environmental Protection Agency (EPA) provided validated data through November 2003 [14]. The database provided also included some historical data.
- Private well sampling data provided by private citizens.
- Private well sampling performed by the New Mexico Environment Department (NMED) Drinking Water Bureau [15].
- Spring sampling data provided by the Rio Colorado Reclamation Committee (RCRC), a local group funded by a Technical Assistance Grant (TAG) from EPA.
- Air sampling data and air permit data provided by the NMED Air Quality Bureau [16].

The conclusions reached in this document are based on the data available at this time and might be modified based on the results of additional samples that will be collected during the remedial investigation process.

ATSDR visited the site to better understand the physical setting of the site and its relationship to the people living and working nearby.[1] During these site visits, staff observed the following:

- Tailings spills had occurred at several locations along the tailings pipeline. The pipeline runs along the Red River and acequias in some areas.
- Entrances to the mine site and tailings facility were gated, but access was unrestricted along most of the tailings pipeline.
- Residences were located near sites of former tailings spills, the tailings pipeline, sites of seeps from waste rock piles, and the tailings facility. Livestock and agricultural land were observed near and downgradient of the tailings pipeline and/or tailings facility.
- The former Questa Junior/Senior High School (now Alta Vista Elementary) is about ¼ mile northeast of the tailings piles. The land in between appears vacant with no hills or obstructions that might prohibit dust from blowing onto the school.
- The land use in the general area is mostly rural, agricultural, and forest land, with residential and commercial use mainly in Questa and along the roads.

ATSDR met with residents during a public meeting about the site.[2] ATSDR also spoke to residents and other concerned community members by telephone. The community expressed many health concerns, which are discussed in the Community Health Concerns section of this document. In addition, residents provided the following information about community use of the site:

[1] Site visits were conducted on June 25, 2003 (ATSDR staff Lisa Hayes, Patrick Young, Leslie Campbell, Debra Joseph, and Kris Larson) and August 27-28, 2003 (ATSDR staff Jill Dyken, Lisa Hayes, and Patrick Young).
[2] A public meeting was held by ATSDR staff in Questa on June 25, 2003. ATSDR staff were also available to meet with the public on June 26, 2003. In addition, ATSDR staff attended an EPA public meeting held on August 27, 2003 and spoke with community members after this meeting.

- People live in areas along the pipeline where tailings spills have occurred.
- Access to the tailings impoundment area is not completely restricted; however, residents rarely enter the area. It is sometimes used as a cut-through by ATV riders.
- Private wells were located downgradient from tailings impoundments and waste rock piles. It is not known how many of these wells are being used for drinking water purposes today.
- People use water from acequias for irrigation and other household uses. Some of the acequias run near the tailings pipeline and were reported to have been affected by tailings spills in the past.
- Citizens reported that municipal water line breaks are thought to result in tailings being introduced into drinking water, because water lines are thought to be buried in tailings.

B. Evaluation Process

The process by which ATSDR evaluates the possible health impact of contaminants is summarized here and described in more detail in Appendix A. The first step involves screening the available data for contaminants of concern (COCs). ATSDR uses comparison values (CVs) to determine which chemicals to examine more closely. CVs are concentrations of chemicals in the environment (air, water, or soil) below which no adverse human health effects should occur. Exceeding a CV does not mean that health effects will occur, just that more evaluation is needed. ATSDR also considers sampling location and data quality; exposure probability, frequency, and duration; and community health concerns in determining which chemicals to evaluate further.

If a chemical contaminant is selected for further evaluation, the next step is to identify which chemicals and exposure situations could be a health hazard. Child and adult exposure doses are calculated for COCs in site media (e.g., soil, groundwater, surface water, sediment, or fish). Exposure doses are the estimated amounts of a contaminant that people come in contact with under specified exposure situations. These exposure doses are compared to appropriate health guidelines for that chemical, including ATSDR's minimal risk level (MRL) or EPA's reference dose (RfD). Health guideline values are considered safe doses; that is, health effects are unlikely below this level. If the exposure dose for a chemical is greater than the health guideline, then the exposure dose is compared to known health effect levels identified in ATSDR's toxicological profiles. If the COC is a carcinogen, the cancer risk is also estimated. These comparisons are the basis for stating whether the exposure is a health hazard.

C. Exposure Pathways and Contaminants of Concern

The following sections describe the various ways people could come into contact with contaminants at the site; each of these ways is called an exposure pathway. Appendix B summarizes the possible exposure pathways for the Molycorp site. If people are unlikely to be exposed to contaminants in a given pathway, then that pathway will not be evaluated further for human health risks.

1. Ingestion of Groundwater from Private Wells

Although many people in Questa use municipal water for drinking water and household purposes, several private wells located near the mine and tailings facility have been affected by site contaminants. Especially in the past, people could have been exposed to contaminants in private well water. According to private citizens, people formerly drank and bathed in wells that were found to be contaminated. Although the people are not thought to use the water now, the contaminated private wells have not been abandoned and could still be used (although some are not functional). Therefore, it is possible that people could drink this water now or in the future. Groundwater potentially contaminated by the site has been monitored during the remedial investigation by sampling seeps, springs, monitoring wells, extraction wells, and private wells in and around the site. In addition to data from the EPA remedial investigation, ATSDR reviewed historical private well sampling data provided by private citizens and results from NMED testing of private wells in 2001. Table 1 shows the contaminants that were detected at least once above the corresponding drinking water CV in any of these groundwater samples. The second column in Table 1 shows the highest concentration of these contaminants measured in “potential drinking water wells,” defined as any private well or other well ever used or potentially used for drinking purposes. For any one well, if samples were collected over time, those results were averaged.

Table 1. Groundwater Contaminants Detected Above Comparison Values for Drinking Water [14]

Contaminant	Highest Concentration Detected in Any Groundwater Sample, μg/L	Highest Concentration Detected in Potential Drinking Water Well (average over time), μg/L	Comparison Value (CV) for Groundwater in μg/L	CV Source (Defined in Appendix A)
2,4,6-Trinitrotoluene	9	No Detections	1	CREG
Aluminum	950,000	40,820	20,000	iEMEG
Ammonia	7,000	Below Comparison Value	3,000	iEMEG
Antimony	174	153	4	RMEG
Arsenic	218	26	3 / 0.02	EMEG/CREG
Barium	1,360	Below Comparison Value	700	RMEG
Beryllium	280	72	20	RMEG
Bis (2-ethylhexyl) phthalate	31	Below Comparison Value	600 / 3	EMEG/CREG
Boron	3,000	1,650	100	iEMEG
Cadmium	250	49	2	EMEG
Chlorine	21,000	21,000	1,000	RMEG
Chromium	503	49	30	RMEG/hexavalent chromium
Cobalt	4,300	153	100	iEMEG
Copper	7,490	894	300	iEMEG
RDX	4	No Detections	0.3	CREG
Fluoride	180,000	25,836	500	EMEG
Iron	420,000	139,000	11,000	EPA Region 9 PRG
Lead	1,660	42	15	EPA AL
Magnesium	1,060,000	110,687	30,000	Recommended Daily Allowance
Manganese	259,000	22,407	500	RMEG
Molybdenum	3,300	2,270	50	RMEG
Nickel	19,200	775	200	RMEG
Nitrate	87,000	Below Comparison Value	20,000	RMEG
Nitrite	4,200	Below Comparison Value	1,000	RMEG
Selenium	71	Below Comparison Value	50	EMEG
Sulfate	9,370,000	1,166,364	500,000	Health-based value from EPA
Thallium	3	Below Comparison Value	2	EPA Region 9 PRG
Vanadium	152	75	30	iEMEG
Zinc	31,400	8,600	3,000	EMEG

The greatest exposures probably occurred in the past when people may have been regularly using private well water. Very little is known about how much well water people drank and what levels of contaminants that water may have contained. However, ATSDR attempted to answer people's questions about the health effects that might have resulted from potential past exposures to contaminated drinking water. Estimates of potential past exposure doses were made for the contaminants that were measured at least once above the corresponding comparison value in potential drinking water wells (second column in Table 1). *However, there is a great deal of* *uncertainty in this estimation.* ATSDR assumed that adults or children drank and bathed in water containing the highest time-averaged contaminant level, every day for many years. Exposure assumptions are detailed in Appendix A. The estimated exposure dose was then compared with health guideline values and toxicologic information for each contaminant. To evaluate the risk for cancer for carcinogenic compounds, we assumed people drank water with the highest contaminant concentration for 30 years. The following sections describe this evaluation for the COCs detected above the comparison values in wells that could potentially have been used for drinking.

Metals (Aluminum, Antimony, Arsenic, Beryllium, Boron, Cadmium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Molybdenum, Nickel, Vanadium, Zinc)

<u>Aluminum</u>
Drinking and bathing in drinking water containing the highest level of aluminum would result in an estimated dose for children of 4 mg/kg/day, which is higher than the intermediate MRL for aluminum of 2 mg/kg/day. No chronic MRL for aluminum was available. The estimated adult dose of 1.2 mg/kg/day is lower than the MRL and would not be expected to result in adverse health effects. The highest estimated child dose is less than one tenth of the intermediate duration no observed adverse effect level (NOAEL) for neurotoxicity found in a mouse study, 62 mg/kg/day [17]. Therefore, past exposure to the highest level of aluminum in well water would be unlikely to result in health effects.

<u>Antimony</u>
Both child and adult highest estimated doses (0.015 mg/kg/day and 0.005 mg/kg/day, respectively) from drinking and bathing in drinking water containing the highest level of antimony would be higher than the oral reference dose (RfD) for antimony of 0.004 mg/kg/day. The RfD is based on a rat study that found a lowest observed adverse effect level (LOAEL) of 0.35 mg/kg/day for decreased lifespan and changes in blood cholesterol and sugar levels [18]. Other rat studies found less serious cardiovascular effects at a LOAEL of 0.075 mg/kg/day [19]. It is unlikely that adverse health effects would result from past ingestion of antimony in water from drinking water wells around the site.

<u>Arsenic</u>
The child dose, 0.0026 mg/kg/day, from drinking and bathing in water with the highest level of arsenic is higher than the MRL of 0.0003 mg/kg/day. The MRL is based on human epidemiologic studies which found a NOAEL of 0.0008 mg/kg/day and a LOAEL of 0.014 mg/kg/day for skin changes [20]. The estimated child dose is higher than the NOAEL but 5 times lower than the LOAEL. The adult dose of 0.0008 mg/kg/day would be equal to the NOAEL. Past regular drinking of water with this level of arsenic could have increased the risk of noncancerous adverse health effects. Arsenic is a known carcinogen [20]. Drinking the highest level of arsenic in water for a 30-year period would result in a low-to-moderate increased risk of developing cancer.

Beryllium

Drinking and bathing in water containing the highest level of beryllium measured over time would result in estimated child and adult exposure doses of 0.008 and 0.005 mg/kg/day, respectively, higher than the MRL of 0.002 mg/kg/day. The MRL is based on a dog study which estimated that a dose of 0.6 mg/kg/day resulted in an increase in the incidence of small intestine lesions [21]. The estimated doses for drinking the highest concentrations of beryllium in water are more than 100 times smaller than this level. Past regular drinking of water with this level of beryllium would not be expected to result in adverse health effects.

Boron

Adverse health effects are not likely from exposure to boron by drinking and bathing in water with the highest level of boron. The estimated child and adult doses, 0.17 and 0.05 mg/kg/day, respectively, are both higher than the intermediate MRL of 0.01 mg/kg/day [22]. The intermediate MRL is based on a study which found a LOAEL of 13.6 mg/kg/day for reversible developmental toxicity in dogs. The estimated doses are 80—270 times lower than the LOAEL. They are also lower than the dietary tolerable upper intake level of 0.3 mg/kg/day for boron established by the Institute of Medicine and the RfD of 0.2 mg/kg/day [23,18].

Cadmium

Drinking and bathing in water containing the highest level of cadmium measured over time would result in estimated child and adult exposure doses of 0.005 and 0.0017 mg/kg/day, respectively. The estimated dose for children is in between the NOAEL of 0.0021 mg/kg/day and a LOAEL for serious kidney problems of 0.0078 mg/kg/day found in human studies [24]. Regular drinking of water containing this level of cadmium could result in kidney problems. Of the 46 wells potentially used for drinking water in the past, 7 had cadmium levels similar to the maximum and high enough to increase the risk of serious kidney problems in small children regularly drinking the water. All adult estimated doses are lower than the NOAEL, so adverse health effects are less likely in adults who drank this water. Animal data indicate that cadmium is a probable human carcinogen [24]. However, there is no oral cancer slope factor for cadmium, so it is not possible to estimate the carcinogenic risk.

Chromium

Most of the available data did not specify the type of chromium detected. When the type was not specified, ATSDR conservatively assumed the reported concentrations to be chromium (VI), which is more toxic than chromium (III). The estimated exposure doses for children, 0.005 mg/kg/day, is only slightly higher than the RfD of 0.003 mg/kg/day [18]. This dose is over 100 times lower than the dose that resulted in gastrointestinal pain and blood effects in a chronic exposure human epidemiologic study of 0.57 mg/kg/day; it is also about 10 times lower than the dose that resulted in dermatitis in a human study of 0.036 mg/kd/day [25]. The estimated adult dose of 0.001 mg/kg/day is lower than the RfD. No adverse health effects are expected from past exposure to chromium from drinking or bathing in well water.

Cobalt

Adverse health effects are not likely from drinking and bathing in water with the highest level of cobalt. The estimated dose for a child drinking water containing the highest amount of cobalt was 0.015 mg/kg/day, higher than the intermediate duration MRL of 0.01 mg/kg/day. No chronic MRL was available for cobalt. The intermediate MRL is based on a LOAEL of 1 mg/kg/day, which caused a reversible increase in the number of red blood cells in adult male volunteers [26]. The estimated child dose is 60 times lower than this LOAEL and is not likely to have resulted in adverse health effects. The estimated adult dose of 0.004 mg/kg/day is lower than the MRL.

Copper

No adverse health effects are expected from drinking and bathing in water with the highest level of copper. The estimated child and adult doses, 0.09 and 0.03 mg/kg/day, respectively, are both higher than the intermediate MRL of 0.02 mg/kg/day. No chronic MRL was available for copper. The intermediate MRL is based on a NOAEL of 0.315 mg/kg/day for liver effects found in a human study [27]. Because the estimated doses are lower than the NOAEL, adverse health effects are unlikely from past exposure to copper in well water.

Iron

Only one of the private wells tested contained iron at a level above the comparison value, and only one time point of testing for that well was available. Assuming this value represents the average iron concentration in the well, drinking and bathing in water from this well would result in estimated exposure to children and adults of 14 and 4 mg/kg/day, respectively. Severe toxic effects are not likely from exposure doses less than 20 mg/kg of body weight [23,28]. The Institute of Medicine has established tolerable upper intake levels (TUIs) for iron ranging from 40 mg/day for infants and children (about 4 mg/kg/day) to 45 mg/day for teenagers and adults (about 0.6 mg/kg/day) [23]. The adult TUI is based on a LOAEL for gastrointestinal effects of 70 mg/day, and the child TUI is based on a NOAEL of 40 mg/day. For the highest concentration of iron measured, the estimated intakes are high enough to result in gastrointestinal effects such as nausea, constipation, diarrhea, or vomiting. In addition, long-term exposure could cause clinical effects such as accumulation of iron in the liver [29]. The actual risk of health effects occurring from drinking from this one private well depends on the actual concentration of iron in the water and how much water was actually drunk. High iron levels would give the water an unpleasant taste. For the other private wells, iron levels were too low to result in adverse health effects.

Lead

Levels of lead in children's blood of 10 micrograms per deciliter (μg/dL), and perhaps lower, have been associated with small decreases in IQ and slightly impaired hearing and growth. A slope factor for the increase in blood lead concentration per increase in water lead concentration for infants has been calculated as 0.04 μg/dL blood per microgram per liter (μg/L) lead for water lead levels above 15 μg/L [30]. The corresponding slope factor for school children was found to be 0.03 μg/dL per μg/L. Only 4 out of the 46 potential drinking water wells tested contained lead at a level above the EPA action level of 15 μg/L. At the highest concentration of 42 μg/L lead measured, the predicted increases in blood lead concentrations for infants and school children are 1.3 μg/dL and 1.7 μg/dL, respectively. Although the highest levels of lead measured were clearly higher than drinking water standards and not acceptable, it is unlikely that this past exposure to lead in well water contributed significantly to children's overall body burden of lead.

Magnesium

The estimated child dose, 11 mg/kg/day, from drinking and bathing in water with the highest level of magnesium is higher than the tolerable upper intake level of 5 mg/kg/day [31]. The adult dose of 3 mg/kg/day is lower than this level. In studies of people taking magnesium supplements, levels around the tolerable upper intake level resulted in mild diarrhea and other mild gastrointestinal effects. In other studies, no adverse effects were noted at the same magnesium levels [31]. The likelihood of people experiencing any adverse effects from drinking magnesium in well water would be lower because the dose would be spread out over the entire day.

Manganese

Epidemiologic studies suggest an association between ingesting water containing elevated concentrations of manganese and the development of neurological symptoms. However, each of the studies had uncertainty regarding the exposure level or whether the effects were solely attributable to manganese, so that no NOAEL, LOAEL, or minimal risk level could be identified [32]. Studies with rats have shown a LOAELs for neurological changes as low as 1 mg/kg/day, lower than the estimated child dose of 2.3 mg/kg/day and only slightly higher than the adult dose of 0.8 mg/kg/day. Also, humans appear to be more sensitive to manganese than are other animals [32]. If people regularly drank well water with the highest levels of manganese, their exposure could have increased the risk of neurological effects. However, how much manganese-contaminated water people actually drank is unknown. EPA's secondary maximum contaminant level for manganese, 50 μg/L, is set for aesthetic reasons. Water containing higher levels of manganese (over 22,000 μg/L) would have a bitter metallic taste, would be black to brown color, and would cause black staining on household goods [33]. The highest levels of manganese measured in well water were thousands of times higher than the secondary MCL and would likely have been unacceptable as a regular drinking water source.

Molybdenum

The estimated highest child and adult exposure doses (0.23 and 0.07 mg/kg/day, respectively) were higher than the oral RfD of 0.005 mg/kg/day. The oral RfD is based on a human epidemiological study that found a LOAEL of 0.14 mg/kg/day for increased serum uric acid levels and prevalence of a gout-like sickness in Armenian villagers [18]. A dietary tolerable upper limit of 0.03 mg/kg/day is derived from a rat study in which adverse reproductive effects were encountered at molybdenum levels exceeding the NOAEL of 0.9 mg/kg/day [23]. Molybdenum is known to interfere with copper metabolism in ruminant animals (that is, grazing animals with more than one stomach, such as cows or sheep); the resulting copper deficiency is reported to cause the animal's hair/wool to turn white [23,29]. The effect of molybdenum intake on copper status in humans remains to be clearly established, but individuals who don't take in enough dietary copper or can't process it correctly could be at increased risk of molybdenum toxicity [23]. If people regularly drank water containing the highest levels of molybdenum measured, they could have had an increased risk of adverse health effects. The actual risk of health effects occurring depends on the actual concentration of molybdenum in the water and how much water was actually drunk. Only 4 out of the 46 wells tested had average molybdenum levels that would result in doses above the tolerable upper intake, and we do not know how much, how often, and for long people actually drank that water.

Recent studies have reported that molybdenum does not interfere with copper processing in humans, and no reports of hair color changes caused by molybdenum exposure were found in a literature search [23]. A number of hypotheses could explain local residents' reports of children in Questa whose hair turned white after drinking molybdenum-contaminated water. Because this happened so long ago and details are not known, it is impossible to determine whether the reported effects might be related to molybdenum exposure. Molybdenum is not stored at high levels in the body, and exposure of the children to contaminated well water was stopped relatively quickly [34]. For these reasons, it is unlikely that these children would suffer long-term adverse health effects from this exposure to molybdenum.

Nickel

The estimated doses for children and adults drinking and bathing in water containing the maximum concentration of nickel are 0.08 and 0.023 mg/kg/day, respectively. The adult dose is only slightly more than EPA's reference dose (RfD) of 0.02 mg/kg/day for soluble nickel salts and more than 100 times smaller than the NOAEL of 5 mg/kg/day for decreased body and organ weights in a rat study [18,35]. Although the child dose is higher than the RfD, it is still more than 60 times smaller than the NOAEL. Oral exposure to nickel has caused skin reactions in sensitive people at doses as low as 0.009 mg/kg/day. In general, reactions are considered unlikely for doses less than the RfD [35]. It is unlikely that health effects occurred from exposure to nickel in well water.

Vanadium

No adverse health effects are expected from drinking and bathing in water with the highest level of vanadium. The estimated dose for children was 0.008 mg/kg/day, at least 40 times lower than effect levels for chronic and intermediate oral exposures to vanadium found in animal studies [36]. The estimated adult dose of 0.002 mg/kg/day is lower than the MRL of 0.003 mg/kg/day.

Zinc

The child dose, 0.9 mg/kg/day, from drinking and bathing in water with the highest level of zinc is higher than the MRL of 0.3 mg/kg/day [37]. The adult dose of 0.2 mg/kg/day is lower than this level. Chronic and intermediate exposure MRLs are based on changes in blood chemistry seen in women given zinc supplements for 10 weeks. The changes were observed at a LOAEL of 1 mg/kg/day [37]. Children who were regularly exposed to the highest levels of zinc in groundwater may have had changes in blood chemistry, including lower red blood cell counts and lower HDL cholesterol. The actual risk of adverse health effects depends on how much zinc was present in the water and how much water children actually drank.

Other Inorganics (Chlorine, Fluoride, Sulfate)

Chlorine

There was only one detection of chlorine in all the wells tested. This detection was at a level that could cause eye or throat irritation or stomach discomfort [33]. However, chlorine is a very volatile and reactive substance; it would not be expected to remain in water at this level for any length of time. None of the other wells tested had any detections, so it is possible that the chlorine detection reported in Table 1 was an anomaly.

Fluoride

Small amounts of fluoride in drinking water are generally conceded to have a beneficial effect in reducing tooth decay, especially in children. However, intake of excessive fluoride can result in dental fluorosis, with effects ranging in severity from cosmetic discoloration to pitted and weakened tooth enamel. Excess fluoride intake can also cause skeletal fluorosis, with effects ranging from increased bone density to severe crippling deformity, and an increased prevalence of bone fractures in the elderly [29,38]. A dose of 10–20 mg/day (equivalent to about 0.5 mg/kg/day for a 10-year old child) for at least 10 years is considered necessary for the development of crippling skeletal fluorosis [29,38]. Human epidemiological studies showed a chronic NOAEL for fluoride of 0.15 mg/kg/day and a LOAEL of 0.25 mg/kg/day for increased fracture rate [38]. The estimated child and adult exposure doses, 2.6 and 0.75 mg/kg/day, respectively, are significantly higher than both the NOAEL and the level commonly cited as leading to skeletal fluorosis. People who regularly drank well water that contained this level of fluoride for a long time have a greater risk of dental fluorosis, crippling skeletal fluorosis, and bone fractures. Of the 21 wells tested that showed detections for fluoride, 9 had average levels of fluoride that would result in an increased risk.

The actual risk of these health effects depends on the actual intake of fluoride and the nutritional status of the individual, among other factors. It is not known whether fluoride at this site is naturally occurring as a result of the geological formations in the area or is a byproduct of mine operations.

<u>Sulfate</u>

Human studies have shown that sulfate induces a laxative effect in people who are suddenly exposed to concentrations greater than 500,000 μg/L [39]. The highest concentration of sulfate measured in any one well (and about one third of the wells total) contained sulfate at a concentration higher than this level. People appear to develop a tolerance to drinking water with high sulfate concentrations over periods of 7–10 days [39]. Thus, any effects due to drinking well water with high sulfate concentrations in the past were likely to be transient.

Summary—Ingestion of Groundwater from Private Wells

According to private citizens and others, people do not drink water from private wells currently. In the past, people could have drunk well water regularly. On the basis of the limited information available, regular drinking of water from some of the wells in the past could have increased the risk for adverse health effects. The levels of arsenic, cadmium, fluoride, iron, magnesium, manganese, molybdenum, sulfate, and zinc were great enough in some wells that regular drinking of water containing the highest levels could increase the risk of adverse health effects, to varying degrees (see the applicable discussion above for each contaminant). The actual risk of adverse health effects occurring depends on how much and how often people actually drank contaminated water and what the contaminant levels in that water actually were. Although reportedly no one in the area is drinking from contaminated wells now, if drinking of water from these wells were to commence again, adverse health effects could result.

2. Inhalation of Tailings Dust

People downwind of the tailings piles could be exposed to contaminants by breathing in dust blowing off of the piles. There are anecdotal reports of high levels of dust being blown into Questa from the tailings piles, especially before operational changes to minimize dust were implemented sometime in the 1990s. Although past data are limited, ambient air monitoring performed near the former junior/senior high school showed some exceedances of the 24-hour standard for total suspended particulates (TSP) in the 1970s and 1980s. Community members and historical newspaper articles reported that dust in the school, and in Questa in general, was very heavy at times during this period. The dust produced a visible “white cloud,” accumulated in thick layers on school desks each day, and restricted outdoor activities.

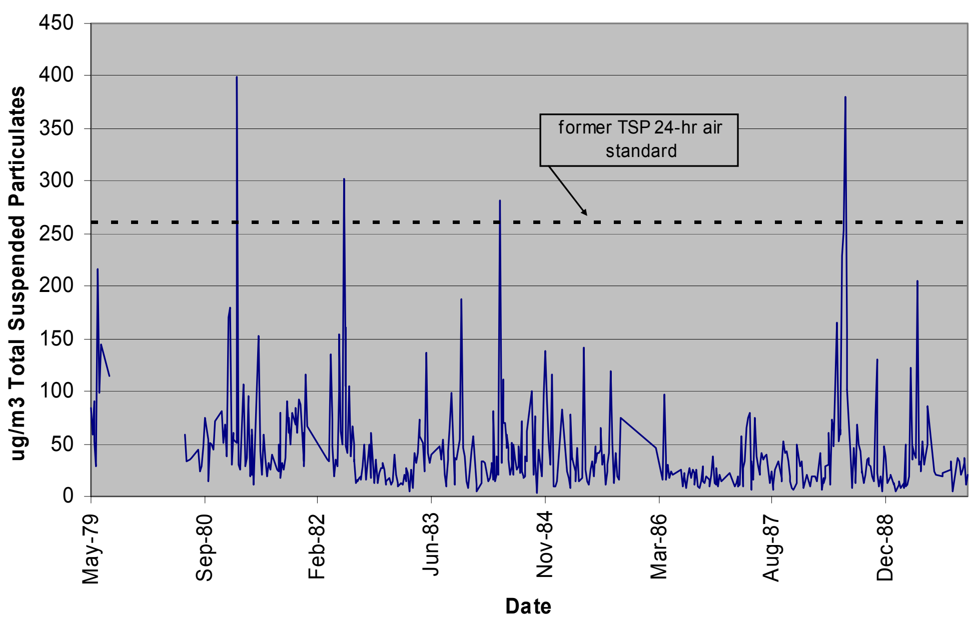
In the 1990s, Molycorp changed operating practices at the tailings impoundment facility, restricting the size of uncovered areas and using dust deterrents (personal communication, Randy Mercer, New Mexico Department of Health, June 2003). However, dust is still occasionally reported, especially on windy days [40].

Implications of Past Inhalation of Dust (1970s and 1980s)

The data for past levels of dust in air, especially for short-term peaks in dust, are limited. **It is impossible to accurately estimate past exposures** of teachers and children at the former junior/senior high school or others in the surrounding community. Because of the community concerns relating to these past exposures, however, ATSDR used the limited information available and professional judgment to form a general idea of the public health consequences that might have resulted from past exposure to wind-blown tailings dust.

NMED's Air Quality Bureau operated an ambient air monitoring station on the south side of the former Questa Junior/Senior High School to monitor 24-hour averages of TSP from 1979 through 1989 [16]. The sampling was performed on one out of five to seven days. Figure 2 shows that EPA's former 24-hour air quality standard for TSP, 260 $\mu g/m^3$, was exceeded at the Questa monitoring station on four sampling occasions. 24-hour standards are set to protect the majority of individuals from adverse health effects. Exceeding the standard may be unhealthy for sensitive groups, such as people with asthma or other respiratory disease, the elderly, and children [42]. Scientific studies conducted in other places and published in the 1980s and 1990s showed that a 1%–5% increase in total deaths, and a 10%–50% increase in respiratory or chronic obstructive pulmonary disease hospital admissions in the elderly, resulted for every 100 $\mu g/m^3$ increase in TSP [43–45]. In addition, short-term exposures to dust in Questa are likely to have been higher than the 24-hour average, increasing the chances that exposed individuals would experience eye, nose, and throat irritation. These symptoms would likely have lessened when the dust level went down and/or exposure to the dust was stopped. To summarize, the limited data indicate that *short-term adverse health effects, including eye and respiratory irritation and respiratory problems in sensitive groups, were possible during periods of high dust levels*.

Figure 2. 24-Hour Total Suspended Particulate Data from NMED Air Quality Bureau Monitoring, Questa, NM: 1979-1989 [16]



In addition to health effects from inhalation of particulate matter in general, ATSDR evaluated the potential for health effects resulting from intake of contaminants present in inhaled dust. Assumptions made in performing these evaluations include the following:

1) *All the particles are respirable*—This overestimates the dose because only particles less than about 10 micrometers (µm) are small enough to penetrate deeply into the lung where

contaminants can be effectively absorbed. No size distribution of dust particles was available.

2) *All the dust particles are tailings*—This also overestimates the dose because the dust would actually include a fraction of inert mineral from other sources besides tailings.
3) *All metals contaminants are in a highly absorbable form*—Some of the metals may have been weathered to chemical forms that are not so easily absorbed.

The evaluation of contaminant exposures from inhalation of dust was performed in two ways. First, exposure from direct intake of contaminants from inhaled dust through the respiratory system into the bloodstream was evaluated. Because toxicological effects might differ, inhalation of dust was also evaluated assuming that inhaled dust was absorbed in the gastrointestinal system (as would happen if dust was coughed up and then swallowed). Contaminant concentrations used in performing these evaluations were from sampling of tailings reported in the RI database through November 2003, summarized in Table 2 [14]. ATSDR assumed that the composition of tailings in the 1970s and 1980s was similar to this more recent tailings composition.

Table 2. Chemical Composition of Tailings from the Molycorp Site [14]

	Concentration, mg of contaminant per kg of tailings				Concentration, mg of contaminant per kg of tailings	
Contaminant	Highest	Average		Contaminant	Highest	Average
Aluminum	32,200	12,200		Lead	192	77
Ammonia	16	11		Magnesium	18,400	7,940
Antimony	1	1		Manganese	1,130	608
Arsenic*	8	4		Molybdenum*	1,510	283
Barium	220	99		Nickel	58	27
Beryllium	18	3		Phosphorus	1,690	1,030
Bismuth	8	7		Potassium	15,500	5,810
Cadmium	3	1		Scandium	9	7
Calcium	28,800	17,400		Selenium	2	1
Chromium	175	64		Silver	6	1
Cobalt	20	9		Sodium	1,900	404
Copper	295	137		Strontium	253	122
Fluoride	8	3		Sulfate	15,600	3,450
Fluorine*†	5,780	4,330		Thallium	1	0
Gallium	10	10		Titanium	1,000	855
Iron*	31,900	17,100		Uranium	3	1
Lanthanum	30	15		Vanadium	84	39
				Zinc	366	160

* Maximum levels are above soil comparison values and/or typical soil levels.
† Reported fluorine concentration in soil refers to total fluorine; a minimal amount is likely to be in the most highly reactive elemental form.

Direct Uptake of Inhaled Tailings Dust

The potential for inhalation of tailings dust to result in health effects was evaluated for short- and long-term exposures. Contaminant air concentration that people might breathe in was calculated using the following equation:

$$Air\ \ Conc\ (\frac{\mu g\ contam}{m^3 air}) \quad = \quad C_{contam}(\frac{mg\ contam}{kg\ tailings}) \times C_{dust}(\frac{\mu g\ tailings}{m^3 air}) \times 10^{-9}\ \frac{kg}{\mu g} \times 10^3\ \frac{\mu g}{mg}$$

For short-term exposure, ATSDR assumed the contaminant concentration (C_{contam}) was the highest measured in tailings and that the dust level in the air (C_{dust}) was 400 µg/m^3 (the highest TSP concentration shown in Figure 2). For long-term exposure, ATSDR assumed C_{contam} was the average concentration in tailings and that C_{dust} was 50 µg/m^3 (the average of the 24-hour TSP measurements shown in Figure 2).

The short-term air concentrations were all at least 100 times lower than occupational standards. Intermittent exposures to these levels are not expected to have resulted in adverse health effects. Long-term air concentrations of contaminants were lower than available air CVs, with the exception of chromium. This contaminant was estimated at an average long-term concentration of 0.0036 µg/m^3, higher than the CREG for hexavalent chromium of 0.00008 µg/m^3. ATSDR does not consider this exceedance to indicate a past exposure of concern, however, because most chromium in soil is present as less toxic chromium (III), not hexavalent chromium (chromium (VI)), and only a fraction of the chromium in dust would be bioavailable, or easily absorbed into the bloodstream. The estimated average chromium concentration is within typical chromium levels measured in urban environments in the United States [25]. *In summary, on the basis of the limited past data, past short- or long-term exposures through inhalation of tailings dust are not expected to have resulted in adverse health effects.*

Indirect Ingestion of Inhaled Tailings Dust

Inhalation of dust was also evaluated assuming that inhaled dust was absorbed in the gastrointestinal system (as would happen if dust was coughed up and then swallowed). To obtain the exposure dose in milligrams contaminant per kg body weight per day (mg/kg/day), the following equation was used:

$$ED\ (\frac{mg}{kg \bullet day}) \quad = \quad \frac{C_{contam}(\frac{mg}{kg\ tailings}) \times C_{dust}(\frac{\mu g\ tailings}{m^3 air}) \times 10^{-9}\ \frac{kg}{\mu g} \times R_{inh}(\frac{m^3 air}{hr}) \times T\ (\frac{hr}{day})}{BW(kg)},$$

where ED is exposure dose, C_{contam} is the concentration of contaminant in tailings, C_{dust} is dust concentration in air, R_{inh} is the inhalation rate, T is the hours of exposure per day, and BW is body weight.

Because short-term dust concentrations could be significantly higher than the 24-hour average, ATSDR estimated a "worst case" ingestion/inhalation exposure by assuming a 10-year old child was exposed to respirable particles containing the highest concentration of each contaminant of concern measured in tailings. The exposure was assumed to be to a level of respirable particles of 4800 µg/m^3 for 1 hour a day and a concentration of 400 µg/m^3 for 8 hours per day. The rate of inhalation during exposure was assumed to be 1.9 m^3 per hour (inhalation rate for children engaged in heavy activity), and the child was assumed to weigh 36 kg (80 pounds, mean weight for a 10-year-old child) [46]. Finally, it was assumed that all tailings dust breathed in was coughed up and swallowed, and that 100% of each contaminant was absorbed from the gastrointestinal tract.

All of the estimated doses were at least 10 times smaller than the corresponding health guideline. *Therefore, no adverse health effects from any of the contaminants inhaled from tailings dust in the 1970s and 1980s are expected.*

Implications of Past Inhalation of Dust (1990s)

For later dates, ambient monitors measured a subset of TSP consisting of particulate matter smaller than 10 microns in diameter (PM_{10}). Monitors measured PM_{10} levels at the junior/senior high school; both hourly and 24-hour average values were available. Figure 3 shows that the 24-hour PM_{10} measurements were within regulatory requirements from 1993–1999. As shown in the hourly PM_{10} results (Figure 4), short-term air concentrations can be significantly higher than the 24-hour averages; however, there are no health-based standards for short-term PM_{10} levels. All 24-hour average PM_{10} values were less than the 24-hour air quality standard. As with TSP, the 24-hour standard was developed to protect most individuals from adverse health effects. Exceeding the standard may be unhealthy for sensitive groups like people with asthma or other respiratory disease, the elderly, and children [42]. Risk estimates from total mortality epidemiologic studies suggest that an increase of 10 $\mu g/m^3$ in the 24-hour PM_{10} level is associated with increased risks of adverse health effects of 0.5%–1.5%, with even higher risks possible for elderly subpopulations and for those persons with preexisting respiratory conditions [47,43]. As indicated by intermittent peaks in Figure 3 and as reported by people in the Questa community, on some days PM_{10} levels were appreciably elevated due to wind blowing dust from the Molycorp tailings facility. *The short-term (hourly) PM_{10} increases might have increased the risk of adverse health effects, especially for sensitive populations*.

To determine whether inhalation or indirect ingestion of contaminants in PM_{10} in the 1990s could increase the risk of adverse health effects, ATSDR assumed that PM_{10} made up 60% of the total suspended particulate matter breathed in and that contaminant concentrations were the same for all the dust. Estimated doses for both inhalation and ingestion of tailings dust were calculated in the same way as for the 1970s and 1980s data described above. The estimated doses were lower than the “worst case” estimates from the 1970s and 1980s and were lower than applicable health guidelines. *Therefore, no adverse health effects from any of the contaminants inhaled from tailings dust in the 1990s are expected.*

Implications of Present Inhalation of Dust

According to comments received by ATSDR, “as recently as January 2003 blowing tailings dust in Questa resulted in complaints to state agencies about the problem” [40]. Molycorp performed two studies between February 2003 and February 2004 to assess potential impact to local air quality from the tailings facility [41]. No exceedances of the 24-hour or annual PM10 standards were observed in monitors located in three locations potentially impacted by the tailings facility, and analysis of dust suggested that local soils contributed more to dust than did tailings [41]. *No adverse health effects from current exposure to tailings dust or tailings contaminants in dust are* *expected. However, as in other areas, sensitive populations could experience adverse health effects from short-term peaks in dust, regardless of the source.*

Figure 3. 24-Hour PM10 Data from NMED Air Quality Bureau Monitoring, Questa, NM: 1993-1999 [16]

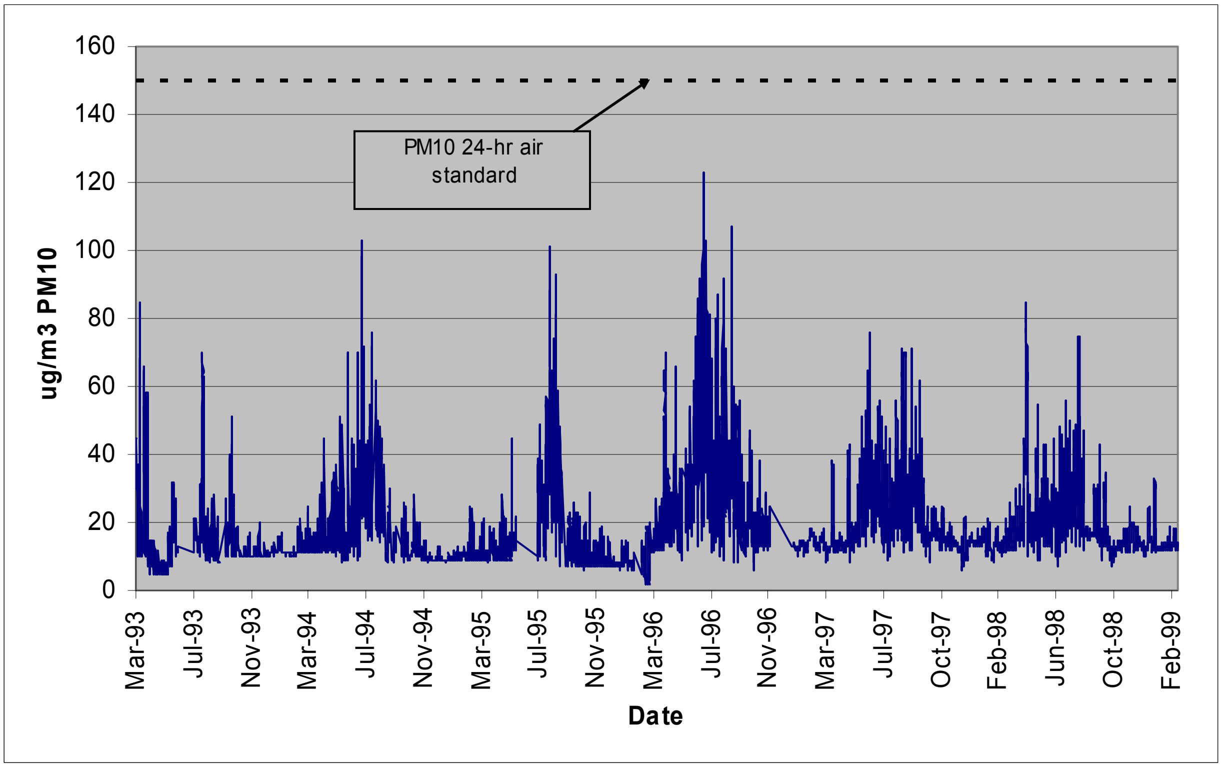
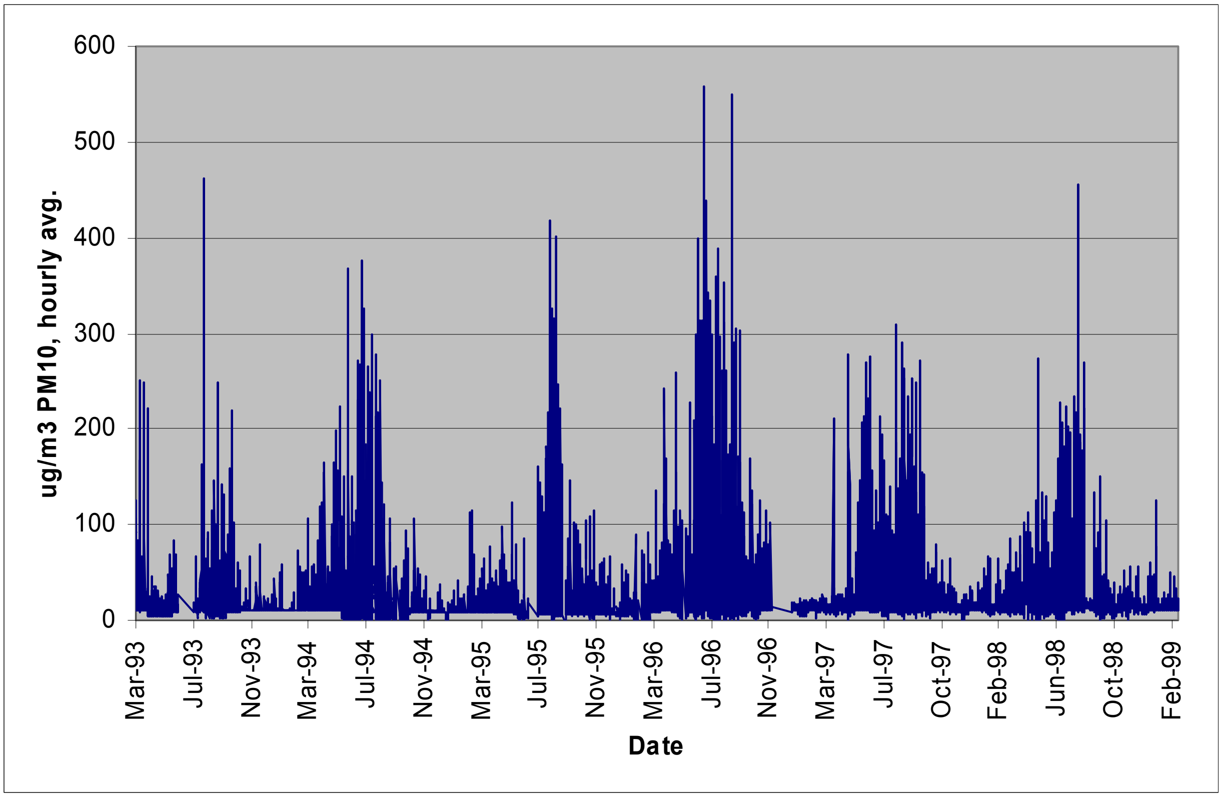


Figure 4. Hourly PM10 Data from NMED Air Quality Bureau Monitoring, Questa, NM: 1993-1999 [16]



3. Incidental Ingestion of Soil or Tailings

People who are in areas where tailings are present could come into contact with them or soil contaminated by them. People could get particles of tailings or soil on their skin, or they might accidentally eat or breathe in the particles. Surface soil and tailings from several areas around the site have been sampled and analyzed for contaminants. In our initial screening, we conservatively assumed that people would contact the tailings as much as they would the soil. Table 3 lists the contaminants found in tailings and surface soil at levels above soil CVs.

Table 3. Tailings or Surface Soil Contaminants Detected Above Comparison Values for Soil [14]

Contaminant	Average concentration, parts per million (ppm)	Maximum concentration, ppm	Comparison Value (CV) for soil in ppm	CV Source (Defined in Appendix A)
Tailings:				
Arsenic	4	8	0.5	CREG
Fluorine	4,330	5,780	2,000	RMEG
Iron	17,100	31,900	23,000	EPA Region 9 PRG
Molybdenum	283	1,510	300	RMEG
Surface Soil:				
Aroclors (1248, 1254, 1260)	4.64	140	0.22	EPA Region 9 PRG
Arsenic	4	186	0.5	CREG
Cadmium	0.8	19.9	10	EMEG
Chromium	33	1,725	200	RMEG / hexavalent chromium
Copper	93	5,870	2,000	iEMEG
Iron	24,240	156,000	23,000	EPA Region 9 PRG
Lead	97	4,290	400	SSL
Manganese	610	4,650	3,000	RMEG
Molybdenum	1,153	189,000	300	RMEG
Thallium	0	33	5.2	EPA Region 9 PRG
Vanadium	39	2,580	200	iEMEG
PAH TEQ	1.8	24	0.09	EPA SSL

For further screening, we estimated worst-case exposure doses for the contaminants listed in Table 3. The exposures were estimated for adults or children as young as 1 year old who contact the average concentrations in surface soil or tailings 4 times a week for 9 months out of the year, over many years. Appendix A provides details of the assumptions used to perform these calculations. For almost all of the contaminants, estimated exposure doses resulting from this exposure are lower than health guideline values and therefore are not expected to result in health effects. Estimated exposure to Aroclors and to molybdenum was greater than the corresponding health guideline value and will be evaluated further in the following paragraphs.

Aroclors

Aroclor is a trade name applied to different mixtures of polychlorinated biphenyls (PCBs) used commercially before 1980. There are differences in PCB composition between the different Aroclor products. To be conservative, the concentrations of Aroclor 1248, 1254, and 1260 detected in each soil sample were added to obtain a “worst case” estimate of potential dose. The estimated child exposure dose of 0.000075 mg/kg/day was higher than the MRL of 0.00002 mg/kg/day, and the adult dose (0.00001 mg/kg/day) was lower than the MRL [48]. The MRL is derived from an animal study that found a LOAEL for decreased antibody response of 0.005 mg/kg/day. The estimated child and adult doses are 60–500 times smaller than the LOAEL. In addition, the samples where Aroclors were detected were exclusively taken from the mine site. Because access is limited and it would be extremely unlikely for a child to spend any time on site, actual exposure is likely to be negligible. Therefore, exposure to Aroclors in soil is not expected to result in any adverse health effects.

Molybdenum

The estimated child exposure dose of 0.011 mg/kg/day is higher than the oral RfD of 0.005 mg/kg/day, but it is lower than the dietary tolerable upper limit of 0.03 mg/kg/day [23]. The estimated adult dose is lower than the oral RfD. Therefore, no adverse health effects would be expected from exposure to molybdenum in surface soil.

4. Incidental Ingestion/ Dermal Contact—Surface Water

Contaminated groundwater and water from seeps and springs may enter surface water in the Red River or acequias. Spills from the tailings pipeline might also contribute to surface water contamination. No use of this water for drinking water purposes was identified, but people who wade or swim in surface waters on the site will get surface water on their skin and might accidentally ingest some of the surface water. To identify contaminants of concern in surface water for direct incidental contact, we used CVs that were 10 times the corresponding drinking water CVs. This assumes that incidental ingestion and dermal exposure would be one-tenth as much as regular drinking water exposure, so that the concentration of contaminant would need to be 10 times as much to result in the same dose. As shown in Table 4, 18 contaminants were detected above the corresponding surface water CVs.

Table 4. Surface Water or Seep Contaminants Detected Above Comparison Values for Surface Water [14]

Contaminant	Average concentration in surface water, micrograms per liter (μg/L)	Maximum concentration in surface water, μg/L	Comparison Value (CV) for surface water in μg/L*	CV Source (Defined in Appendix A)
Aluminum	68,271	1,560,000	200,000	Drinking water iEMEG × 10
Antimony	20	139	40	Drinking water EMEG × 10
Arsenic	20	230	0.2	Drinking water CREG × 10
Benzo(a)pyrene	0.1	0.1	0.050	Drinking water CREG × 10
Beryllium	45	536	200	Drinking water RMEG × 10
Cadmium	37	661	20	Drinking water EMEG × 10
Chromium	83	729	300	Drinking water RMEG × 10
Cobalt	323	4,740	1,000	Drinking water iEMEG × 10
Copper	553	13,900	3,000	Drinking water iEMEG × 10
Fluoride	5,762	208,000	22,000	Drinking water R9 PRG × 10
Iron	50,306	1,290,000	110,000	Drinking water R9 PRG × 10
Lead	39	3,020	150	Drinking water AL × 10
Magnesium	47,664	1,200,000	650,000	Drinking water TUI × 10
Manganese	20,248	675,000	5,000	Drinking water RMEG × 10
Molybdenum	176	4,000	500	Drinking water RMEG × 10
Nickel	424	10,400	2,000	Drinking water RMEG × 10
Sulfate	734,184	22,000,000	2,500,000	Drinking water SMCL × 10
Zinc	5,852	164,000	30,000	Drinking water EMEG × 10

* Surface water CV calculated as ten times the drinking water CV because incidental surface water ingestion was assumed to be one-tenth of the normal drinking water ingestion.

For further screening, worst-case exposure doses for the contaminants listed in Table 4 were then estimated for adults or children 6 years or older who contact the average concentrations in surface water or seeps 4 times a week for 6 months out of the year, over many years. Details of the assumptions used to perform these calculations can be found in Appendix A. All estimated exposure doses resulting from this exposure are lower than health guideline values and therefore are not expected to result in health effects.

5. Incidental Ingestion/ Dermal Contact—Sediment

People who swim in the river might accidentally ingest some of the river sediments or get the sediments on their skin. Sediment CVs were not available, so sediment CVs were set at 10 times the corresponding soil CV. This is because it was assumed that sediment would be contacted one-tenth as much as soil particles, so that the concentration of contaminant would need to be 10 times as high for the same dose. As shown in Table 5, arsenic, cadmium, and molybdenum were detected above the corresponding sediment CVs.

Table 5. Sediment Contaminants Detected Above Comparison Values for Sediment [14]

Contaminant	Average concentration in sediment, parts per million (ppm)	Maximum concentration in sediment, ppm	Comparison Value (CV) for sediment in ppm*	CV Source (Defined in Appendix Y)
Arsenic	5	16	5	Soil CREG × 10
Cadmium	23	3,820	100	Soil EMEG × 10
Molybdenum	66	19,400	3,000	Soil RMEG × 10

* Sediment CV calculated as ten times the soil CV because sediment ingestion was assumed to be one-tenth of the average soil ingestion.

For further screening, worst-case exposure doses for the contaminants listed in Table 5 were then estimated for adults or children 6 years or older who contact the average concentrations in sediment 4 times a week for 6 months out of the year, over many years. Appendix A provides details of the assumptions used to perform these calculations. Estimated exposure doses resulting from this exposure are lower than health guideline values and therefore are not expected to result in health effects.

D. Potential Exposure Pathways

1. Ingestion of Questa Municipal Water

The Village of Questa's municipal water is obtained from groundwater drawn from two supply wells located generally on the northeast side of the village, west of the Sangre de Christo mountain front [12,49]. The wells draw groundwater from 295 feet and 350 feet below ground surface [12]. These wells are subject to the federal Safe Drinking Water Act and the New Mexico Drinking Water Regulations. They undergo routine testing for inorganic chemicals (including metals), organic chemicals, radiochemicals, and microbiological contaminants. The only violations reported for the Questa water system are four instances of excess coliform, an indicator of possible bacterial contamination (in September 1996, August 1999, November 2001, and January 2002) [50]. The New Mexico state legislature has designated funding for upgrading the water system [51]. Biological contamination, while an important public health issue, does not appear to be related to operations at the Molycorp mine and will not be evaluated further.

Routine testing has shown the Questa source water to meet drinking water standards for metals [52]. However, it was recently brought to light that many of the municipal water lines were buried in tailings from Molycorp operations when the lines were installed in 1968 as part of the village's efforts to upgrade and install the current water system [13]. Many citizens expressed concern that these tailings or contaminants leached from the tailings could enter the water lines through breaks in the lines, especially at times when there is a loss of pressure in the system, and result in contaminated water at residential taps. To address these questions, the Village of Questa and EPA collected water samples from several residential taps in Questa in September 2003 [53,54]. All metals contaminant levels in these samples were well below drinking water standards and/or ATSDR comparison values. *No adverse health effects from drinking this water are expected.*

Some individuals felt that the September 2003 tap sampling may not have been representative of times when tailings or other contaminants entered the system. They raised the possibility that contaminants could enter municipal lines on an intermittent basis, on the basis of local residents' reports that home filters were being clogged with solids at an unusually high rate. Although some homes have filters to remove suspended materials that may be present in the water, it is possible that people at homes without filters could drink water containing suspended tailings, if tailings did intermittently enter the water lines. We emphasize that *we have no evidence showing that water from municipal water lines has been infiltrated with suspended tailings, or further that people have drunk such water*. However, to address the questions we have received about whether such contamination could result in adverse health effects, ATSDR evaluated potential health effects, if this were to occur, using "worst case" assumptions about potential tailings contamination.

The "worst case" assumptions made are described here. We assumed that residential water lines were, twice a week, contaminated with tailings used to bury the lines. We assumed that the water would contain a level of suspended solids, consisting purely of tailings, of 150 milligrams of tailings solids per liter of water. This level of suspended solids would appear "dirty" to the naked eye and it would be unlikely people would drink a large quantity of it. To be conservative, however, we further assumed that an adult would drink 2 liters, and a small child would drink 1 liter, per day of this water. We also assumed that each contaminant present in the tailings suspended in the water was at the maximum level detected in any tailings sampled during the remedial investigation. Using these assumptions, potential exposure doses were calculated for each of the contaminants. All the estimated "worst case" doses were lower than health guideline values. *Therefore, in the unlikely event people regularly drank water containing some tailings, adverse health effects would not be expected.*

Some individuals also raised the possibility that during times of wet soil conditions, the water in the tailings bed could become acidic due to pyrite generation in the tailings and leach metals out of the tailings. This contaminated water might then enter the municipal water lines if the lines were depressurized. ATSDR considers this exposure pathway very unlikely, because groundwater would be unlikely to be in contact with tailings for a long enough time and to become acidic enough to leach significant amounts of metals out of the tailings. In addition, only a small amount of the groundwater would be likely to enter the water lines during a time of depressurization. Once normal water pressure was restored, any extraneous water would be immediately diluted and restored to a normal pH, such than any dissolved metals would fall back out of solution. ATSDR considers potential exposures through this scenario would only be a small fraction of the "worst case" calculations for drinking of suspended tailings in the preceding paragraph.

Questa is in the process of replacing the municipal water system [55]. This will remove any question about the possibility of tailings entering the system.

2. Ingestion of Garden Vegetables

In addition to direct incidental contact with surface water contaminants, people who use the surface water to irrigate crops or garden vegetables might be indirectly exposed to surface water contaminants. In summer 2003, representative beans, zucchini, and lettuce from gardens in Questa and were sampled and tested for metals [14]. ATSDR estimated an average dose for each contaminant using typical consumption rates for each vegetable [46]. All the estimated doses were below health guideline values and therefore are not expected to result in adverse health effects.

Sampling of washed and unwashed vegetation in the area indicated that some contaminants might be present in soil or dust on the surfaces of vegetation. To minimize the chance for exposure to contaminants, crops and vegetables grown using surface water in the area should be washed before being eaten.

3. Ingestion of Fish from the Red River

In addition to direct incidental contact with surface water and sediment contaminants, people who eat fish from the river might be indirectly exposed to contaminants. EPA performed sampling of fish from the Red River in fall 2002 and fall 2003 as part of the remedial investigation. According to an EPA informational bulletin published in April 2004, the fish sampling results showed that all metals in fish tissue were below levels that could present a health risk. Arsenic in tissue samples of rainbow trout raised at the Red River Fish Hatchery were above the screening level, but further testing showed that the arsenic was in an organic form posing little or no human health threat. In addition, the source of the arsenic was traced to the fish food used at the hatchery [56].

Because most of the fish caught and consumed from the Red River are hatched in the Red River Fish Hatchery, they do not live in contaminant-impacted areas of the Red River long enough to build up appreciable amounts of contaminants in their tissues. They are, however, susceptible to surface water contamination, and a number of fish kills have been attributed to spills of tailings or other mine-related contaminants [6].

E. Physical Hazards

Long-term stability of the waste rock piles has been questioned. The following information was obtained from the Mining and Mineral Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department [57]. A Stability Review Committee (SRC) has been established to examine the failure risk of all waste rock piles. The SRC includes representatives from the Village of Questa, Amigos Bravos, NMED, MMD, and Molycorp. Molycorp submitted a plan for the Goathill North Rock Pile Mitigation Project Final Design to MMD and NMED on May 27, 2004. On June 16, 2004, MMD and NMED issued a joint letter of approval. Completion of the mitigation project is slated for August 2005. Analysis of the other rock piles continues.

F. Child Health Considerations

ATSDR recognizes that infants and children might be more vulnerable to exposures than adults in communities faced with contamination of their air, water, soil, or food. This vulnerability is a result of the following factors:

- Children are more likely to play outdoors and bring food into contaminated areas.
- Children are shorter, so they are more likely to breathe dust, soil, and heavy vapors close to the ground.
- Children are smaller, resulting in higher doses of chemical exposure per body weight.
- The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

The major exposure pathways for children around the Molycorp site are past inhalation of dust from tailings piles and past ingestion of contaminated groundwater from private wells. At present, children's main exposure pathways are incidental ingestion and skin contact with surface water and sediment and incidental ingestion of surface soil. These present exposure pathways are not expected to result in appreciable exposure of children to site contaminants. Refer to the appropriate section for discussion of the possible health effects for children to contaminants associated with the site.

G. Health Outcome Data

Health outcome data can be used to give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (for example, the number of people who have died from a certain disease) or morbidity information (for example, the number of people in an area who have a certain disease or illness).
To thoroughly evaluate health outcome data as it relates to a hazardous waste site, four elements are necessary:

1) the presence of a completed human exposure pathway,
2) sufficiently high contaminant levels to result in measurable health effects,
3) a sufficient number of people in the completed pathway for the health effect to be measured, and
4) a health outcome database in which disease rates for populations of concern can be identified.

To our knowledge, an official database containing disease rates for the Questa area is not available. Even if it were, contaminant levels for pathways that would have affected the general population (soil, surface water, sediment) were not and are not high enough to result in an increased risk of adverse health effects. In the past, the general population might have occasionally been exposed to enough dust blowing off of the tailings piles to increase the risk of short-term eye and respiratory irritation and respiratory effects in sensitive groups. However, these past health effects cannot be measured effectively today. Dust levels measured in the 1990s (and expected to be similar today) are within ambient air quality standards and not likely to result in measurable adverse health effects in the general population. Also in the past, people who regularly drank highly contaminated private well water could have experienced adverse health effects as a result of their exposure to contaminants. However, because few details are known about each individual's specific activities and the exact level of contaminants they might have been exposed to, it is impossible to directly and definitely link their potential past exposure with past or current health status.

H. Community Health Concerns

An earlier version of this document was released for public comment in September 2002. ATSDR received several comments about the lack of sufficient contact with and notification of the community. In response to these comments and through negotiations with community members, ATSDR is issuing this revised public health assessment for the site. In this revised document, we have evaluated additional exposure pathways and community health concerns and attempted to address many of the concerns expressed about the previous document. We have also included additional data collected during EPA's remedial investigation in our evaluation. ATSDR is accepting public comments on this document and will address those comments in a final release to follow.

ATSDR staff spoke with local residents in a public availability session held June 25, 2003 in Questa and after an EPA public meeting held in Questa on August 27, 2003. During the meetings, ATSDR asked community members to share their health concerns related to contaminants at the site. ATSDR also collected health concerns from community members by email and by telephone. Community members thought a number of health problems might be related to contaminants at the Molycorp site; these are listed in Table 6. The next section summarizes what is known about the relation of these health problems to contaminants at the Molycorp site.

Table 6. Health Concerns Expressed by Community Members

Health Problem	Comment	Any association with contaminants found at this site?	How do the levels at this site compare?
Immune System Problems:			
Allergies		None known.	N/A
Immune System Deficiencies		Very high blood lead levels associated with immune system changes [30].	Lead not found at high enough levels to result in elevated blood lead levels
Chronic Fatigue Syndrome		None known.	N/A
Thyroid Problems		None known.	N/A
Neurological Problems:			
Alzheimer's Disease	Genetic factors thought to play a causal role [58].	Conflicting reports on association with aluminum intake [59].	Estimated exposure to aluminum not high enough to result in adverse health effects.
Bell's Palsy	Partial or complete paralysis on one side of the face; usually temporary	No; Cause of this condition is probably viral [60].	N/A
Mental Disturbances	Including stress disorders, anxiety, mood swings, panic attacks, depression, bipolar disorder, attention deficit and hyperactivity disorder (ADHD)	Very high levels of lead, manganese have been associated with ADHD, behavioral problems, and psychiatric disturbance [30,32]. Stress from living near hazardous wastes may influence mental state more than the waste itself [61].	Estimated exposure to lead not high enough to cause effects. Some private wells used for drinking in the past had manganese levels high enough to increase the risk for adverse effects. People in community could have experienced stress from community conflicts, litigation related to the site.

Health Problem	Comment	Any association with contaminants found at this site?	How do the levels at this site compare?
Learning Disabilities		Elevated levels of lead in children's blood associated with learning disabilities and cognitive impairment [30]. Some studies have linked excessive manganese ingestion with learning disabilities [32].	Lead not found at high enough levels to result in elevated blood lead levels in children. Some private wells used for drinking in the past had manganese levels high enough to result in adverse effects. Other manganese estimated exposures not high enough to cause effects.
Migraine and Cluster Headaches		None known. Stress or anxiety can trigger migraines or cluster headaches [62].	N/A
Hearing Loss and Ear Problems		Some studies have indicated that very high blood lead levels adversely affect auditory function in children [30].	Lead not found at high enough levels to result in elevated blood lead levels in children.
Musculoskeletal Problems:			
Tooth Discoloration and Decay		Very high fluoride levels can result in tooth discoloration or weakening of the enamel [38].	Some private wells that supplied drinking water in the past had fluoride levels high enough to cause tooth problems. Fluoride was not elevated in Questa municipal water.
Bone Problems		Very high fluoride levels can result in increased bone fractures in the elderly or skeletal fluorosis [38].	Some private wells that supplied drinking water in the past had fluoride levels high enough to cause bone problems. Fluoride was not elevated in Questa municipal water.

Health Problem	Comment	Any association with contaminants found at this site?	How do the levels at this site compare?
Osgood Schlatter Disease	Knee pain common in athletic teenagers	Caused by overuse during exercise and sports, especially during the teenage growth spurt [63].	N/A
Fibromyalgia		None known.	N/A
Other Problems:			
Hepatitis		None known	N/A
Kidney Problems	Renal problems	Ingesting lead or cadmium associated with renal problems [30,24]. Inhaling beryllium or cadmium increased risk of renal diseases [21,24].	7 out of 46 private wells tested had cadmium levels high enough to increase the risk of serious kidney effects in children. Elevated contaminant levels in surface soil, surface water, sediment, and other private wells used for drinking in the past, but estimated exposure not high enough to cause kidney problems.
Gastrointestinal Problems		Very high levels of sulfate in drinking water can cause diarrhea and other gastrointestinal problems until people get acclimated (7-10 days) [39]. Very high intakes of some metals can lead to gastrointestinal distress (nausea, abdominal pain, etc.)	Some private wells that supplied drinking water in the past had sulfate levels high enough to result in adverse effects. Sulfate was not elevated in Questa municipal water. One private well had iron levels high enough to cause gastrointestinal distress. Elevated metals levels in surface soil, surface water, sediment, and the other private wells used for drinking in the past, but estimated exposure not high enough to cause this effect.

Health Problem	Comment	Any association with contaminants found at this site?	How do the levels at this site compare?
Hypertension	High blood pressure	Some studies have found associations between arsenic in drinking water or elevated blood lead levels and hypertension [20,30].	No arsenic or lead levels were high enough to result in increased risk of hypertension.
Chronic Respiratory Problems	Including asthma, chronic obstructive pulmonary disease (COPD)	Particulate matter in air can aggravate asthma and contribute to COPD [42,43,47]. Breathing some metals can lead to COPD.	Occasionally, past particulate levels were high enough to increase risk of respiratory problems. No metals levels were high enough in increase the risk of disease.

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In addition to concerns about specific health problems, community members expressed other concerns about exposures and public health implications of contaminants from the site, listed below.

Concern: *What is the potential for people to be exposed to contaminants through the Questa municipal water supply, considering that the water lines are known to have been buried in tailings from the mine?*

Response: As described in the "Ingestion of Questa Municipal Water" section of this document beginning on page 27, source water for the municipal system was tested and found to meet water quality standards for metals. However, because at least some water lines leading to residences are buried in tailings, there is the potential for contaminated tailings to seep into the water lines during times of depressurization. This would likely be intermittent. Residential tap sampling in the fall of 2003 detected no contaminants exceeding water quality standards. ATSDR performed "worst case" calculations assuming a resident occasionally drank water containing a moderate amount of suspended tailings. These calculations indicated that *no short-term or long-term health effects would be expected*. Further details can be found in the "Ingestion of Questa Municipal Water" section of this document beginning on page 27.

Concern: *What are the health implications of eating fish from the Red River?*

Response: According to an EPA informational bulletin published in April 2004, fish sampling along the Red River showed that all metals in fish tissue were below levels that could present a health risk. Arsenic in tissue samples of rainbow trout raised at the Red River Fish Hatchery was above the screening level, but further testing showed that the arsenic was in an organic form posing little or no human health threat [56].

Concern: *What information on chronic respiratory problems and other health effects did you get from local health providers?*

Response: For public health assessments, ATSDR evaluates health outcome data that is available in databases maintained by federal, state, or local agencies. No database containing disease rates for the Questa area was identified. ATSDR will evaluate health outcome data if it becomes available.

Concern: *I am concerned about the stability of waste rock piles in the Questa area.*

Response: The following information was obtained from the Mining and Mineral Division (MMD) of the New Mexico Energy, Minerals, and Natural Resources Department [57]. A Stability Review Committee (SRC) has been established to examine the failure risk of all waste rock piles. The SRC includes representatives from the Village of Questa, Amigos Bravos, NMED, MMD, and Molycorp. Molycorp submitted a plan for the Goathill North Rock Pile Mitigation Project Final Design to MMD and NMED on May 27, 2004. On June 16, 2004, MMD and NMED issued a joint letter of approval. Completion of the mitigation project is slated for August 2005. Analysis of the other rock piles continues.

Concern: *I am concerned about cases of metals poisoning in children and adults in the Questa area.*

Response: Some private wells are contaminated with metals at high enough levels to cause adverse health effects if people drank the water regularly. However, local citizens and federal officials stated that no one has drunk contaminated private well water since the late 1990s, so the private well pathway is incomplete and could not be responsible for poisonings that may have taken place within the past several years. ATSDR asked the community for information about how children or adults might come in contact with contaminants from the site, how often, and for how long. We did not receive specific information on these items, so we used generally conservative default assumptions in performing exposure estimates for other pathways of exposure (soil, surface water, sediment). None of the estimated exposures were high enough to result in an increased risk of any adverse health effects, including metals poisoning. ATSDR cannot speculate on the causes of any current metals poisoning cases in the community.

Concern: *How have the numerous tailings spills from the tailings pipeline affected my health?*

Response: ATSDR recognizes that numerous spills of tailings from the pipeline have taken place over the years. ATSDR evaluated direct exposures to tailings as part of the "Incidental Ingestion of Soil or Tailings" section beginning on page 23. In this section, ATSDR assumed that people would contact tailings in the same way they contact surface soil. Estimated exposures to contaminants in either pure tailings or in surface soil were too low to result in adverse health effects.

Concern: *I am concerned that some affected wells were just not tested.*

Response: According to a report in the Albuquerque Journal published on October 11, 2000, NMED offered testing of privately owned wells within a 2-mile radius of the tailings piles or in the Red River Valley area downriver from the mine [64]. A number of wells were sampled through this program. Some untested wells might contain contaminants that may or may not be related to the site. It is a good idea for people who drink from private wells to have the water tested regularly to ensure its safety. Testing for a limited number of water quality parameters, including nitrate, fluoride, and iron, can be requested through the New Mexico Environment Department field office in Taos (505-758-8808). Testing for other parameters can be performed by any commercial laboratory specializing in water quality.

Concern: *I am concerned about contamination of the acequias.*

Response: The acequias (irrigation ditches) are likely to contain levels of contaminants in sediment and surface water similar to the Red River. Incidental exposure to contaminants in surface water and sediment were too low to increase the risk of adverse health effects. To minimize the chance for exposure to contaminants on the surface of irrigated crops and vegetables, these items should be washed thoroughly before eating.

IV. Health Hazard Category

The following hazard categorization, conclusions, and recommendations are based on data available at the time of the writing of this report. Additional environmental sampling data or changing exposure scenarios could alter these findings.

Estimated past exposures to arsenic, cadmium, iron, magnesium, manganese, molybdenum, zinc, fluoride, or sulfate in water from some private wells or to particulate matter blowing off of tailings piles were potentially high enough to result in adverse health effects. Therefore, ATSDR categorizes the site as a *past public health hazard*.

No indication that anyone is currently drinking contaminated well water was found. Current measurements of particulate matter blowing off of tailings piles indicate that dust levels are within ambient air standards. Other completed and potential exposure pathways are not expected to result in adverse health effects. Present exposure pathways associated with the Molycorp site pose *no apparent public health hazard*.

Without actions and regulations to protect the public from contaminants and physical hazards at the site, the potential for adverse health effects remains. Discontinuing dust control measures, resuming drinking of contaminated well water, or failing to address waste rock pile stability issues could all adversely affect public health. Therefore, ATSDR categorizes the site a potential *future public health hazard*.

V. Conclusions

1. Information about use of private wells and their levels of contamination in the past was limited. Some of the wells potentially used for private consumption in the past have levels of arsenic, cadmium, iron, magnesium, manganese, molybdenum, zinc, fluoride, or sulfate high enough to have increased the risk of adverse health effects, to varying degrees, if people drank water from the affected wells regularly. No adverse health effects are likely today as long as people avoid drinking contaminated well water.

2. Information about levels of dust blowing off of tailings piles towards Questa was also limited. Using available data and professional judgment, rough “worst case” estimates of past exposures indicated that exposures to metals contaminants from breathing in tailings dust were too low to result in short- or long-term health effects. However, intermittently high dust levels in the 1970s, 1980s, and (to a lesser extent) the 1990s could have resulted in short-term eye and respiratory irritation and an increased risk of respiratory problems in sensitive groups (people with asthma or other respiratory disease, the elderly, and children). Recent studies indicate that adverse health effects are unlikely today.

3. Contaminants in Questa municipal water meet applicable water quality standards and are not expected to result in adverse health effects. Although there is no evidence of it occurring, even if people occasionally drank tap water with tailings particles or contaminants in it, estimated contaminant exposures would be too low to result in adverse health effects.

VI. Recommendations

1. People should avoid drinking water from wells shown to be contaminated. The most highly contaminated wells should be decommissioned to prevent people from drinking the water. People who drink out of private wells are encouraged to have the well water quality tested regularly.

2. Continue dust mitigation/suppression at the tailings facility as long as suspendable tailings are present. People in sensitive groups (people with asthma or other respiratory disease, the elderly, and children) should limit outdoor activity on dry, windy days or if dust levels appear to be high.

3. To improve the community's acceptance of Questa's water supply, ATSDR supports the planned upgrading of the municipal water system to remove water lines from tailings.

VII. Public Health Action Plan

The public health action plan for the Molycorp site contains a description of actions that have been or will be taken at the site by ATSDR and/or other government agencies. The purpose of the plan is to ensure that this public health assessment not only identifies public health hazards at the site, but also outlines a plan of action to prevent or minimize the potential for adverse human health effects from exposure to site-related hazardous substances. ATSDR will follow up on this plan to ensure that it is implemented.

Actions Completed

- ATSDR conducted two site visits to verify site conditions and to gather pertinent information and data for the site.
- ATSDR held a public availability session and attended a public meeting to inform the community about the public health assessment process and to gather health concerns from the site community.
- ATSDR's Division of Health Education and Promotion worked with the Questa community to develop a Needs Assessment for health education related to the site. This document was used to assist in identifying community concerns addressed in this public health assessment.

Planned Actions

- EPA will complete remedial investigation activities for the site.
- ATSDR will continue to work with federal and state environmental and health agencies and review the results of future investigations, as necessary.
- ATSDR's Division of Health Education and Promotion will provide health-related educational activities to the community, upon request.

ATSDR will re-evaluate and expand the public health action plan if needed. New environmental, toxicologic, or health outcome data or the results of implementing the above proposed actions might determine the need for additional actions at this site.

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IX. References

1. New Mexico Environment Department. Expanded site inspection report on Molycorp Inc., Questa Division, Taos County, New Mexico. Santa Fe: New Mexico Environment Department, Groundwater Protection and Remediation Bureau—Superfund Program; October 1995.

2. US Environmental Protection Agency. Hazard ranking system documentation record. Dallas: US Environmental Protection Agency, Region 6; May 2000.

3. New Mexico Environment Department. Discharge permit, Molycorp Questa Mine, DP-1055. Santa Fe: November 2000.

4. New Mexico Environment Department. Red River groundwater investigation. Santa Fe: New Mexico Environment Department, Surface Water Quality Bureau; March 1996.

5. Taos News. Series of newspaper articles regarding tailings dust provided by Amigos Bravos. Taos: 1978—1995.

6. Taos News. Series of newspaper articles regarding tailings spills provided by Amigo Bravos. Taos: 1966—1996.

7. US Census Bureau. American fact finder, data set from 2000 summary file 1. Washington, DC: US Department of Commerce. URL: http://factfinder.census.gov.

8. National Center for Education Statistics. Common Core of Data public school district data for the 2001—2002 school year. Washington, DC: US Department of Education. URL: http://nces.ed.gov/ccd/ Accessed on October 22, 2003.

9. Allen BD, Groffman AR, Molles MC, Anderson RY, Crossey LJ. Geochemistry of the Red River stream system before and after open-pit mining, Questa area, Taos County, New Mexico. Prepared for the New Mexico Office of the Natural Resources Trustee. Socorro, New Mexico: October 1999.

10. New Mexico Department of Game and Fish. Public fishing waters map. Available at URL: http://www.wildlife.state.nm.us/publications/index.htm Accessed August 2, 2004.

11. New Mexico Department of Game and Fish. Northeast management areas, Red River state fish hatchery. Available at URL: http://www.wildlife.state.nm.us/conservation/wildlife_management_areas/ne_areas.htm Accessed August 2, 2004.

12. Gannett Fleming West, Inc. Preliminary engineering report: fire protection and water system improvements. Prepared for the Village of Questa. Questa: January 2003.

13. Taos News. Questa suspects mine tailings used as bedding material for water system; drinking water remains safe. The Taos News 2003 Sep 5.

14. US Environmental Protection Agency. Validated Molycorp chemistry database, version 1.0, February 18, 2004. Dallas: US Environmental Protection Agency. Provided electronically, March 2004.

15. New Mexico Environment Department. Questa well sampling 4-9-01, file dated 4-18-01. Santa Fe: New Mexico Environment Department, Drinking Water Bureau. Provided electronically, July 2003.

16. New Mexico Environment Department. TSP and PM10 data files. Santa Fe: New Mexico Environment, Air Quality Bureau. Provided electronically, September 2003.

17. Agency for Toxic Substances and Disease Registry. Toxicological profile for aluminum: update. Atlanta: US Department of Health and Human Services; 1999.

18. US Environmental Protection Agency. Integrated Risk Information System. Washington, DC: US Environmental Protection Agency, Office of Research and Development. Available from URL: http://www.epa.gov/iris Accessed May 6, 2002.

19. Agency for Toxic Substances and Disease Registry. Toxicological profile for antimony. Atlanta: US Department of Health and Human Services; 1992.

20. Agency for Toxic Substances and Disease Registry. Toxicological profile for arsenic: update. Atlanta: US Department of Health and Human Services; 2000.

21. Agency for Toxic Substances and Disease Registry. Toxicological profile for beryllium: update. Atlanta: US Department of Health and Human Services; 2002.

22. Agency for Toxic Substances and Disease Registry. Toxicological profile for boron. Atlanta: US Department of Health and Human Services; 1992.

23. Food and Nutrition Board of the Institute of Medicine. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium, and zinc. Washington, DC: National Academy Press; 2001.

24. Agency for Toxic Substances and Disease Registry. Toxicological profile for cadmium: update. Atlanta: US Department of Health and Human Services; 1999.

25. Agency for Toxic Substances and Disease Registry. Toxicological profile for chromium: update. Atlanta: US Department of Health and Human Services; 2000.

26. Agency for Toxic Substances and Disease Registry. Toxicological profile for cobalt: update. Atlanta: US Department of Health and Human Services; 2001.

27. Agency for Toxic Substances and Disease Registry. Toxicological profile for copper: update. Atlanta: US Department of Health and Human Services; 2002.

28. Northwestern University. Nutrition fact sheet: iron. Chicago: Feinberg School of Medicine, Northwestern University. Available at URL: http://www.nums.nwu.edu/nutrition/factsheets/iron.html Accessed on July 18, 2003.

29. Amdur, MO, Doull J, Klaassen C, editors. Casarett and Doull's toxicology: the basic science of poisons. 4th ed. New York: Pergamon Press; 1991.

30. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead: update. Atlanta: US Department of Health and Human Services; 1999.

31. Food and Nutrition Board of the Institute of Medicine. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D, and fluoride. Washington, DC: National Academy Press; 1997.

32. Agency for Toxic Substances and Disease Registry. Toxicological profile for manganese: update. Atlanta: US Department of Health and Human Services; 2000.

33. US Environmental Protection Agency. List of drinking water contaminants and MCLs. Washington, DC: US Environmental Protection Agency, Office of Water; EPA 816-F-02-013; 2002.

34. Turnlund JR, Thompson KH, and Scott KC. Key features of copper versus molybdenum metabolism models in humans. In: AJ Clifford and HG Müller, editors. Mathematical Modeling in Experimental Nutrition. New York: Plenum Press; 1998.

35. Agency for Toxic Substances and Disease Registry. Toxicological profile for nickel: update. Atlanta: US Department of Health and Human Services; 2003.

36. Agency for Toxic Substances and Disease Registry. Toxicological profile for vanadium. Atlanta: US Department of Health and Human Services; 1992.

37. Agency for Toxic Substances and Disease Registry. Toxicological profile for zinc: update. Atlanta: US Department of Health and Human Services; 1994.

38. Agency for Toxic Substances and Disease Registry. Toxicological profile for fluorides, hydrogen fluoride, and fluorine: update. Atlanta: US Department of Health and Human Services; 2003.

39. US Environmental Protection Agency. Drinking water advisory: consumer acceptability advice and health effects analysis on sulfate. Washington DC: US Environmental Protection Agency, Office of Water; 2003.

40. Blodgett S. Comments on public health assessment for Molycorp, Incorporated, Questa, New Mexico, EPA facility ID: NMD002899094, prepared by Agency for Toxic Substances and Disease Registry, September 24, 2002. Prepared for Rio Colorado Reclamation Committee; June 2003. Available at URL: http://www.rcrc.nm.org/documents/atsdr/main.html Accessed July 27, 2004.

41. Molycorp. Air quality assessment performed at the tailings facility information sheet. Questa: Molycorp. August 23, 2004.

42. US Environmental Protection Agency. Guideline for reporting of daily air quality – air quality index (AQI). Research Triangle Park: US Environmental Protection Agency, Office of Air Quality Planning and Standards; July 1999. EPA 454/R-99-010. Available at URL: http://www.epa.gov/airnow/publications.html Accessed July 26, 2004.

43. US Environmental Protection Agency. Air quality criteria for particulate matter. Washington, DC: US Environmental Protection Agency, National Center for Environmental Assessment; 1996. EPA/600/P-95/001aF.

44. US Environmental Protection Agency. Fact sheet on EPA's revised particulate matter standards, July 1997. Available at URL: http://www.epa.gov/ttn/oarpg/t1/fact_sheets/pmfact.pdf Accessed July 26, 2004.

45. Schwartz J. Health effects of air pollution from traffic: ozone and particulate matter. In: Fletcher, T, editor. Health at the crossroads: transportation policy and urban health proceedings of the Fifth Annual Public Health Forum of the London School of Hygiene and Tropical Medicine. London: John Wiley and Sons; April 1995.

46. US Environmental Protection Agency. Exposure factors handbook. Washington, DC: US Environmental Protection Agency, Office of Research and Development; 1999. Rpt. No.: EPA/600/C-99/001.

47. Pope CA. Epidemiology of fine particle air pollution and human health: biological mechanisms and who's at risk? Environ Health Perspect 2000; 108(suppl 4):713-723.

48. Agency for Toxic Substances and Disease Registry. Toxicological profile for polychlorinated biphenyls: update. Atlanta: US Department of Health and Human Services; 2000.

49. Knight Piésold and Company. Source water assessment of Village of Questa's water supply as potentially impacted by the Questa mine final report. Prepared for Molycorp, Inc. – Questa Division. Denver: May 2003.

50. US Environmental Protection Agency. Safe Drinking Water Information System. Washington: US Environmental Protection Agency, Envirofacts Warehouse. Available from URL: http://www.epa.gov/enviro/html/sdwis/sdwis_query.html Accessed July 23, 2004.

51. New Mexico State Legislature. Locator for capital outlay requests. Available at URL: http://legis.state.nm.us/newsite/locator.asp Accessed July 26, 2004.

52. New Mexico Environment Department. Village of Questa results and national primary drinking water regulations. Santa Fe: New Mexico Environmental Department, Drinking Water Bureau. Provided electronically, April 2001.

53. Purcell M. Fax to J. Dyken of Agency for Toxic Substances and Disease Registry, Questa drinking water test results. Dallas: US Environmental Protection Agency, Region 6; September 4, 2003.

54. Purcell M. e-mail to J. Dyken of ATSDR, Water samples from Questa etc. Dallas: US Environmental Protection Agency, Region 6; December 17, 2003.

55. Magill B. EPA officials say Molycorp not a polluter. The Taos News 2004 Jun 24.

56. US Environmental Protection Agency. Molycorp site informational bulletin, April 2004, results of fish tissue sampling, EPA remedial investigation and feasibility study. Dallas: US Environmental Protection Agency, Region 6; April 2004.

57. New Mexico Energy, Minerals, and Natural Resources Department. Molycorp Questa mine summary. Available at URL: http://www.emnrd.state.nm.us/Mining/Moly_default.htm Accessed July 27, 2004.

58. Alzheimer's Disease Education and Referral Center. AD: unraveling the mystery. Available at URL: http://www.alzheimers.org/unraveling/09.htm Accessed July 26, 2004.

59. National Institute of Environmental Health Sciences. Alzheimer's question and answer. Available at URL: http://www.niehs.nih.gov/external/faq/aluminum.htm - Accessed July 26, 2004.

60. National Institute of Neurological Disorders and Stroke. NINDS Bell's Palsy information page. Available at URL: http://www.ninds.nih.gov/health_and_medical/disorders/bells_doc.htm Accessed July 26, 2004.

61. Kroll-Smith JS and Couch SR. As if exposure to toxins were not enough: the social and cultural system as a secondary stressor. Environ Health Perspect 1991; 95:61-66.

62. National Institute of Neurological Disorders and Stroke. NINDS Migraine information page. Available at URL: http://www.ninds.nih.gov/health_and_medical/pubs/migraineupdate.htm Accessed July 26, 2004.

63. American Academy of Family Physicians. Osgood Schlatter disease: a cause of knee pain in children. Available at URL: http://familydoctor.org/135.xml Accessed July 26, 2004.

64. Albuquerque Journal. Private wells to be tested. The Albuquerque Journal 2000 Oct 11.

Appendix A. Explanation of Evaluation Process

A. Screening Process

In evaluating these data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of air, water, and soil that someone might inhale or ingest each day.

As health-based thresholds, CVs are set at a concentration below which no known or anticipated adverse human health effects are expected to occur. Different CVs are developed for cancer and noncancer health effects. Noncancer levels are based on valid toxicologic studies for a chemical, with appropriate safety factors included, and the assumption that small children (22 pounds) and adults are exposed every day. Cancer levels are based on a one-in-a-million excess cancer risk for an adult eating contaminated soil or drinking contaminated water every day for 70 years. For chemicals for which both cancer and noncancer levels exist, we use the lower level to be protective. Exceeding a CV does not mean that health effects will occur, just that more evaluation is needed.

CVs used in this document are listed below:

Environmental Media Evaluation Guides (EMEGs) are estimated contaminant concentrations in a media where noncarcinogenic health effects are unlikely. EMEGs are derived from the Agency for Toxic Substances and Disease Registry's (ATSDR) minimal risk level (MRL).

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations that would be expected to cause no more than one additional excess cancer in one million persons exposed over a lifetime. CREGs are calculated from the U.S. Environmental Protection Agency's (EPA) cancer slope factors (CSFs).

Reference Media Evaluation Guides (RMEGs) are estimated contaminant concentrations in a media where noncarcinogenic health effects are unlikely. RMEGs are derived from EPA's reference dose (RfD).

Preliminary Remediation Goals (PRGs) are the estimated contaminant concentrations in a media where carcinogenic or noncarcinogenic health effects are unlikely. The PRGs used in this public health assessment were derived using provisional reference doses or CSFs calculated by EPA's Region 9 toxicologists.

Risk-Based Concentrations (RBCs) are the estimated contaminant concentrations at which carcinogenic and noncarcinogenic health effects are not expected to occur as a result of exposure. The RBCs used in this public health assessment were derived using provisional reference doses or CSFs calculated by EPA's Region 3 toxicologists.

EPA Action Levels (ALs) are the estimated contaminant concentrations in water of which additional evaluation is needed to determine whether action is required to eliminate or reduce exposure. Action levels can be based on mathematical models.

EPA Soil Screening Levels (SSLs) are estimated contaminant concentrations in soil at which additional evaluation is needed to determine if action is required to eliminate or reduce exposure.

Some CVs may be based on different durations of exposure. Acute duration is defined as exposure lasting 14 days or less. Intermediate duration exposure lasts between 15 and 364 days, and chronic exposures last 1 year or more. Comparison values based on chronic exposure studies are used whenever available. If an intermediate or acute comparison value is used, it is denoted with a small *i* or *a* before the CV (e.g., iEMEG refers to the intermediate duration EMEG).

B. Determination of Exposure Pathways

ATSDR identifies human exposure pathways by examining environmental and human components that might lead to contact with contaminants of concern (COCs). A pathway analysis considers five principal elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and an exposed population. Completed exposure pathways are those for which the five elements are evident, and indicate that exposure to a contaminant has occurred in the past, is now occurring, or will occur in the future. Potential exposure pathways are those for which exposure seems possible, but one or more of the elements is not clearly defined. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. The identification of an exposure pathway does not imply that health effects will occur. Exposures might be, or might not be, substantive. Therefore, even if exposure has occurred, is now occurring, or is likely to occur in the future, human health effects might not result.

ATSDR reviewed site history, information on site activities, and the available sampling data. On the basis of this review, ATSDR identified numerous exposure pathways that warranted consideration. Additional information regarding the completed and potential exposure pathways identified for the Molycorp site is provided in Appendix B of this public health assessment. Summaries of these pathways are discussed below.

C. Evaluation of Public Health Implications

The next step is to take those contaminants present at levels above the CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Child and adult exposure doses are calculated for the site-specific exposure scenario, using our assumptions of who goes on the site and how often they contact the site contaminants. The exposure dose is the amount of a contaminant that gets into a person’s body. Following is a brief explanation of how we calculated the estimated exposure doses for the site.

Ingestion of Groundwater
Exposure doses for groundwater ingestion were calculated using the highest time-averaged concentration for a contaminant in a well, in milligrams per liter (mg/L), multiplied by the EPA default drinking water rate of 2 L/day for adults or 1 L/day for children. The multiplication product was divided by the average weight for an adult (70 kg or 154 pounds), or for a 1-year-old child (10 kg or 22 pounds).

Inhalation of Tailings Dust
For short-term exposure to contaminants via inhalation of fugitive dust from the tailings facility, the highest contaminant concentration detected in tailings (in mg/kg) was multiplied by the highest total suspended particulate concentration measured in ambient monitoring in the 1980s (in $\mu g/m^3$). For long-term exposure, the average contaminant concentration measured in tailings was multiplied by the average TSP concentration. The multiplication product was multiplied by a conversion factor of 10^{-6} to obtain an effective air concentration of each contaminant in $\mu g/m^3$.

Exposure from indirect ingestion of inhaled dust was estimated by multiplying the highest contaminant concentration detected in tailings (in mg/kg) by an assumed concentration of total suspended particulates (in $\mu g/m^3$), a conversion factor of 10^{-9} $\mu g/kg$, the exposure time in hours per day, and an assumed inhalation rate of 1.9 cubic meters per hour (m^3/hour) for children engaged in heavy activity. The multiplication product was divided by the average weight for a 10-year old child, 36 kg (80 pounds) to obtain the dose in mg/kg/day. The assumed TSP concentrations and times were 4800 $\mu g/m^3$ for 1 hour plus 400 $\mu g/m^3$ for 8 hours each day.

Incidental Ingestion of Soil or Tailings
Exposure doses for ingestion of contaminants present in soil from the source areas were calculated using the average concentration measured in the source areas, in milligrams per kilogram (mg/kg), or parts per million (ppm), multiplied by the soil ingestion rate for adults (100 mg/day) or children (200 mg/day). The multiplication product was divided by the average weight for an adult, 70 kg (154 pounds) or a 1-year-old child, 10 kg (22 pounds). The resulting dose was then multiplied by factors of 4/7 and 9/12, because the exposure was assumed to occur 4 times per week for 9 months out of the year.

Incidental Ingestion of Surface Water
Exposure doses for ingestion of contaminants from surface water were calculated using the average concentration measured in the surface water, in milligrams per liter (mg/L), multiplied by an incidental surface water ingestion rate of 0.02 L/day for adults or 0.01 L/day for children. These ingestion rates are 1/100th of the EPA default drinking water rates. The multiplication product was divided by the average weight for an adult (70 kg or 154 pounds), or for a 6-year-old child (23 kg or 51 pounds). The resulting dose was then multiplied by a factor of 104/365, because the exposure was assumed to occur 4 days per week during 6 months of the year.

Incidental Ingestion of Sediment
Exposure doses for ingestion of contaminants from the sediment were calculated using the average concentration measured in the sediment, in mg/kg or ppm, multiplied by 1/10th of the soil ingestion rate, 10 mg/day for adults or 20 mg/day for children. The multiplication product was divided by the average weight for an adult (70 kg or 154 pounds), or for a 6-year-old child (23 kg or 51 pounds). The resulting dose was then multiplied by a factor of 104/365, because the exposure was assumed to occur 4 days per week during 6 months of the year.

Dermal (Skin) Exposure
In this public health assessment, we evaluated dermal exposure to groundwater, soil and/or tailings, surface water, and sediment. Dermal absorption depends on numerous factors including the area of exposed skin, anatomic location of exposed skin, length of contact, concentration of chemical on skin, chemical-specific permeability, soil adherence, medium in which the chemical is applied, and skin condition and integrity. Because chemicals differ greatly in their potential to be absorbed through the skin, each chemical needs to be evaluated separately and is discussed as needed in the main body of the public health assessment. The assumed receptor body weights, exposure frequency, and exposure duration are the same as described in the above calculations of the ingestion route. The skin surface area and soil-to-skin adherence factors used in this public health assessment were taken from EPA's *Exposure Factor Handbook*.[1] Absorption factors and other chemical-specific factors were taken from the ATSDR *Toxicological Profile* for each specific chemical.

Ingestion of Biota
Exposure doses for ingestion of garden vegetables were calculated using the average detected concentration of each contaminant measured in vegetable samples, in mg/kg or ppm, multiplied by average consumption rates of the vegetable of interest in grams per kilogram of body weight per day (g/kg/day), taken from EPA's *Exposure Factor Handbook*.[1] The calculated value was also multiplied by a conversion factor of 0.001 kilograms per gram.

D. Noncancer Health Effects

The calculated exposure doses are then compared to an appropriate health guideline for that chemical. Health guideline values are considered safe doses; that is, health effects are unlikely below this level. The health guideline value is based on valid toxicological studies for a chemical, with appropriate safety factors built-in to account for human variation, animal-to-human differences, and/or the use of the lowest adverse effect level. For noncancer health effects, the following health guideline values are used.

[1] Environmental Protection Agency (EPA). Exposure factors handbook. Washington (DC): US Environmental Protection Agency, Office of Research and Development; 1999. Rpt. No.: EPA/600/C-99/001.

Minimal Risk Level (MRLs) —Developed by ATSDR
An MRL is an estimate of daily human exposure – by a specified route and length of time – to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects. A list of MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

Reference Dose (RfD) —Developed by EPA
An RfD is an estimate, with safety factors built in, of the daily, life-time exposure of human populations to a possible hazard that is not likely to cause noncancerous health effects. RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, then the exposure is unlikely to cause a noncarcinogenic health effect in that specific situation. If the exposure dose for a chemical is greater than the health guideline, then the exposure dose is compared to known toxicologic values for that chemical and is discussed in more detail in the public health assessment (see Discussion section). These toxicologic values are doses derived from human and animal studies that are summarized in the ATSDR *Toxicological Profiles*. A direct comparison of site-specific exposure and doses to study-derived exposures and doses that cause adverse health effects is the basis for deciding whether health effects are likely or not.

E. Calculation of Risk of Carcinogenic Effects

The estimated risk of developing cancer resulting from exposure to the contaminants was calculated by multiplying the site-specific adult exposure dose by EPA's corresponding CSF (which can be found at http://www.epa.gov/iris). The results estimate the maximum increase in risk of developing cancer after 70 years of exposure to the contaminant.

The actual increased risk of cancer is probably lower than the calculated number, which gives a worst-case excess cancer risk. The method used to calculate EPA's CSF assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. The method also assumes that no safe level exists for exposure. Little experimental evidence exists to confirm or refute those two assumptions. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.[2]

Because of uncertainties involved in estimating carcinogenic risk, ATSDR employs a weight-of-evidence approach in evaluating all relevant data.[3] Therefore, the carcinogenic risk is described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure

[2] US Environmental Protection Agency (EPA), Office of Emergency and Remedial Response. Risk assessment guidance for Superfund, volume 1, human health evaluation manual. Washington: US Environmental Protection Agency; 1989.
[3] Agency for Toxic Substances and Disease Registry (ATSDR). Cancer policy framework. Atlanta (GA): US Department of Health and Human Services; 1993.

conditions. The actual parameters of environmental exposures must be given careful consideration in evaluating the assumptions and variables relating to both toxicity and exposure.

Appendix B. Exposure Pathways for Molycorp Site

Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Time	Notes	Complete?
Groundwater	Infiltration to groundwater	Drinking water taps supplied by private wells	Ingestion, dermal exposure	Residents and workers drinking out of private wells near the site	Past, potential future	Population might have included young children	N – present Y – past, potential future
Tailings Dust	Dust blown off of tailings facility, transported in air	Areas affected by dust blowing off of tailings facility	Inhalation	Nearby residents, school children	Past, present, future	Population includes children	Y
Soil or tailings	Waste rock and tailings piles on site; dispersed to soil by wind or water erosion	Residential yards, schoolyard, or recreational areas	Incidental ingestion, dermal exposure	Workers, residents, visitors	Past, present, future	Population includes children	Y
Surface water	Ground water and surface water drainage through waste rock; tailings spills into surface water	Red River, ponds and creeks in area	Incidental ingestion, dermal exposure	Fishers, recreational users of Red River (children and adults)	Past, present, future	Population includes children	Y
Sediment	Tailings spills into surface waters; deposition from surface water	Red River, ponds and creeks in area	Incidental ingestion, dermal exposure	Fishers, recreational users of Red River (children and adults)	Past, present, future	Population might include children	Y
Fish	Bioaccumulation of contaminants from surface water and sediments into fish	Meal prepared using fish from Red River	Ingestion	Fishers and their families	Past, present, future	Population might include young children	N
Garden Vegetables/ Crops	Uptake of contaminants from surface water, groundwater into plants	Meal prepared using garden vegetables or crops	Ingestion	Residents and their families, purchasers of produce	Past, present, future	Population might include young children	N
Municipal Water	Infiltration of municipal water lines with tailings or tailings contaminants	Drinking water taps supplied by municipal system	Ingestion, dermal exposure	Residents drinking water from Questa municipal supply	Past, present, future	Population might include young children	N

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Appendix C. ATSDR Plain Language Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption	How a chemical enters a person's blood after the chemical has been swallowed, has come into contact with the skin, or has been breathed in.
Acute Exposure	Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.
Additive Effect	A response to a chemical mixture, or combination of substances, that might be expected if the known effects of individual chemicals, seen at specific doses, were added together.
Adverse Health Effect	A change in body function or the structures of cells that can lead to disease or health problems.
Antagonistic Effect	A response to a mixture of chemicals or combination of substances that is **less** than might be expected if the known effects of individual chemicals, seen at specific doses, were added together.
ATSDR	The **A**gency for **T**oxic **S**ubstances and **D**isease **R**egistry. ATSDR is a federal health agency in Atlanta, Georgia that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background Level	An average or expected amount of a chemical in a specific environment. Or, amounts of chemicals that occur naturally in a specific environment.
Bioavailability	See **Relative Bioavailability**.

Biota	Used in public health, things that humans would eat – including animals, fish and plants.
Cancer	A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control
Cancer Slope Factor (CSF)	The slope of the dose-response curve for cancer. Multiplying the CSF by the dose gives a prediction of excess cancer risk for a contaminant.
Carcinogen	Any substance shown to cause tumors or cancer in experimental studies.
Chronic Exposure	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.
Completed Exposure Pathway	See **Exposure Pathway**.
Community Assistance Panel (CAP)	A group of people from the community and health and environmental agencies who work together on issues and problems at hazardous waste sites.
Comparison Value (CV)	Concentrations of substances in air, water, food, and soil that are unlikely, upon exposure, to cause adverse health effects. Comparison values are used by health assessors to select which substances and environmental media (air, water, food and soil) need additional evaluation while health concerns or effects are investigated.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	**CERCLA** was put into place in 1980. It is also known as **Superfund**. This act concerns releases of hazardous substances into the environment, and the cleanup of these substances and hazardous waste sites. This act created ATSDR and gave it the responsibility to look into health issues related to hazardous waste sites.
Concentration	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Contaminant	See **Environmental Contaminant**.
Delayed Health Effect	A disease or injury that happens as a result of exposures that may have occurred far in the past.

Dermal Contact	A chemical getting onto your skin (see **Route of Exposure**).
Dose	The amount of a substance to which a person may be exposed, usually on a daily basis. Dose is often explained as “amount of substance(s) per body weight per day”.
Dose / Response	The relationship between the amount of exposure (dose) and the change in body function or health that results.
Duration	The amount of time (days, months, years) that a person is exposed to a chemical.
Environmental Contaminant	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the **Background Level**, or what would be expected.
Environmental Media	Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals that are eaten by humans. **Environmental Media** is the second part of an **Exposure Pathway**.
US Environmental Protection Agency (EPA)	The federal agency that develops and enforces environmental laws to protect the environment and the public’s health.
Epidemiology	The study of the different factors that determine how often, in how many people, and in which people will disease occur.
Exposure	Coming into contact with a chemical substance. (For the three ways people can come in contact with substances, see **Route of Exposure**.)
Exposure Assessment	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.
Exposure Pathway	A description of the way that a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical. ATSDR defines an exposure pathway as having 5 parts: 1. Source of Contamination, 2. Environmental Media and Transport Mechanism, 3. Point of Exposure, 4. Route of Exposure, and

	5. Receptor Population.
	When all 5 parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. Each of these 5 terms is defined in this Glossary.
Frequency	How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.
Hazardous Waste	Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.
Health Effect	ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).
Indeterminate Public Health Hazard	The category is used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.
Ingestion	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (see **Route of Exposure**).
Inhalation	Breathing. It is a way a chemical can enter your body (see **Route of Exposure**).
LOAEL	Lowest **O**bserved **A**dverse **E**ffect **L**evel. The lowest dose of a chemical in a study, or group of studies, that has caused harmful health effects in people or animals.
Malignancy	See **Cancer**.
MRL	Minimal **R**isk **L**evel. An estimate of daily human exposure – by a specified route and length of time -- to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.
NPL	The **N**ational **P**riorities **L**ist. (Which is part of **Superfund**.) A list kept by the U.S. Environmental Protection Agency (EPA) of the most serious uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or is being looked at to see if people can be exposed to chemicals from the site.
NOAEL	No **O**bserved **A**dverse **E**ffect **L**evel. The highest dose of a chemical in a

	study, or group of studies, that did not cause harmful health effects in people or animals.
No Apparent Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals may have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.
No Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.
PHA	Public **H**ealth **A**ssessment. A report or document that looks at chemicals at a hazardous waste site and tells if people could be harmed from coming into contact with those chemicals. The PHA also tells if possible further public health actions are needed.
Plume	A line or column of air or water containing chemicals moving from the source to areas further away. A plume can be a column or clouds of smoke from a chimney or contaminated underground water sources or contaminated surface water (such as lakes, ponds and streams).
Point of Exposure	The place where someone can come into contact with a contaminated environmental medium (air, water, food or soil). Some examples include: the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
Population	A group of people living in a certain area; or the number of people in a certain area.
PRP	**P**otentially **R**esponsible **P**arty. A company, government or person that is responsible for causing the pollution at a hazardous waste site. PRP's are expected to help pay for the clean up of a site.
Public Health Assessment(s)	See **PHA**.
Public Health Hazard	The category is used in PHAs for sites that have certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.
Public Health Hazard Criteria	PHA categories given to a site which tell whether people could be harmed by conditions present at the site. Each are defined in the

Glossary. The categories are:
– Urgent Public Health Hazard
– Public Health Hazard
– Indeterminate Public Health Hazard
– No Apparent Public Health Hazard
– No Public Health Hazard

Receptor Population People who live or work in the path of one or more chemicals, and who could come into contact with them (See **Exposure Pathway**).

Reference Dose (RfD) An estimate, with safety factors (see **safety factor**) built in, of the daily, life-time exposure of human populations to a possible hazard that is <u>not</u> likely to cause harm to the person.

Relative Bioavailability The amount of a compound that can be absorbed from a particular medium (such as soil) compared to the amount absorbed from a reference material (such as water). Expressed in percentage form.

Route of Exposure The way a chemical can get into a person's body. There are three exposure routes:
– breathing (also called inhalation),
– eating or drinking (also called ingestion), and
– getting something on the skin (also called dermal contact).

Safety Factor Also called **Uncertainty Factor**. When scientists don't have enough information to decide if an exposure will cause harm to people, they use "safety factors" and formulas in place of the information that is not known. These factors and formulas can help determine the amount of a chemical that is <u>not</u> likely to cause harm to people.

SARA The **S**uperfund **A**mendments and **R**eauthorization **A**ct in 1986 amended CERCLA (see **CERCLA**) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects resulting from chemical exposures at hazardous waste sites.

Sample Size The number of people that are needed for a health study.

Sample A small number of people chosen from a larger population (see **Population**).

Source (of Contamination) The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.

Special Populations People who may be more sensitive to chemical exposures because of certain factors such as age, a disease they already have, occupation, sex, or certain behaviors (like cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Statistics A branch of the math process of collecting, looking at, and summarizing data or information.

Superfund Site See **NPL**.

Survey A way to collect information or data from a group of people (**population**). Surveys can be done by phone, mail, or in person. ATSDR cannot do surveys of more than nine people without approval from the U.S. Department of Health and Human Services.

Synergistic Effect A health effect from an exposure to more than one chemical, where one of the chemicals worsens the effect of another chemical. The combined effect of the chemicals acting together are greater than the effects of the chemicals acting by themselves.

Toxic Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.

Toxicology The study of the harmful effects of chemicals on humans or animals.

Tumor Abnormal growth of tissue or cells that have formed a lump or mass.

Uncertainty Factor See **Safety Factor**.

Urgent Public Health Hazard This category is used in ATSDR's Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.