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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 500
DENVER, CO 80202-2466

MAY 23 2000

Ref: 8EPR-ER

ACTION MEMORANDUM

SUBJECT: Request for a Time Critical Removal Action Approval and Exemption from the 12-month, $2-million Statutory Limit at the Libby Asbestos Site-Export Plant & Screening Plant former Processing Areas, Libby, Lincoln County, Montana.

FROM: Paul Peronard, On-Scene Coordinator
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THROUGH: Steve D. Hawthorn, Supervisor
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TO: Max H. Dodson, Assistant Regional Administrator
Office of Ecosystems Protection & Remediation

Site ID#: BC

Category of Removal: Time Critical

I. PURPOSE

The purpose of this ACTION MEMORANDUM is to request and document approval of the Removal Action described herein for two portions of the **Libby Asbestos Site (Site), the Export Plant and the Screening Plant** located in Libby, Lincoln County, Montana. In addition, this document shall serve as the request and documentation of approval of an exemption from the $2 million and 12-month statutory limits.

This Removal Action addresses the need to mitigate the threats to the local population and the environment posed by fibrous form amphibole asbestos into the environment during the extraction and processing of vermiculite ore. High concentrations of asbestos posing a health threat have been detected at two former vermiculite processing plants located in Libby: the Screening Plant and the Export Plant.

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The proposed Removal Action will address immediate threats identified during EPA's first round of sampling in Libby which occurred from December 1999 through April 2000. EPA plans to conduct further evaluation of the results from sampling of 121 homes, as well as six Libby school buildings, other potential source areas, and various other businesses in Libby. This subsequent sampling, analysis and evaluation may identify additional time critical threats at the Site.

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

Vermiculite was discovered just outside Libby, Montana, in 1881 by gold miners. In the early 1920's initial mining operations were begun by Mr. Edward Alley on the vermiculite ore body located approximately 7 miles northeast of Libby (Figure 1). Full scale operations began later that decade under the name of the Universal Zonolite Insulation Company (Zonolite). This ore body also contained amphibole asbestos fibers of the tremolite-actinolite-richterite-winchite solid solution series (herein referred to as amphibole asbestos) (Bureau of Mines Monograph, 1928). Unlike, the commercially exploited chrysotile asbestos, the tremolite-actinolite material has never been used commercially on a wide scale, and for most of the mine's operating life was considered a contaminant. The commercially exploited vermiculite was used in a variety of insulation products and construction materials, as a carrier for fertilizer and other agricultural chemicals, and as a soil conditioner.

Operations at the mine were fairly simple. The ore was strip mined using conventional equipment and then processed in an on-site dry mill to remove waste rock and overburden. Once beneficiated, the processed ore was trucked down Rainey Creek Road to a screening plant, which separated the milled ore into five size ranges for use in various products. From there, the material was shipped across the country, predominantly by rail, for either direct inclusion in products, or for expansion (also known as exfoliation) prior to use in products. Expansion was accomplished by heating the ore, usually in a dry kiln, to approximately 2000 °F, which boiled the water trapped in the crystalline matrix of the vermiculite, thus expanding the material by a factor of 10 to 15 fold.

In Libby, operations handling this material occurred at four main locations: the Mine and Mill located on Rainey Creek Road on top of Zonolite Mountain; the Screening Plant and Railroad Loading Station located astride the Kootenai River at the intersection of Rainy Creek Road and Highway 37 (the Screening Plant); the Expansion/Export Plant (the Export Plant) located off Highway 37 where it crosses the Kootenai River; and an Expansion Plant located at the end of Lincoln Road, near 5th Street (Figure 2). The Lincoln Road Expansion Plant apparently went off line sometime in the 1950's, and has

since been demolished. Investigations are underway to determine the exact location of this facility.

In 1963, the W.R. Grace Company (Grace) purchased Zonolite and continued operations in a similar fashion. A wet milling process was added to the operation in 1975, which operated in tandem with the dry mill, until the dry mill was taken off line in 1985. Expansion operations at the Export Plant ceased in Libby sometime prior to 1981, although this area was still used to bag and export milled ore until mining operations were stopped in 1990. Before the mine closed in 1990, Libby produced about 80% of the world's supply of vermiculite.

1. Physical location

The Site is located in Montana, within Sections 3 and 10, T.30N.,R.31W. of the Libby Quadrangle, in the county of Lincoln. (See Figure 1). The Export Plant occupies approximately 11 acres of property which is now owned by the City of Libby, and leased to a retail lumberyard (Figure 2). Some amphibole asbestos contamination has been found on adjacent parcels of land which had been used as youth baseball fields, but are now unused. During operations the screened ore was trucked from the Screening Plant to the Export Plant, and staged with various other vermiculite related materials between the ballfields and the Export Plant, and in a few other outlying areas. All of these areas are considered part of the Export Plant for purposes of this Action Memo.

Currently, the Export Plant is used as a retail lumber mill. Its main features are five buildings used to house finished and rough lumber, and other construction related materials. These buildings also contain various milling equipment, tools, and a retail center. The buildings are all of basic wood construction. The Export Plant has paved access to Highway 37, and part of the property is now being used as a laydown area in support of improvements to the Highway 37 Bridge across the Kootenai River.

The Screening Plant occupies approximately 21 acres of property which is now used for combined commercial/residential use. It is likely that amphibole asbestos contamination has spread to the parcels of land (zoned residential) to the west and south of the Screening Plant proper. During operations the screened ore was moved by conveyor belt across the Kootenai River to a rail loading operation adjacent to a Burlington-Northern Rail Line. Amphibole asbestos contamination has also been found in this area. All of these areas are considered part of the Screening Plant for purposes of this Action Memo.

Currently, the Screening Plant is used as a wholesale nursery; a covered storage facility for recreational vehicles, motor boats, and other equipment; and a farm for medicinal mushrooms. It is also the location of the primary residence for the current property owners and is frequently visited by relatives, including their children and young grandchildren. Its main features are the residence (former lab/office building); an approximately one acre, 40' high storage building; several green houses; a series of concrete tunnels that house the mushroom farm, and are also used for storage; several smaller storage units; a tree orchard; and a planting operation.

2. Removal Site evaluation

In response to local concerns and news articles, an Environmental Protection Agency (EPA) Response Team, conducted an initial site visit on November 23, 1999. The initial investigation consisted of the following: a brief inspection of the former mine and processing facilities; interviews with local officials and some members of impacted families; an interview with a pulmonologist in Spokane, Washington who specializes in the treatment of asbestos related diseases; and the collection of a small set of environmental samples.

This investigation revealed two important findings. First, there are a large number of current and historic cases of asbestos related diseases centered around Libby, Montana. The pulmonologist in Spokane alone was currently treating over 200 cases of asbestos related diseases among people who had either lived in Libby or worked at the mine, and had provided care to dozens more who had already died. Out of this physician's cases were 33 incidents of apparently non-occupational exposures. Of these 33, six had no family or other ties to anyone working at the mine. While anecdotal in nature, these findings suggest definitive health effects from the amphibole asbestos found at Libby.

The second finding was the likelihood that significant amounts of asbestos contaminated vermiculite still remained in and around Libby. It is clear that high concentrations of amphibole asbestos remain in the tailings pile and tailings pond at the former mine itself. In addition, visible piles of unexpanded vermiculite remained at the Screening Plant, and the base material of Rainey Creek Road appeared to contain tailings and sands from the mine. Historic sampling by Grace and the EPA have documented that the beneficiated, but unexpanded ore from the Libby mine contained asbestos concentrations ranging from reported trace to 7% fibrous amphibole asbestos by weight (MRI,1982 and Grace Data -- Grace data has been reviewed by EPA, but documentation has not yet been provided by Grace to put into the administrative record). Residents described how piles of expanded and

unexpanded vermiculite used to sit at the Export Plant, next to two former youth baseball fields (Figure 2). Children were described as having regularly played in and around these piles. Both expanded and unexpanded vermiculite from waste piles around the mining operations were commonly used by local residents in their yards and gardens as a soil conditioner (Community Interview Summary, ISSI, 2000), and the expanded vermiculite was used as wall and attic insulation in many homes. Descriptions of historic operations of the mine, mill, and processing centers indicated that large amounts of dust and other fugitive emissions were released into the environment when these operations were still running.

These findings led EPA to initiate a larger scale rapid investigation with the following distinct goals:

i. Obtain information on airborne asbestos levels in Libby (a limited number of homes, businesses and the Export Plant and Screening Plant) in order to judge whether time-critical intervention is needed to protect public health.
ii. Obtain data on asbestos levels in potential source materials (at the Export Plant and Screening Plant), and identify the most appropriate analytical methods to screen and quantify asbestos in source material.

In December 1999, the Agency collected samples of air and dust from inside 32 homes and 2 businesses around Libby, and collected samples from yards, gardens, insulation, and driveways at these same locations. In addition, air, dust and soil samples were collected from the Screening Plant and Export Plant. Samples were also collected from along Rainy Creek Road. This was followed by the sampling at an additional 89 residences, area schools and other potential source areas around Libby in March and April 2000. To date, over 2000 samples have been collected. Seasonal sampling of ambient air around Libby and the former mine also began this past January, and will continue monthly, at least through next Fall.

Environmental data collected in Libby since November 23, 1999 clearly indicated the presence of complete pathways of exposure between residents and hazardous types of asbestos fiber. Asbestos is of potential concern because chronic inhalation exposure to excessive levels of asbestos fibers suspended in air can result in lung disease such as asbestosis, mesothelioma, and lung cancer. Subacute exposures as short as a few days have been shown to cause mesothelioma. Exposures via ingestion and dermal contact are considered to be of lesser concern. Therefore, as its first priority, EPA analyzed the air samples collected during the December, 1999 sampling effort. Characteristics of airborne amphibole asbestos were found to be in the *range of concern - i.e., fibers greater than 5 microns in length and having an aspect ratio of greater than 5 to 1* inside 4 of the 32 homes (3 with amphibole

fibers, one with chrysotile fibers). These fibers were also detected inside buildings (including several open air buildings) at the Export Plant and Screening Plant. Shorter amphibole asbestos fibers, i.e. less than 5 microns in length, were detected in roughly 30% of the indoor air and dust samples collected during this round. High concentrations, ranging up to 10% by weight, were also detected in soils from these two processing facilities. At the Screening Plant dust measurements showed numerous amphibole asbestos fibers greater than 5 microns in length and having an aspect ratio of greater than 5 to 1 (see Attachment 1 - Summary of Asbestos Measurements, and Figure 3 and Figure 4 - Asbestos Levels in Soils by PLM).

The samples from the remainder of the 34 homes/locations do not initially indicate an immediate concern, but the finding of the shorter amphibole asbestos fibers in air samples, as well as the indication that there is some asbestos content in yards and gardens around Libby is somewhat troubling. This information provides evidence of widespread fiber distribution in Libby and the possibility of complete exposure pathways for residents. Further analyses, with more refined analytical techniques are necessary to evaluate these issues, and are underway. Additionally, more sampling and analysis is necessary in the additional 89 homes tested in March and April, and of ambient air around Libby and the mine area of the Site. EPA will also investigate all potential source areas identified by local residents and through research.

3. Site characteristics

The population of Libby and surrounding communities located within a four-mile radius is estimated at 13,800. The principal industries in the area consist of lumber production, mining, and summer tourism. The topography is mountainous with pronounced river valleys. Libby and the surrounding area are subject to significant weather inversions.

The economy of Libby is somewhat depressed and the community has a high unemployment rate. Many of the homes tested by EPA are in need of repair, with obvious gaps in drywall where vermiculite insulation can enter the living space. Lawns are typically not sodded and exposed, unvegetated areas are common.

4. Release or threatened release into the environment of a hazardous substance, or pollutant or contaminant

Asbestos is a hazardous substance as defined by 40 CFR Section 302.4 of the NCP. During operation of the mine and related processing facilities, residents reported that large amounts of dust and fugitive emissions were released into the environment. The solid-solution series of tremolite-actinolite-richterite- winchite (referred to as

amphibole asbestos in this Action Memo) are present in the fibrous habit throughout the areas of concern for this Action Memo. Residents describe having to halt baseball games as large dust clouds swept through the ballfield area from the piles of vermiculite at the Export Plant. Data collected by W.R. Grace in 1975 shows levels of airborne asbestos in downtown Libby of 1.5 fibers/cubic centimeter (cc), over 10 times the current NIOSH, OSHA and ACGIH occupational limits of 0.1 fibers/cc (Eshenbach Deposition, Exhibit 182.126). Data collected by a contractor to EPA in the1980's measured airborne asbestos levels at 0.5 fibers/cubic centimeter (cc), five times higher than today's occupational limits, 4.5 miles from the mine site (MRI, 1982). The contaminated dust and soil created by these fugitive emissions likely remains in the environment and can be re-entrained leading to inhalation exposures. There is extensive literature indicating that at various times workers at the mine site, mill and processing facilities were exposed to high levels of asbestos from fugitive dust emissions (Amandus, 1987; MacDonald,1986). Other environmental releases of asbestos occurred from workers bringing home dust covered clothing and personal vehicles. It is known that asbestos fibers accumulate in indoor environments, and re-entrainment of indoor fibers can multiply indoor ambient air levels 50-fold (Sabastien, 1979).

Recent sampling conducted by EPA's removal program in December 1999 through April 2000 detected amphibole asbestos fibers at concentrations of concern in indoor air samples collected at the Screening Plant and at the Export Plant. These sample results indicate an on-going risk to workers and residents at and near these locations. The Screening Plant is now a primary residence and nursery business with two main occupants. In addition the residents have regular visits from their children and grandchildren, who all have been observed working and playing in the asbestos contaminated vermiculite. In addition to the current nursery workforce (6 to 20 workers, depending on the season), the Screening Plant has regular visits by people storing recreational vehicles on the property, or who have business with the nursery. The Export Plant is owned by the City of Libby but is leased by a lumber yard employing several individuals. The Export Plant is located adjacent to a large open field that was formerly used as two baseball fields. Access to the area is unrestricted during non-business hours.

Air samples were collected inside each of the main buildings at the Export Plant and Screening Plant. The samples were analyzed using transmission electron microscopy (TEM) which allows fibers to be distinguished both by type and by size. The concentrations of amphibole asbestos fibers greater than 5 microns and with an aspect ratio greater than 5:1 detected at each of these facilities are reported in the Attachment 1.

In addition to significant air concentrations, soils at the Screening Plant and the Export Plant contained high levels of amphibole asbestos which can act as a

continuing source of exposure to individuals working and living at the properties. At the Screening Plant, amphibole asbestos was detected using polarized light microscopy (PLM) in 84 of 102 samples collected, with 18 samples containing asbestos at or above 2% by weight and one sample as high as 4% asbestos. Also at the Screening Plant, rocks containing high concentrations of fibrous form amphibole asbestos have been uncovered. These rocks come from the mine area of the Site, and apparently have been used as backfill in a few locations at the Screening Plant. These very friable materials are reported to be a favorite throwing stone among the grandchildren.

Similarly, at the Export Plant, 76 out of 109 samples contained detectable levels of amphibole asbestos by PLM, with 17 samples containing asbestos at or greater than 2%, and one sample measuring 10%. At both properties, pockets of unexpanded and expanded vermiculite are visible at the surface in many locations.

It should be noted that all the laboratories used to do this analysis reported some difficulty in reading the samples due to the matrix and the long thin nature of the amphibole asbestos. All labs indicated that they were likely under reporting asbestos concentrations. Because of this the Region is currently developing a Scanning Electron Microscope (SEM) analysis which should overcome these reported difficulties, and more accurately report asbestos concentrations. Preliminary results of the SEM investigation indicate the widespread presence of amphibole asbestos fibers in all samples observed, including those that were reported as non-detect by PLM. Additional dust samples collected from window sills in the main residence and from several areas in the Long Shed at the Screening Plant, show abundant long, thin amphibole asbestos fibers when analyzed by SEM. Visible dust accumulations are prevalent in all of the buildings at the Screening Plant and the Export Plant.

5. NPL status

The Site is currently not on the National Priorities List (NPL). EPA has not yet made a decision regarding NPL listing for the Site.

B. Other Actions to Date

1. Previous actions

There have been no previous Removal Actions at this Site. EPA Region 8's air program was previously involved in an asbestos NESHAPS violation case, but no previous CERCLA activities have been performed.

2. Current actions

Besides the sampling and activities which have already been described, a *Community Advisory Group* (CAG) has been formed. This group contains representatives from many diverse interests in Libby. The CAG will provide a forum for community residents to review documents, hear and make presentations, express concerns, and make recommendations. EPA, the Agency for Toxic Substances and Disease Registry (ATSDR), and the Montana Department of Environmental Quality (MDEQ) will provide technical and administrative support to the CAG.

EPA is also developing a *Community Involvement Plan* (CIP) to help guide the interaction and involvement of the citizens and officials of Libby. A voluntary medical testing and exposure assessment involving radiological testing and pulmonary function tests are being planned for the immediate future in coordination with ATSDR and the Montana Department of Public Health and Human Services.

C. State and Local Authorities' Roles

EPA became involved at the Site in response to requests from the State of Montana, Lincoln County Health Board (meeting of 11/23/99), and City officials of Libby, who asked that EPA address questions and concerns by citizens regarding possible ongoing exposure to asbestos fibers as a result of historical mining, processing, and exportation of asbestos-containing vermiculite. Both State and local agencies are very involved in providing input into the goals, objectives and implementation of the site investigations. MDEQ has assigned a project manager who is fully engaged in the design and implementation of the investigations and the actions proposed herein. However, neither the State nor local agencies have the needed resources to conduct the needed site investigations or clean-ups independently.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

A. Threats to Public Health or Welfare

The threat of exposure to workers and residents exists through inhalation of amphibole asbestos at the two former vermiculite processing facilities, the Screening Plant and the Export Plant. The conditions at the Site present an imminent and substantial threat to human health and the environment and meet the criteria for initiating a Removal Action under Section 300.415(b)(2) of the NCP. The following factors from §300.415(b)(2) of the NCP form the basis for EPA's determination of the threat presented, and the appropriate action to be taken:

(i) *Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances;* The large concentrations of asbestos found at the Screening Plant and Export Plant in all media: soil, dust, and airborne, clearly indicate that the human exposure pathway is complete. In evaluating the threat posed by this exposure there are several factors to consider. The first is a historic review of the effects that have been documented by exposures to similar conditions. The second is construction of an appropriate conceptual risk model to quantitatively estimate current risks.

From a historical perspective, it is clear that exposure to Libby vermiculite ore mining and processing operations has resulted in asbestos related disease and death. Studies by NIOSH researchers at expanding plants (Lockey, 1984) and at the Libby mine (Amandus et. al., 1987), as well as by Grace sponsored investigations (MacDonald, 1987) clearly show the deleterious health effects to people who were exposed to fibers from this ore. In addition, the Public Health Service (PHS) and ATSDR are in the beginning stages of the development of a full case series/epidemiological evaluation of facilities that processed Libby vermiculite ore, both in Libby, and around the country. So far, they have discovered documented medical cases that appear to have as the primary source of exposure contact with unexpanded vermiculite in non-occupational settings. The concentrations of amphibole asbestos found at the Screening Plant and the Export Plant are very similar to those that have been reported in unexpanded vermiculite historically.

It is also evident that direct contact with this material would tend to generate significant airborne fiber concentrations. Grace data from various job categories associated with handling and moving the vermiculite ore range up to over 120 fibers/cc (Amandus et. al, 1987). EPA also saw evidence of bulk materials generating airborne fibers in results of aggressive sampling conducted at two homes in Libby in December, 1999. Given the number of reported (over 575) and documented (over 200) cases of asbestos related disease and death associated with handling the ore from the Libby mine it is reasonable to conclude that this known and completed exposure pathway is an imminent and substantial threat to public health and welfare. In support of this conclusion the OSC sought and received concurrent opinions from the EPA Regional Toxicologist, the PHS, and ATSDR (see Attachment 2).

With respect to a quantitative estimate of risk posed by measured airborne concentrations at the Export Plant and Screening Plant, EPA's Regional Toxicologist detailed his findings in Attachment 2.

Both the Export Plant and Screening Plant are no longer used for processing of vermiculite, but are occupied by residents and/or workers who are currently being exposed to these airborne levels or higher. It is worth noting that at both locations

normal work activities were curtailed in order to accommodate the EPA's sampling activities, and that the sampling was conducted on fairly wet, winter days which would tend to suppress airborne fiber concentrations leading to conservative results. The Screening Plant is now a primary residence for two individuals, plus receives frequent visits from family members, and its on-going nursery business employs several full-time workers when in operation. The Export Plant is owned by the City of Libby, but is leased by a commercial lumber yard. It employs several individuals and receives a fair amount of retail traffic. The Export Plant is located adjacent to a large open field that was formerly used for two baseball fields. Access to the area is unrestricted during non-business hours.

(iii) *Hazardous substances or pollutants or contaminants in drums, barrels, tanks, or other bulk storage containers that may pose a threat of release;* At the Export Plant there is bulk storage of vermiculite in small piles inside and outside of various buildings on the property. In addition, there appears to be a large pit containing asbestos contaminated vermiculite adjacent to the main retail building on the property. The owners and their employees come into frequent contact with these storage piles.

At the Screening Plant there are over 3000 three gallon buckets of unexpanded Libby vermiculite that are being used as part of the mushroom farm. In addition there is bulk storage of vermiculite in piles inside and outside of various buildings on the property. There are approximately 2 tons of unexpanded vermiculite and expanded vermiculite stacked in deteriorating bags at the property. At the Screening Plant the owners and/or their family members or employees come into near daily contact with these materials and the amphibole asbestos they contain.

(iv) *High levels of hazardous substances in soils largely at or near the surface, that may migrate;* Vermiculite (expanded and unexpanded) is visible at the surface at both the Screening Plant and Export Plant. Surface soils at both the Screening Plant and Export Plant contain high measured asbestos levels scattered widely over the surface of the properties. There are several pathways by which these asbestos fibers can become entrained in air leading to inhalation exposures, both on and off the Screening Plant or Export Plant properties. Contaminated soils can easily be tracked into buildings or off the Plant properties by truck, automobile, equipment, and/or pedestrian traffic; and then through normal activities, such as vacuuming or other air disturbance, become respirable dust. Wind, particularly in dry summer months, can lead to the migration of fine asbestos fibers from contaminated soils. Rainfall and snow melt would also tend to wash the fibers off of the Export and Screening Plants onto neighboring parcels, or into the Kootenai River. In addition, there is documentation that in the past, area residents would remove in bulk expanded and unexpanded vermiculite that had been abandoned by Grace at the two processing centers. This has resulted in the contamination of yards, driveways, and gardens with amphibole asbestos in the Libby area. Since there still remain piles,

pits, and other containers of unexpanded vermiculite at both the Screening Plant and the Export Plant this is still a potential pathway for exposure.

Currently EPA has not established, under any of its regulatory programs, an asbestos level in soil below which an exposure does not pose a risk. The 1% cut-off level for regulation under the Toxic Substances Control Act abatement program was established on the basis of analytical capability at the time, and was not established based on the level of risk represented. To the contrary, at Superfund sites in California EPA Region IX found in certain settings that concentrations of asbestos less than 1% posed unacceptable inhalation risks when subject to disturbance by traffic (EPA, 1994)

(v) *Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released*; The hotter temperatures and dry weather typical in the summer months in Libby will contribute to the migration of asbestos containing soils. As soils dry out they are more likely to be transported by wind, causing the asbestos to become airborne and available for inhalation. In the spring time snow melt, rainfall, or other forms of run-off inducing events will tend to spread the contamination further. In addition, because of the mountain/river bottom topography of the area, Libby is subject to severe and persistent inversion patterns, so entrained airborne contaminants remain in the area for longer periods of time.

(vii) *The (lack of) availability of other appropriate federal or state mechanisms to respond to the release*; No other Local, State, or Federal agency is in the position or has the resources to independently implement an effective response action to address the on-going threats presented at the site. EPA will conduct its actions in concert with State and Local authorities.

B. Threats to the Environment

The Site investigation has not proceeded far enough to know if the asbestos contamination is a threat to animals, water, and other parts of the environment. Asbestos is primarily a threat to human health. Nonetheless, the Agency has been requested to evaluate the potential effects that the mine and processing facilities have, or have had on environmental receptors in the area. It is suspected that the actions described herein for the Screening Plant and for the Export Plant, will address any potential environmental threats at these two facilities.

IV. ENDANGERMENT DETERMINATION

Asbestos is a generic term for a group of six naturally-occurring fibrous silicate minerals. The predominant fibrous habit of minerals found at the Libby Site are of the tremolite-actinolite solid solution series (referred to in this Action Memo as amphibole asbestos). Asbestos can cause asbestosis and is a recognized human carcinogen, causing lung cancer and mesothelioma, a lethal

neoplasm of the lining of the chest and abdominal cavities. All of these asbestos related diseases have been found, to an unprecedented extent among former mine workers, their families, and to nearby residents with no known occupational or familial connection to the vermiculite mining and processing operations in Libby. Cancer of the larynx and esophageal lining has also been associated with exposure to asbestos. Commercial forms of asbestos have been found to be carcinogenic in experimental animals.

Actual or threatened releases of asbestos from this Site, if not addressed by implementing the response action selected in this Action Memorandum, present an imminent and substantial endangerment to public health, welfare, and the environment.

V. EXEMPTION FROM STATUTORY LIMITS

A. Emergency Exemption:

Site conditions meet the criteria set forth in CERCLA §104(c)(1)(A) [40 CFR 300.415 (b)(5)(i) of the NCP]. It should be noted that this exemption is being requested for response actions proposed at both the Screening Plant and the Export Plant as additive removal actions at the Libby Asbestos Site. Removal Action expenditures will be tracked cumulatively against a single, total Site ceiling. Any subsequent actions deemed necessary as of the result of the on-going investigations in Libby will be documented in additional Action Memorandum(s), and will be considered covered by this exemption request, and tracked in a likewise, cumulative fashion.

1. There is an immediate threat to the local population posed by the amphibole asbestos released to the environment. If action is not taken at the Screening Plant and Export Plant, individuals living and working on these properties will continue to be exposed to hazardous mineral fibers. Non-enclosed buildings at both facilities contain significant amounts of dust containing asbestos fibers of the length and type of concern. This dust is easily disturbed leading to additional potential inhalation exposures. Surface soils at each property contain in excess of 2% asbestos by weight. These soils are subject to disturbance by wind, tracking through and off the property by human activities, and migration from potential new development and construction which can give rise to additional exposure to asbestos fibers. Subsequent inhalation of these fibers by workers, visitors and on-site residents could cause an immediate public health threat. Inhalation of asbestos fibers is known to cause three major respiratory diseases: asbestosis, lung cancer and mesothelioma. Asbestosis is a disease characterized by fibrotic scarring of the lung and is caused specifically by exposure to asbestos mineral fibers. Mesothelioma is a cancer of the chest cavity lining. Cases of asbestosis, mesothelioma, and other lung cancers have all been diagnosed by area physicians, and attributed to exposure to the Libby vermiculite processing operations and ore.

The exposure pathways at both the Export Plant and Screening Plant are known and complete. Given, the documented death and illnesses associated with similar exposure circumstances to the hazardous substances found in the Libby vermiculite, it is imperative that these actions be undertaken and completed in a timely manner.

2. Continued response actions are required to prevent, limit, or mitigate an emergency. If the request for a 12-month, $2 million statutory exemption is not granted, the Removal Action will not be able to proceed to completion. Total costs of both Removal Actions (combined Screening Plant and Export Plant costs) are anticipated to exceed $2 million due to the large size of the properties, the extensive amount of soil contamination, the need to temporarily relocate a residence at the Screening Plant and a business at the Export Plant, the difficulty in removing asbestos containing dust and fibers from buildings on each of the properties, the probable need to demolish some or all of the buildings, and extensive restoration needs. Given the short construction season in this mountainous part of northwest Montana (May-September), it is likely that some restoration activities (e.g, re-vegetation, building reconstruction) will carry over into the spring/summer of 2001. If the removal actions are not completed asbestos will continue to migrate from the two properties and residents and workers will continue to be exposed to airborne asbestos fibers.

3. Assistance from other government agencies is not anticipated on a timely basis for these Removal Actions. Neither the State nor the County has the response capabilities or resources to take any actions independently at the Site. No other mitigation actions are expected to occur to abate the threats described in this action memo. Consequently, the timely completion of this Removal Action can only be accomplished if this combined Removal Action and 12-month exemption and $2 million request is approved.

VI. PROPOSED ACTIONS AND ESTIMATED COSTS

A. Proposed Actions

1. Proposed action description

To mitigate the threat to the public health and welfare or the environment posed by the asbestos present on the Screening Plant and the Export Plant, the proposed removal actions are outlined below. A more detailed Scope of Work for these projects is being developed with the assistance of the Department of Transportation -Volpe Engineering Center (DOT-Volpe), in conjunction with MDEQ. The removal will involve the following:

a. Temporary relocation of on-site business at the Export Plant and on-site residence at the Screening Plant
b. Preparation of Site property (e.g.-power, access roads, etc.)
c. Demolition/cleaning of contaminated buildings and structures - buildings will be assessed on a case-by-case basis to determine if decontamination is technically feasible and cost effective. It is anticipated that many of the buildings can not be adequately or cost effectively decontaminated due to the extensive amount of asbestos dust which has infiltrated into porous surfaces.
d. Excavation of contaminated soil, debris, and vermiculite
e. Preparation of disposal location at the mine, or other appropriate disposal location
f. Transportation and disposal of waste
g. Property restoration

In accordance with Section 300.415(l), EPA will pursue appropriate arrangements for post-removal site controls at the disposal site to ensure the long-term integrity of the removal.

2. Contribution to remedial performance

EPA has not yet made a decision regarding NPL listing for the Site. The proposed removal actions should compliment and contribute to the overall success of any remedial actions in the future.

3. Description of alternative technologies

No alternative technologies were found to be appropriate given the nature of the asbestos contamination, the scope of the project, and its time critical nature. If in the course of these, or any subsequent removal actions at the Site, any alternative remediation technologies are identified that will enhance response actions, they will be considered as appropriate.

4. EE/CA

This is a Time-Critical Removal Action; thus, an EE/CA is not required.

5. Applicable or relevant and appropriate requirements

As this Action is being conducted as a Time Critical Removal Action, all Federal and State ARARs may not have been identified at this time. The ARARs identified to date are provided as Attachment 3. In accordance with the NCP, all ARARs for the Site will be attained to the extent practicable, given the scope of the project and the urgency of the situation as they are identified.

Many of the ARARS identified for these Removal Actions come from the Clean Air Act National Emission Standards for Hazardous Pollutants (NESHAPS) for asbestos. These regulations were designed specifically for renovation and demolition of buildings with asbestos containing material (ACM) such as floor tile, ceiling tile and pipe wrapping. The regulations were not designed for loose fill vermiculite insulation, piles of unexpanded vermiculite, contaminated soils or heavily contaminated dust. As such, it is anticipated that it may not be practicable to achieve all ARARS during these Removal Actions. Additional discussion is found in Attachment 3.

6. Project Schedule

Activity	Planned Start Date	Planned Completion Date
1. Site Mobilization	19 May 2000	15 June 2000
2. Relocation of on-site residents	19 May 2000	01 June 2000
3. Preparation of Site property	05 June 2000	19 June 2000
4. Demolition/cleaning of contaminated buildings and structures	19 June 2000	19 July 2000
5. Excavation of contaminated soil, debris, and vermiculite	30 June 2000	30 August 2000
6. Preparation of disposal location	15 June 2000	30 June 2000
7. Transportation and disposal of waste	19 June 2000	26 August 2000
8. Property restoration	15 August 2000	Spring/Summer 2001

B. Estimated Costs

The following cost estimates include costs associated with both removal actions for purposes of creating a total Site ceiling. It is anticipated that the Removal Action for the Export Plant will be done as a PRP lead. These costs are being estimated in the event that the project must be done as a fund lead action. The costs do not include any past or future investigation costs on the Site. These are being tracked separately as well. Costs are projected as follows:

EXTRAMURAL COSTS (Additional AOA)		Screening Plant	Export Plant
	A. DOT-Volpe Oversight and Engineering	$ 250,000	$ 100,000
	B. Site Mobilization	100,000	30,000
	C. Relocation of on-site residents/business	80,000	80,000
	D. Preparation of Site property	100,000	5,000
	E. Demolition/cleaning of contaminated buildings and structures	525,000	125,000
	F. Excavation of contaminated soil, debris, and vermiculite	525,000	200,000
	H. Preparation of disposal location at the mine	50,000	20,000
	I. Transportation and disposal of waste (assumes at mine site)	200,000	200,000
	J. Property restoration	1,000,000	300,000
	K. Analytical Support	275,000	275,000
Subtotal Extramural		**$3,105,000**	**$1,325,000**
	20% Contingency	620,000	265,000
Total Extramural		**$3,725,000**	**$1,590,000**
INTRAMURAL COSTS			
	Direct, Including Travel	$ 150,000	$ 100,000
	Indirect	150,000	100,000
Total Intramural		**$ 300,000**	**$ 200,000**
Total Removal Costs		**$4,025,000**	**$1,790,000**
TOTAL SITE CEILING			**$5,[illegible]00**

VII. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Delayed action will increase public health risks to the local population/environment posed by airborne asbestos fibers.

VIII. OUTSTANDING POLICY ISSUES

Asbestos removals have been completed in Region 8, and around the country at numerous removal sites which were initiated under Section 300.415 of the NCP and in compliance with NESHAPS regulation under 40 CFR Section 61.150. This removal does not set a precedent or constitute a nationally significant issue. However, the Site does raise a series of policy questions that have broad regional and national impact.

IX. ENFORCEMENT

EPA is reviewing the enforcement status of the Site (See Attachment 4).

X. RECOMMENDATION

This decision document represents the selected Removal Action for the Export Plant and Screening Plant which are a portion of the Libby Asbestos Site, located in Libby, Lincoln County, Montana, developed in accordance with CERCLA as amended, and not inconsistent with the NCP. This decision is based on the Administrative Record for the Site.

Conditions at the Site meet the NCP §300.415(b)(2) criteria for a Removal Action, and I recommend your approval. If the PRP conducts the action at the Export Plant then the EPA Site Ceiling will be the costs of the Screening Plant only, approximately $4,0250,000 budgeted with $3,725,000 budgeted out of the Regional Advice of Allowance (AOA). If EPA performs the work at the Export Plant, then the Site Ceiling will be $5,825,000 with $5,350,000 budgeted out of the Regional AOA (including contingency). The requested Site ceiling includes a cost of $1,800,000 for a fund lead action at the Export Plant, with $1,600,000 coming from the Regional AOA (including contingency).

Approve: Max H. Dodson Date: 5-23-00

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Disapprove:_____ Date:_____

Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection
and Remediation

Attachments:

Figure 1 -		Site Location Map
Figure 2 -		Screening Plant & Export Plant Location Map
Figure 3 -		Export Plant Asbestos Level in Soils by PLM
Figure 4 -		Screening Plant Asbestos Level in Soils by PLM
Attachment 1	-	Summary of Asbestos Measurements
Attachment 2	-	Toxicologist, PHS, and ATSDR Memos
Attachment 3	-	Applicable or Relevant & Appropriate Requirements
Attachment 4	-	Confidential Enforcement Summary

SUPPLEMENTAL DOCUMENTS

Support/reference documents which may be helpful to the reader and/or have been cited in the report may be found in the Administrative Record File at the Superfund Records Center for Region VIII EPA, 999 18th Street, Denver, Colorado 80202.

ATTACHMENT 1

SUMMARY OF ASBESTOS MEASUREMENTS FOR Screening Plant

Table 1: Indoor Air Sampling Results for Screening Plant

Sample Location	Fiber Length (microns)	Asbestos Concentration (Fibers per cubic centimeter)					
		Tremolite/Actinolite Series		Chrysotile		Other Amphiboles	
		Original	Recount	Original	Recount	Original	Recount
Covered Workshop	<5	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
	5 - 10	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
	>10	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00185	0.00062	Not Detected	Not Detected	Not Detected	Not Detected
Living Room	<5	0.00278	0.00123	Not Detected	Not Detected	0.00278	Not Detected
	5 - 10	0.00093	0.00062	Not Detected	0.00031	0.00093	Not Detected
	>10	Not Detected	0.00062	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00463	0.00250	Not Detected	0.00031	Not Detected	Not Detected
Office	<5	0.00185	0.00062	Not Detected	Not Detected	Not Detected	Not Detected
	5 - 10	0.00093	0.00093	Not Detected	Not Detected	Not Detected	Not Detected
	>10	Not Detected	0.00031	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00278	0.00093	Not Detected	Not Detected	Not Detected	Not Detected
Mushroom Tunnel	<5	Not Detected	Not Detected	0.00463	0.00154	Not Detected	Not Detected
	5 - 10	0.00093	0.00031	Not Detected	Not Detected	Not Detected	Not Detected
	>10	0.00093	0.00093	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00093	0.00031	0.00093	0.00031	Not Detected	Not Detected

SUMMARY OF ASBESTOS MEASUREMENTS FOR
Screening Plant

Table 2: Indoor Dust Sampling Results (Fiber Counts) for Screening Plant

Sample Location	Fiber Length (microns)	Number of Fibers Counted	
		Tremolite/Actinolite Series	Chrysotile
REINELL BOAT #MT949AJU	<5	50	1
	5 - 10	12	1
	>10	4	1
	Excluded <5	0	0
	Excluded 5 - 10	0	0
	Excluded >10	13	0
GREEN LINCOLN CONTINENTAL #56-5850B	<5	60	0
	5 - 10	25	0
	>10	8	0
	Excluded <5	0	0
	Excluded 5 - 10	0	0
	Excluded >10	7	0
SEAWIND SPEEDBOAT SW CORNER OF BUILDING	<5	23	1
	5 - 10	7	0
	>10	0	0
	Excluded <5	0	0
	Excluded 5 - 10	0	0
	Excluded >10	6	0
SMOKER CRAFT MAGNUM 162 - NE CORNER	<5	3	4
	5 - 10	5	0
	>10	1	0
	Excluded <5	0	0
	Excluded 5 - 10	0	0
	Excluded >10	1	0
PONTIAC SUNRISE #569558A	<5	40	1
	5 - 10	13	2
	>10	4	0
	Excluded <5	0	0
	Excluded 5 - 10	0	0
	Excluded >10	13	0

SUMMARY OF ASBESTOS MEASUREMENTS FOR Screening Plant

Table 3: Indoor Dust Sampling Results (Fibers/cm2) for Screening Plant

Sample Location	Fiber Length (microns)	Dust Loading (fibers/square centimeter)	
		Tremolite/Actinolite Series	Chrysotile
REINELL BOAT #MT949AJU	<5	42076.5	841.5
	5 - 10	10098.4	841.5
	>10	3366.1	841.5
	Excluded <5	Below Detection Limit	Below Detection Limit
	Excluded 5 - 10	Below Detection Limit	Below Detection Limit
	Excluded >10	10939.9	Below Detection Limit
GREEN LINCOLN CONTINENTAL #56-5850B	<5	11220.4	BDL
	5 - 10	4675.2	Below Detection Limit
	>10	1496.0	Below Detection Limit
	Excluded <5	Below Detection Limit	Below Detection Limit
	Excluded 5 - 10	Below Detection Limit	Below Detection Limit
	Excluded >10	1309	Below Detection Limit
SEAWIND SPEEDBOAT SW CORNER OF BUILDING	<5	19355.2	841.5
	5 - 10	5890.7	Below Detection Limit
	>10	Below Detection Limit	Below Detection Limit
	Excluded <5	Below Detection Limit	Below Detection Limit
	Excluded 5 - 10	Below Detection Limit	Below Detection Limit
	Excluded >10	5049.2	Below Detection Limit
SMOKER CRAFT MAGNUM 162 - NE CORNER	<5	504.9	673.2
	5 - 10	841.5	Below Detection Limit
	>10	168.3	Below Detection Limit
	Excluded <5	Below Detection Limit	Below Detection Limit
	Excluded 5 - 10	Below Detection Limit	Below Detection Limit
	Excluded >10	168.3	Below Detection Limit
PONTIAC SUNRISE #569558A	<5	33661.2	841.5
	5 - 10	10939.9	1683.1
	>10	3366.1	Below Detection Limit
	Excluded <5	Below Detection Limit	Below Detection Limit
	Excluded 5 - 10	Below Detection Limit	Below Detection Limit
	Excluded >10	10939.9	Below Detection Limit

Table 4: Soil and Bulk Insulation Sampling Results for the Screening Plant Analyzed by Polarized Light Microscopy

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil/bedding	Dec. 1999	Soil	1%	Not Detected
fill/bedding	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
fill/topsoil	Dec. 1999	Soil	1%	Not Detected
fill/topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
sediment	Dec. 1999	Soil	Not Detected	Not Detected
fill	Dec. 1999	Soil	2%	Not Detected
vermiculite pile; height of pile 8'; likely all vermiculite	Dec. 1999	Soil	2%	Not Detected
1" frozen; vermiculite pile	Dec. 1999	Soil	1%	Not Detected
1" frozen; vermiculite over surface; asphalt at 3"	Dec. 1999	Soil	Trace (< 1%)	Not Detected
vermiculite piles; depth of piles 6-12"	Dec. 1999	Soil	2%	Not Detected
vermiculite spread on slab; depth >6"	Dec. 1999	Soil	4%	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
vermiculite spread on road; asphalt at 3" to 6"	Dec. 1999	Soil	2%	Not Detected
vermiculite pile >18" deep	Dec. 1999	Soil	2%	Not Detected
vermiculite pile	Dec. 1999	Soil	Trace (< 1%)	Not Detected
pile of vermiculite >24" deep	Dec. 1999	Soil	Trace (< 1%)	Not Detected
mixed vermiculite and soil to 24"	Dec. 1999	Soil	1%	Not Detected
pile of mixed vermiculite and soil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
fill	Dec. 1999	Soil	2%	Not Detected
fill	Dec. 1999	Soil	1%	Not Detected
bedding soil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	1%	Not Detected
bedding soil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
bedding soil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	2%	Not Detected
topsoil	Dec. 1999	Soil	2%	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
fill	Dec. 1999	Soil	1%	Not Detected
fill	Dec. 1999	Soil	Trace (< 1%)	Not Detected
soil and vermiculite mix	Dec. 1999	Soil	2%	Not Detected
fill	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	2%	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
subsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
fill	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
fill	Dec. 1999	Soil	1%	Not Detected
fill	Dec. 1999	Soil	Trace (< 1%)	Not Detected
fill	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	1%	Not Detected
topsoil	Dec. 1999	Soil	1%	Not Detected
fill	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	2%	Not Detected
bedding soil	Dec. 1999	Soil	Not Detected	Not Detected
bedding soil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
bedding soil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	2%	Not Detected
fill	Dec. 1999	Soil	3%	Not Detected
fill	Dec. 1999	Soil	1%	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
bedding	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
topsoil	Dec. 1999	Soil	Trace (< 1%)	Not Detected
topsoil	Dec. 1999	Soil	1%	Not Detected
topsoil	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	1%	Not Detected
2-12 inches depth	Mar. 2000	Soil	1%	Not Detected
0-2 inches depth	Mar. 2000	Soil	2%	Not Detected
2-12 inches depth	Mar. 2000	Soil	2%	Not Detected
0-2 inches depth	Mar. 2000	Soil	2%	Not Detected
2-12 inches depth	Mar. 2000	Soil	3%	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-1 inch depth	Mar. 2000	Soil	1%	Not Detected
0-1 inch depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	3%	Not Detected
0-2 inches depth	Mar. 2000	Soil	2%	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	3%	Not Detected
0-2 inches depth	Mar. 2000	Soil	3%	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	4%	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	3%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-12 inches depth	Mar. 2000	Soil	8%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-24 inches depth	Mar. 2000	Soil	1%	Not Detected
0-24 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-24 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
26-30 inches depth	Mar. 2000	Soil	2%	Not Detected
18-32 inches depth	Mar. 2000	Soil	2%	Not Detected

SUMMARY OF ASBESTOS MEASUREMENTS FOR Export Area

Table 1: Indoor Air Sampling Results for Export Area

Sample Location	Fiber Length (microns)	Asbestos Concentration (Fibers per cubic centimeter)			
		Tremolite/Actinolite Series		Chrysotile	
		Original	Recount	Original	Recount
Main Open Warehouse	<5	Not Detected	0.00028	Not Detected	Not Detected
	5 - 10	Not Detected	Not Detected	Not Detected	Not Detected
	>10	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00085	Not Detected	Not Detected	Not Detected
Main Open Warehouse (Planer Bldg.)	<5	0.00340	0.00113	Not Detected	Not Detected
	5 - 10	Not Detected	0.00028	Not Detected	Not Detected
	>10	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00255	0.00085	Not Detected	Not Detected
Main Open Warehouse (Spencer Bldg.)	<5	Not Detected	Not Detected	Not Detected	Not Detected
	5 - 10	Not Detected	Not Detected	Not Detected	Not Detected
	>10	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00089	0.00030	Not Detected	Not Detected
Garage	<5	0.00085	0.00028	Not Detected	Not Detected
	5 - 10	Not Detected	Not Detected	Not Detected	Not Detected
	>10	Not Detected	Not Detected	Not Detected	Not Detected
	Other	0.00085	0.00028	Not Detected	Not Detected
Woodshed	<5	0.00085	0.00028	Not Detected	Not Detected
	5 - 10	0.00085	0.00028	Not Detected	Not Detected
	>10	0.00085	0.00028	Not Detected	Not Detected
	Other	0.00255	0.00085	Not Detected	Not Detected

Table 2: Soil and Bulk Insulation Sampling Results for the Export Area Analyzed by Polarized Light Microscopy

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	2%	Not Detected
2-12 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
0-2 inches depth	Dec. 1999	Soil	3%	Not Detected
2-12 inches depth	Dec. 1999	Soil	5%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-24 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-24 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Dec. 1999	Soil	Not Detected	Not Detected
0-2 inches depth	Dec. 1999	Soil	2%	Not Detected
2-12 inches depth	Dec. 1999	Soil	2%	Not Detected
0-2 inches depth	Dec. 1999	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	5%	Not Detected
2-12 inches depth	Mar. 2000	Soil	10%	Not Detected
0-2 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	5%	Not Detected
2-12 inches depth	Mar. 2000	Soil	2%	Not Detected

Sample Location	Date Sampled	Material	Asbestos Concentration (%)	
			Tremolite/Actinolite Series	Chrysotile
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	2%	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Not Detected	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	1%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	1%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	1%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	1%	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
2-12 inches depth	Mar. 2000	Soil	Trace (< 1%)	Not Detected
0-2 inches depth	Mar. 2000	Other	2%	Not Detected

ATTACHMENT 2

MEMOS FROM REGIONAL TOXICOLOGIST, THE AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY, AND THE PUBLIC HEALTH SERVICE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII (8EPR-PS)
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

MAY 17 2000

Region VIII

MEMORANDUM

SUBJECT: Residual mineral fiber contamination at the former W.R. Grace **Screening Plant** and **Export Plant** poses an imminent and substantial endangerment to public health.

FROM: Christopher P. Weis, Ph.D., DABT
Regional Toxicologist

TO: Paul Peronard, On-Scene Coordinator
Libby Asbestos Site

I PURPOSE

This memorandum addresses rationale for determination of an imminent and substantial endangerment to public health posed by residual amphibole mineral fiber contamination at former vermiculite processing facilities in and near Libby, Montana. Processed ore from former vermiculite mining operations on nearby Zonolite mountain was brought to these facilities for refining which included screening, sizing (Screening Plant), exfoliation, bagging (Export Plant) and shipping (both). During the refining, amphibole mineral fibers of the tremolite-actinolite-richterite-winchite solid solution series (figure 1, hereafter referred to as 'tremolite, amphibole, or asbestos'[1]) were released to the environment in large quantities. In the interest of public health, I recommend that appropriate actions be initiated to reduce or eliminate exposure to mineral fibers at these locations.

II SUMMARY OF FINDINGS:

1) Fibrous minerals found in the vicinity of the former Screening and Export Plants are amphibole asbestiform in habit, are of respirable size, and are known to induce lung cancer, mesothelioma, and asbestosis upon inhalation exposure.

2) Soil exposure pathways from source areas to humans are presently complete at both facilities. Known concentrations of asbestos mineral fibers have been identified in soil at and near the subject facilities. This contaminated soil presents an ongoing source of asbestos which can become entrained in air and can be transported on vehicles, pets, and shoes to homes and other areas of potential secondary human exposure.

[1] The tremolite solid solution series of fibers found in the Libby ore deposit is known to have caused human disease and death of workers, family members of workers, and individuals not otherwise associated with the mining, milling, or processing operations in and near Libby. Mineral fibers of this solid solution series are the focus of the present EPA investigation in Libby.

3) Asbestiform mineral fibers have been identified in dust at both facilities. This dust has settled from air during ongoing re-entrainment of fibers from solid media (soil, source material, etc.). As activity patterns fluctuate at these facilities fibers can become entrained in air presenting an ongoing source of inhalation exposure to residents, workers, and the public.

4) Despite passive sampling procedures conducted during wet meteorological conditions (expected to bias sampling such as to undercount fiber concentrations), asbestiform mineral fibers have been identified in air at both facilities.

5) Fibers identified in air include a high proportion of long, thin amphiboles. There is strong evidence for increased toxicity for these longer fibers.

III BACKGROUND:

Vermiculite ore bodies on Zonolite mountain are associated with tremolite ranging in concentration to nearly 100% in selected areas (W.R. Grace). Although early exploration and mining efforts by the Zonolite Company focused upon the commercial viability of fibrous amphibole deposits found on Zonolite Mountain (DOI, 1928) no commercial production of tremolite is reported. Vermiculite was discovered in the Rainy Creek Mining District of Lincoln County, Montana in 1916 by E.N. Alley. Alley formed the Zonolite Company and began commercial production of vermiculite in 1921. Another company, the Vermiculite and Asbestos Company (later known as the Universal Insulation Company), operated on the same deposits (BOM, 1953). W.R. Grace purchased the mining operations in 1963 and greatly increased production of vermiculite until 1990 when mining and milling of vermiculite ceased. During early mining operations airborne fiber concentrations at the mine exceeded 100 fibers/cc in several job classifications (Amandus et al, 1987). Airborne fiber concentrations in the residential area of Libby exceeded the present occupational Permissible Exposure Level (PEL) of 0.1 fiber/cubic centimeter established by OSHA 1994 (MRI, 1982; Eschenbach deposition). This exposure limit is recognized as being associated with significant risk (3.4 additional asbestos-related cancers per 1000 individuals as per OSHA estimates) but is the practical lower limit of detection using phase contrast microscopy (PCM) as a measurement technique (OSHA, 1994).

Amphibole mineral fibers, including tremolite, are known to cause a variety of lethal and sub-lethal health effects as discussed below. Evidence of the lethal effects of exposure to tremolite from the vermiculite ore body on Zonolite Mountain is abundant. During the 1980s Lockey et al. (1984) and then the National Institutes for Occupational Safety and Health (NIOSH) (Amandus et al., 1987) conducted investigations of tremolite exposure and the morbidity and mortality of workers in various aspects of the mining, milling and refining process. These investigations, conducted during active vermiculite mining and processing activities in Libby, MT, demonstrated multiple cases of lung cancer, mesothelioma, and asbestosis in workers exposed to variable concentrations of tremolite fiber at the mine. These findings were independently confirmed by a concurrent investigations conducted by MacDonald et al., (1986).

Since the cessation of vermiculite mining and processing operations in Libby, local physicians and nearby pulmonary specialists have continued to identify individuals suffering from

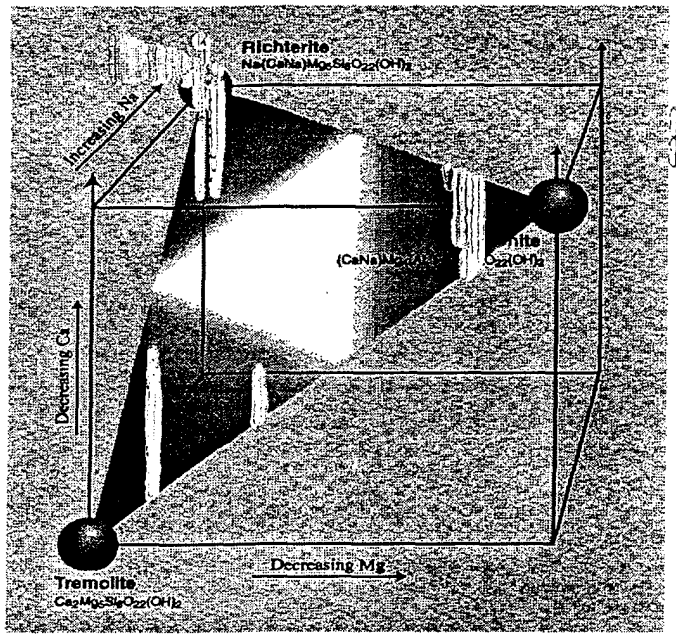

Figure 1: Phase diagram of the tremolite-richterite-winchite solid solution series (source: USGS, 2000).

asbestosis, lung cancer and mesothelioma as a result of exposure to tremolite mineral fibers. One pulmonologist has seen over 250 cases of asbestos-related disease from the Libby area (Whitehouse, 2000). While 142 of these individuals are believed to have been occupationally exposed during vermiculite mining operations, 29 individuals were secondarily exposed through household contact. Eleven cases are reported to have no connection with former mining or processing activities. These estimates are derived from a single physician working in the vicinity of Libby. Actual numbers of affected individuals are unknown and may be considerably higher.

Residual fiber contamination from the subject facilities continues to present uncontrolled exposure to workers, residents, and visitors at these facilities. These uncontrolled residual exposures prompted action by the U.S. Environmental Protection Agency Region 8 office in Denver, CO beginning on November 22, 1999. The investigative team is working closely with Local, State, and other Federal Agencies to determine the nature and extent of mineral fiber contamination throughout Libby. This memorandum presents the preliminary analytical results and endangerment findings for the subject facilities.

IV ENDANGERMENT RATIONALE:

The rationale for determination of an imminent and substantial endangerment from exposures at these former processing facilities is four fold: 1) amphibole fibers from the Libby vermiculite have been demonstrated to cause a variety of lethal and sublethal health effects in former workers, families of workers, and in non-occupationally exposed members of the Libby community; 2) complete human exposure pathways (by inhalation and ingestion) have been positively identified by personal observation and empirical measurement; 3) amphibole fibers of the tremolite series have been positively identified in multiple media (air, soil, and dust) at the subject facilities; and 4) risk estimation by a variety of qualitative and quantitative techniques indicates unacceptable human exposure by the inhalation route.

A. Health Effects of Libby Tremolite: *Hazard Assessment*

Fibrous minerals found in association with the Libby vermiculite are members of a solid solution series of hydrated magnesium silicates in which varying amounts of iron (Fe^{++}), sodium (Na^{+}), and aluminum (Al^{3+}) can substitute for calcium and magnesium in the solid solution (figure 1). The solid solution series includes tremolite [$Ca_2 Mg_5[Si_8 O_{22}](OH)_2$], actinolite [$Ca_2(Fe\ 2+,Mg)_5$

$(Si_8O_{22})(OH)_2]$, richterite $[Na(CaNa)(Mg,Fe^{2+}{}_5(Si_8O_{22})(OH)_2]$, and winchite $[NaCa(Mg,Fe^{++})_4AlSi_8O_{22}(OH)_2]$. Collectively with other minerals such as anthophyllite and amosite, these materials are referred to as amphiboles. In their fibrous habit, as identified in the ore body on Zonolite mountain, in association with un-expanded vermiculite, and in the exfoliated or expanded vermiculite product, these materials are generally referred to as asbestos (Eschenbach, 1983) and are capable of causing significant human morbidity and mortality upon inhalation.

Health effects associated with fiber exposure from the Libby facilities is documented in a variety of technical reports (EPA 1980; EPA 1985; EPA 1986), and peer reviewed studies. Lockey et al. (1984) demonstrated pleural radiographic changes and pleuritic chest symptoms in occupationally exposed workers with exposure to tremolite fiber from Libby. In a detailed study of occupational exposure (Amandus et al., 1987) to tremolite during vermiculite ore processing, Amandus and Wheeler (1987) documented significant increases of non-malignant respiratory disease and lung cancer in workers. In a study conducted concurrently with the NIOSH investigation, McDonald et al. (1986) determined independently that workers in the mine experienced a *"serious hazard from lung cancer, pneumonconiosis, and mesothelioma"* as a result of exposure to tremolite fibers associated with the vermiculite processing.

In addition to effects associated with inhalation exposure to mineral fibers several studies indicate elevated risk of gastrointestinal cancer following exposure (Seidman et al., 1986; Ehrlich et al., 1991; Gerhardsson de Verdier et al., 1992)

B. Identification of Complete Human Exposure Pathways: ***Dose-Response***

The EPA *Sampling and Quality Assurance Project Plan: Revision 1 for Libby, MT* -2000 (SAP, 2000) outlines the strategy, rationale, and specific procedures employed to characterize the presence of tremolite fibers in the environment in and around Libby, MT. Figure 1 of the Sampling Plan (presented herein as figure 2) is the ***Conceptual Site Model for Potential Human Exposure Pathways*** at the site. Environmental sampling in Libby is designed to identify mineral fibers at key locations along the pathways defined in figure 2 by quantitative and qualitative analysis. Pathways identified as 'complete' may be further analyzed to estimate risk associated with exposure. Alternatively, pathways judged to be of negligible risk may be addressed qualitatively during risk assessment. Asbestos exposure causes most significant risk by the inhalation pathway. Thus, sampling efforts and risk evaluation have focused on this important and primary exposure route. Also of importance for control of human exposures at the site are secondary pathways which may contribute to the air pathway. For example, house dust, soil, and primary source areas may significantly contribute to airborne fiber concentrations when they are stirred by wind or human activity. Additionally, materials may be purposely moved by bulk transport as ore or vermiculite product is removed or may be accidentally transported away from the site as contamination becomes attached to shoes, truck tires, pets, and clothing, etc.

At both subject facilities, tremolite fibers associated with former mining and milling operations have been identified and quantified using a variety of optical (Polarized Light Microscopy, transmission electron microscopy) and spectroscopic (electron diffraction, x-ray microprobe) techniques. Mineral fibers of the tremolite series have been identified at the subject facilities in all media tested including soil, dust, air, and in bulk materials left at the site. Bulk materials identified at the screening facility includes waste rock which contain high concentrations of fibrous tremolite, processed unexpanded vermiculite contaminated with mineral fiber in large dispersed piles at various uncontrolled locations,