Health Consultation

Former Robinson Insulation Minot Plant

826 4th Avenue NE
Minot, Ward County, North Dakota

EPA Facility Identification Number: ND0010165116

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Foreword: ATSDR's National Asbestos Exposure Review

Vermiculite was mined and processed in Libby, Montana, from the early 1920s until 1990. We now know that this vermiculite, which was shipped to many locations around the U.S. for processing, contained asbestos.

The National Asbestos Exposure Review (NAER) is a project of the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is working with other federal, state, and local environmental and public health agencies to evaluate public health impacts at sites that processed Libby vermiculite.

The evaluations focus on the processing sites and on human health effects that might be associated with possible past or current exposures. They do not consider commercial or consumer use of the products of these facilities.

The sites that processed Libby vermiculite will be evaluated by (1) identifying ways people could have been exposed to asbestos in the past and ways that people could be exposed now and (2) determining whether the exposures represent a public health hazard. ATSDR will use the information gained from the site-specific investigations to recommend further public health actions as needed. Site evaluations are progressing in two phases:

Phase 1: ATSDR has selected 28 sites for the first phase of reviews on the basis of the following criteria:

- The U.S. Environmental Protection Agency (EPA) mandated further action at the site based upon contamination in place

- or -

- The site was an exfoliation facility that processed more than 100,000 tons of vermiculite ore from Libby mine. Exfoliation, a processing method in which ore is heated and "popped," is expected to have released more asbestos than other processing methods.

The following document is one of the site-specific health consultations ATSDR and its state health partners are developing for each of the 28 Phase 1 sites. A future report will summarize findings at the Phase 1 sites and include recommendations for evaluating the more than 200 remaining sites nationwide that received Libby vermiculite.

Phase 2: ATSDR will continue to evaluate former Libby vermiculite processing sites in accordance with the findings and recommendations contained in the summary report. ATSDR will also identify further actions as necessary to protect public health.

Background

Site information in this section comes mostly from the Focused Removal Assessment Report prepared in June 2002 for the US Environmental Protection Agency (EPA), Region 8 [1]. The Robinson Insulation Minot Plant site is located at 826 4th Avenue NE in Minot, North Dakota. The site location, shown in Figure 1, is between 8th Street and 10th Street and bounded by 4th Avenue to the north and by 3rd Avenue NE to the south. There were two processing buildings on the 1- to 2-acre site, but they have been removed. The property was served by a railroad spur passing along the south side of the buildings. The immediate surroundings of the site are mixed commercial, industrial, and residential. Residences were formerly located directly across the street from the east side of the processing buildings; however, these residences have been removed, and the nearest current residences are approximately 175 yards south of the former processing buildings. Homes to the east are approximately 500 yards from the site. Currently, approximately 9,500 people live within a one-mile radius of the site (Figure 2).

In about 1945, the facility was built and began processing vermiculite obtained primarily from the mine located in Libby, Montana. The facility expanded, or exfoliated, the vermiculite ore to produce a lightweight substance used in home insulation products. Vermiculite processing continued at the facility until about 1983. The Minot City Parks Department purchased the property and two processing buildings from Robinson Insulation in 1993 and used the buildings to store equipment. Both buildings were demolished during the EPA Removal Action in 2002. The land and a large warehouse that was not associated with vermiculite processing are currently owned by the Minot City Parks Department.

Between 1967 and 1983, the plant processed over 16,000 tons of vermiculite ore. It is not known how much ore was processed in the period 1945-1967. Over time, it became known that the vermiculite mined from Libby was contaminated with naturally occurring asbestos fibers. Vermiculite from Libby was found to contain several types of asbestos fibers, including the amphibole asbestos varieties tremolite and actinolite and the related fibrous asbestiform minerals winchite, richterite, and ferro-edenite [2]. In this report, ATSDR will use the term *Libby asbestos* to refer to the characteristic composition of asbestos contaminating the Libby vermiculite. It is difficult to measure all the different mineral fibers in Libby asbestos specifically. In this document, soil sample results are reported as “tremolite-actinolite” asbestos to indicate the presence of Libby asbestos.

Scientific studies throughout the 1980s and information that received media attention in 1999 indicated that Libby mine workers had high rates of asbestos-related respiratory diseases [3,4,5,6,7]. This site is being investigated further because EPA identified the site as requiring further action due to existing contamination.

In 2001, EPA collected soil samples at and around the site and dust samples from inside the two former processing buildings [1]. Grains of tremolite asbestos, indicating the presence of Libby asbestos, were observed visually in soil and in raw vermiculite at some locations on the property or the railroad spur. Microscopic analysis measured tremolite-actinolite asbestos at levels higher than 5% in some of the surface soil samples. The highest levels were immediately around the former processing buildings and the railroad spur; the levels tapered off with distance. In addition, asbestos fibers were detected in the building dust samples. EPA proceeded with cleanup of the site, a process that included demolishing and removing the former processing buildings and removing contaminated soil and replacing it with clean fill. Cleanup was complete by December 2002.

Vermiculite Processing and Later Uses of the Site

Vermiculite is a non-fibrous, platy mineral similar in form to mica and used in many commercial and consumer applications. Raw vermiculite ore is used in gypsum wallboard, cinder blocks, and many other products, and exfoliated vermiculite is used as loose fill insulation, as a fertilizer carrier, and as an aggregate for concrete. Exfoliated vermiculite is formed by heating the ore to approximately 2,000 degrees Fahrenheit (^{o}F), which explosively vaporizes the water in the mineral structure and causes the vermiculite to expand by a factor of 10 to 15 [9].

Detailed process information was not available for the site. Vermiculite ore was apparently delivered to the facility on a railroad spur leading to the south side of the processing building where exfoliation took place [1]. Workers used shovels to unload ore from the railcars to the furnace conveyor [10]. No documentation was found describing how the stoner rock (waste material) exiting the furnace was stored. However, former workers and/or local officials stated that stoner rock was stockpiled on site and then taken to a local landfill [10,11]. Stoner rock from other exfoliation facilities has been shown to contain percentage levels of Libby asbestos (personal communication, James Kelly, Minnesota Department of Health, August 12, 2002).

ATSDR and its partners in the National Asbestos Exposure Review have learned other information about past processing methods that could apply to this site. Some vermiculite processing facilities in the United States allowed or encouraged workers and nearby community members to take stoner rock, vermiculite ore, or other process materials for personal use [12]. ATSDR does not know if this was a common practice at the Minot site.

Former workers at similar facilities described the exfoliation process as dusty to very dusty at times [13]. At other facilities, air samples collected by representatives from the Occupational Safety and Health Administration (OSHA) and W.R. Grace at various process locations during operations in the 1970s and 1980s showed asbestos levels higher than current standards (unpublished information from EPA database of W.R. Grace documents). On the basis of information from other sites, it is likely that respirators were often not used by workers [13]. By the 1970s, many plants had installed baghouses to capture dust from some plant operations. For the Minot plant, no reports of community complaints about dust from the facility were found.

In 1993, the facility was sold to the Minot City Parks Department. No documentation of cleaning of the facility by the former owners before the sale, or of post-cleaning asbestos sampling, was located. However, the Parks Department reportedly hired local lifeguards to sweep the buildings out after the transfer of ownership (personal communication, Joyce Ackerman, US Environmental Protection Agency, April 16, 2003). The Parks Department used the buildings for storage of equipment. It is not known whether additional or periodic cleaning of the buildings occurred. Following sampling of the facility by EPA in 2001 (see below), stored equipment was either decontaminated or disposed of, both former processing buildings were demolished, and contaminated soil on the site and in the surrounding areas was removed and replaced with clean fill. Cleanup of the site was complete by December 2002.

Soil Contamination at the Robinson Insulation Minot Plant and Surrounding Areas

Between June 2001 and April 2002, representatives of EPA collected soil and waste product samples at the site and nearby streets, residences, and businesses. EPA analyzed soil samples by polarized light microscopy for tremolite-actinolite asbestos to indicate the presence of Libby asbestos. More than 400 samples were collected at the surface (0–2 inches, 5-point composites) and subsurface (2–6 inches and 6–12 inches) to characterize asbestos levels at and around the facility. The results for surface soils, shown graphically in Figure 3, indicate that several samples had detectable tremolite-actinolite asbestos. The highest measurements, shown in red, were mostly around Building 1 and along the railroad spur. Subsurface samples generally showed the same trends as the surface samples [1].

During three sampling events between April 2001 and April 2002, a subcontractor conducted microvacuum dust sampling from surfaces within the former processing buildings, from surfaces of pressure-washed equipment formerly stored in the buildings, and from an abandoned house across the street from the former processing buildings. The samples were analyzed using a transmission electron microscope (TEM) method for number of tremolite-actinolite structures per square centimeter (s/cm^2). In addition, personal air sampling was conducted on personnel during both actual and simulated sampling events. These samples were collected from the breathing zone onto filters and analyzed using the same TEM method as for the microvacuum dust samples. Amphibole asbestos fibers were detected in the former processing buildings as well as on equipment stored there; no fibers were detected in the abandoned house [1]. Air sampling of the large warehouse currently used by the Minot City Parks Department (which was never associated with the Robinson Insulation Minot Plant) showed no detection of asbestos fibers (personal communication, Joyce Ackerman, US Environmental Protection Agency, January 2003).

Site Visit

ATSDR staff visited the site in September 2002. A walk-through of the property and surrounding area was conducted. The EPA cleanup had recently been completed. Staff also toured the neighborhood to observe distances to residences. The following observations were made:

- The former processing buildings and an abandoned house across the street from the former processing buildings had been removed. Fresh fill soil was observed in the area around the removed buildings; this fill had been seeded with grass and planted with trees, and it was being watered.
- The nearest residences were approximately 175 yards south of a garden supply warehouse south of where the former processing buildings were.
- Additional homes were present approximately 500 yards east of the site.
- No sign of residual contamination was observed.

Asbestos Overview

Asbestos is a general name applied to a group of silicate minerals consisting of thin, separable fibers in a parallel arrangement. Asbestos minerals fall into two classes, serpentine and amphibole. Serpentine asbestos has relatively long and flexible crystalline fibers; this class includes chrysotile, the predominant type of asbestos used commercially. Amphibole asbestos minerals are brittle and have a rod- or needle-like shape. Amphibole minerals regulated as asbestos by OSHA include five classes: fibrous tremolite, actinolite, anthophyllite, crocidolite, and amosite. However, other amphibole minerals, including winchite, richterite, and others, can exhibit fibrous asbestiform properties [14].

Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate, and they are resistant to heat, fire, and chemical and biological degradation.

The vermiculite mined at Libby contains amphibole asbestos, with a characteristic composition that includes tremolite, actinolite, richterite, and winchite; this characteristic material will be referred to as Libby asbestos. The raw ore was estimated to contain up to 26% Libby asbestos [15]. For most of the mine's operation, Libby asbestos was considered a byproduct of little value and was not used commercially. The mined vermiculite ore was processed to remove unwanted materials and sorted into various grades or sizes. The ore was then shipped to sites across the nation for expansion (exfoliation) or use as a raw material in manufactured products. Samples of the various grades of unexpanded vermiculite shipped from the Libby mine contained 0.3–7% fibrous tremolite-actinolite (by mass) [15].

The following sections provide an overview of several concepts relevant to the evaluation of asbestos exposure, including analytical techniques, toxicity and health effects, and the current regulations concerning asbestos in the environment. A more detailed discussion of these topics will also be provided in ATSDR's upcoming Summary Report for the national review of vermiculite sites.

Methods for Measuring Asbestos Content

There are a number of different analytical methods used to evaluate asbestos content in air, soil, and other bulk materials. Each method varies in its ability to measure fiber characteristics such as length, width, and mineral type.

For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers longer than 5 µm and with an aspect ratio (length:width) greater than 3:1. This is the standard method by which regulatory limits were developed. Disadvantages of this method include the inability to detect fibers thinner than 0.25 µm in diameter and the inability to distinguish between asbestos and nonasbestos fibers [14].

Asbestos content in soil and bulk material samples is commonly determined using polarized light microscopy (PLM), a method that uses polarized light to compare refractive indices of minerals and can distinguish between asbestos and nonasbestos fibers and between different types of asbestos. The PLM method can detect fibers with lengths greater than ~1 µm, widths greater than ~0.25 µm, and aspect ratios (length to width ratios) of greater than 3. Detection limits for PLM methods are typically 0.25-1% asbestos.

Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods and can detect smaller fibers than light microscopic techniques. TEM allows the use of electron diffraction and energy-dispersive x-ray methods, which give information on crystal structure and elemental composition, respectively. This information can be used to determine the elemental composition of the visualized fibers. SEM does not allow measurement of electron diffraction patterns. One disadvantage of electron microscopic methods is that it is difficult to determine asbestos concentration in soils and other bulk materials [14].

For risk assessment purposes, TEM measurements are sometimes multiplied by conversion factors to give PCM equivalent fiber concentrations. The correlation between PCM fiber counts and TEM mass measurements is very poor. A conversion factor of 30 micrograms per cubic meter per fiber per cubic centimeter (µg/m3)/(f/cc) was adopted as a means of converting between TEM mass and PCM fiber count. However, this value is highly uncertain, since it represents an average of conversions ranging from 5 to 150 (µg/m3)/(f/cc) [16]. The correlation between PCM fiber counts and TEM fiber counts is also very uncertain, and no generally applicable conversion factor exists for these two measurements [16]. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular sample.

EPA is currently working with several contract laboratories and other organizations to develop, refine, and test a number of methods for screening bulk soil samples. The methods under investigation include PLM, infrared (IR), and SEM (personal communication, Jim Christiansen, US Environmental Protection Agency, November 2002).

Asbestos Health Effects and Toxicity

Breathing any type of asbestos increases the risk of the following health effects.

Malignant mesothelioma—Cancer of the lining of the lung (pleura) and other internal organs. This cancer can spread to tissues surrounding the lungs or other organs. The vast majority of mesothelioma cases are attributable to asbestos exposure [14].

Lung cancer—Cancer of the lung tissue, also known as bronchogenic carcinoma. The exact mechanism relating asbestos exposure with lung cancer is not completely understood. The combination of tobacco smoking and asbestos exposure greatly increases the risk of developing lung cancer [14].

Noncancer effects— These include *asbestosis*, scarring and reduced lung function caused by asbestos fibers lodged in the lung; *pleural plaques*, localized or diffuse areas of thickening of the pleura (lining of the lung); *pleural thickening*, extensive thickening of the pleura which may restrict breathing; *pleural calcification*, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and *pleural effusions*, fluid buildup in the pleural space between the lungs and the chest cavity [14].

There is not enough evidence to conclude whether inhalation of asbestos increases the risk of cancers at sites other than the lungs, pleura, and abdominal cavity [14].

Ingestion of asbestos causes little or no risk of noncancer effects. However, there is some evidence that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors [14].

ATSDR considers the inhalation route of exposure to be the most significant in the current evaluation of sites that received Libby vermiculite. Exposure scenarios that are protective of the inhalation route of exposure should also be protective of dermal and ingestion exposures.

There is general acceptance in the scientific community of correlations of asbestos toxicity with fiber length as well as fiber mineralogy. Fiber length may play an important role in clearance, and mineralogy may affect both biopersistence and surface chemistry.

ATSDR, responding to concerns about asbestos fiber toxicity from the World Trade Center disaster, held an expert panel meeting in December 2002 to review fiber size and its role in fiber toxicity [17]. The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths less than 5 µm are essentially nontoxic when considering a role in mesothelioma or lung cancer promotion. However, fibers less than 5 µm in length may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to definitively make this conclusion.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly due to physical characteristics that allow chrysotile to be broken down and cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue [18]. Some researchers believe the resulting increased duration of exposure to amphibole asbestos significantly increases the risk of mesothelioma and, to a lesser extent, asbestosis and lung cancer [18]. However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, because both types increase the risk of disease [19]. EPA's Integrated Risk Information System assessment of asbestos also treats mineralogy and fiber length as equipotent [16].

Evidence suggesting that the different types of asbestos fibers vary in carcinogenic potency and site specificity is limited by the lack of information on fiber exposure by mineral type. Other data indicate that differences in fiber size distribution and other process differences can contribute at least as much to the observed variation in risk as does the fiber type itself [20].

Counting fibers by using the regulatory definitions (see below) does not adequately describe risk of health effects, because fiber size, shape, and composition contribute collectively to risks in ways that are still being elucidated. For example, shorter fibers appear to preferentially deposit in the deep lung, but longer fibers might disproportionately increase the risk of mesothelioma [14, 20]. Some of the unregulated amphibole minerals, such as the winchite present in Libby asbestos, can exhibit asbestiform characteristics and contribute to risk. Fiber diameters greater than 2 to 5 µm are considered above the upper limit of respirability (that is, too large to inhale) and do not contribute significantly to risk [14, 20]. Methods are being developed to assess the risks posed by varying types of asbestos and are currently awaiting peer review [20].

Current Standards, Regulations, and Recommendations for Asbestos

In industrial applications, asbestos-containing materials are defined as any material with greater than 1% bulk concentration of asbestos [21]. It is important to note that 1% is not a health-based level, but instead represents the practical detection limit in the 1970s when OSHA regulations were created. Studies have shown that disturbing soils containing less than 1% amphibole asbestos can still suspend fibers at levels of health concern [22].

Friable asbestos (asbestos that is crumbly and can be broken down to suspendable fibers) is listed as a Hazardous Air Pollutant on EPA's Toxic Release Inventory [23]. EPA requires companies that release friable asbestos at concentrations greater than 0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to-Know Act.

OSHA has set a permissible exposure limit (PEL) of 0.1 f/cc for asbestos fibers longer than 5 μm and having an aspect ratio (length:width) greater than 3:1, as determined by PCM [19]. This value represents a time-weighted average (TWA) exposure level based on 8 hours a day for a 40-hour work week. In addition, OSHA has defined an excursion limit in which no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes [19]. Historically, the OSHA PEL has steadily decreased from an initial standard of 12 f/cc established in 1971. The PEL levels prior to 1983 were determined on the basis of empirical worker health observations, while the levels set from 1983 forward employed some form of quantitative risk assessment. ATSDR has used the current OSHA PEL of 0.1 f/cc as a reference point for evaluating asbestos inhalation exposure for past workers. ATSDR does not, however, support using the PEL for evaluating community member exposure, as the PEL is based on an unacceptable risk level.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in homes in the area, the Department of Health and Human Services, EPA and the Department of Labor formed the Environmental Assessment Working Group. This work group was made up of ATSDR, US Environmental Protection Agency, National Institute of Occupational Safety and Health, CDC National Center for Environmental Health, Occupational Safety and Health Administration, New York City Department of Health and Mental Hygiene, the New York State Department of Health, and other state, local, and private entities. The workgroup set a re-occupation level of 0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure to this level [24].

The National Institute of Occupational Safety and Health (NIOSH) set a recommended exposure limit of 0.1 f/cc for asbestos fibers longer than 5 μm. This limit is a TWA for up to a 10-hour workday in a 40-hour work week [25]. The American Conference of Government Industrial Hygienists (ACGIH) has also adopted a TWA of 0.1 f/cc as its threshold limit value [26].

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7 million fibers longer than 10 μm per liter, based on an increased risk of developing benign intestinal polyps

[27]. Many states use the same value as a human health water quality standard for surface water and groundwater.

Asbestos is a known human carcinogen. Historically, EPA has calculated an inhalation unit risk for cancer (cancer slope factor) of 0.23 per f/cc of asbestos [16]. This value estimates additive risk of lung cancer and mesothelioma by using a relative risk model for lung cancer and an absolute risk model for mesothelioma. This quantitative risk model has significant limitations. First, the unit risks were based on measurements with phase contrast microscopy and therefore cannot be applied directly to measurements made with other analytical techniques. Second, the unit risk should not be used if the air concentration exceeds 0.04 f/cc, because above this concentration the slope factor might differ from that stated [16]. Perhaps the most significant limitation is that the model does not consider mineralogy, fiber size distribution, or other physical aspects of asbestos toxicity. EPA is in the process of updating its asbestos quantitative risk methodology, given the limitations of the current assessment and the knowledge gained since it was implemented in 1986.

Discussion

The vermiculite processed at this site originated from the mine in Libby, Montana known to be contaminated with asbestos. Studies conducted in the Libby community indicate health impacts that are associated with asbestos exposure [31,32]. The findings at Libby provided the impetus for investigating this site, as well as other sites across the nation that received asbestos-contaminated vermiculite from the Libby mine. It is important to recognize, however, that the asbestos exposures documented in the Libby community are in many ways unique and will not collectively be present at other sites that processed or handled Libby vermiculite. The site investigation at the Robinson Insulation Minot Plant is part of a national effort to identify and evaluate potential asbestos exposures that may be expected at these other sites.

Exposure Assessment and Toxicological Evaluation

Evaluating the health effects of exposure to Libby asbestos requires extensive knowledge of both exposure pathways and toxicity data. The toxicological information currently available is limited, and therefore the exact level of health concern for different sizes and types of asbestos remains controversial. Site-specific exposure pathway information is also limited or unavailable.

- There is limited information on past concentrations of Libby asbestos in air in and around the plant. Also, as described in the preceding section, significant uncertainties and conflicts in the methods used to analyze asbestos exist. These limitations make it hard to estimate the levels of Libby asbestos that people may have been exposed to.
- There is not enough information known about how and how often people came in contact with the Libby asbestos from the plant, because most exposures happened so long ago. This information is necessary to estimate accurate exposure doses.
- There is not enough information available about how some vermiculite materials, such as waste rock, were handled or disposed. This lack of information makes it difficult to identify and assess potential current exposures.

Given these difficulties, the public health implications of past operations at this site can be evaluated only qualitatively. The following sections describe the various types of evidence ATSDR used to evaluate exposure pathways and reach conclusions about the site.

Exposure Pathway Analysis

An exposure pathway is the way in which an individual is exposed to contaminants originating from a contamination source. Every exposure pathway consists of the following five elements: 1) a *source* of contamination; 2) a *media* such as air or soil through which the contaminant is transported; 3) a *point of exposure* where people can contact the contaminant; 4) a *route of exposure* by which the contaminant enters or contacts the body; and 5) a *receptor population*. A pathway is considered complete if all five elements are present and connected. A pathway is considered potential if the pathway elements are (or were) likely present, but insufficient information is available to confirm or characterize the pathway elements. A pathway may also be considered potential if it is currently missing one or more of the pathway elements, but the element(s) could easily be present at some point in time. An incomplete pathway is missing one or more of the pathway elements and it is likely that the elements were never present and not likely to be present at a later point in time. An eliminated pathway was a potential or completed pathway in the past, but has had one or more of the pathway elements removed to prevent present and future exposures.

After reviewing information from Libby, Montana and from facilities that processed vermiculite ore from Libby, the National Asbestos Exposure Review team has identified possible likely exposure pathways for vermiculite processing facilities. All pathways have a common source—vermiculite from Libby contaminated with Libby asbestos—and a common route of exposure—inhalation. Although asbestos ingestion and dermal exposure pathways could exist, health risks from these pathways will not be evaluated because they are minor in comparison to those resulting from inhalation exposure.

The pathways that will be considered for each site are listed below. More detail on the pathways is included in Appendix A. Not every pathway identified will be a significant source of exposure for a particular site. An evaluation of the pathways for this site is presented in the paragraphs that appear after the following summary chart.

Table 1. Summary of Inhalation Pathways Considered for Robinson Insulation Minot Plant

Pathway Name	Exposure Scenario(s)	Past Pathway Status	Present Pathway Status	Future Pathway Status
Occupational	Former workers exposed to airborne Libby asbestos during handling and processing of contaminated vermiculite	Complete	Not applicable	Not applicable
	Current workers exposed to airborne Libby asbestos from residual contamination inside former processing buildings	Not applicable	Eliminated	Eliminated
Household Contact	Household contacts exposed to airborne Libby asbestos brought home on workers' clothing	Complete	Eliminated	Eliminated
Waste Piles	Community members (particularly children) playing in or otherwise disturbing onsite piles of contaminated vermiculite or waste rock	Potential	Eliminated	Eliminated
Ambient Air	Community members or nearby workers exposed to airborne fibers from plant emissions during handling and processing of contaminated vermiculite	Potential	Eliminated	Eliminated
Residential Outdoor	Community members using contaminated vermiculite or waste material at home (for gardening, paving driveways, fill material)	Potential	Potential	Potential
Residential Indoor	Community members disturbing household dust containing Libby asbestos fibers from plant emissions or residential outdoor waste	Potential	Potential	Potential
Onsite Soils	Current onsite workers, contractors, or community members disturbing contaminated onsite soils (residual contamination, buried waste)	Not applicable	Eliminated	Eliminated
Consumer Products	Community members, contractors, and repairmen disturbing consumer products containing contaminated vermiculite	Potential	Potential	Potential

Occupational (past and present) —No records on past levels of Libby asbestos in the Minot facility were found; however, according to data from other vermiculite processing facilities, it is reasonable to assume that workers were exposed to high levels of Libby asbestos in the air at the plant. At other exfoliation plants, TWAs for asbestos exposure of employees in the late 1970s ranged from 0.02 f/cc to 2.37 f/cc, higher than the current OSHA limit of 0.1 f/cc (although it should be noted that OSHA limits were higher in the past) [28,29]. In addition, records exist of very high fiber counts (>30 f/cc) in specific processing locations [28]. The records available from other facilities were from the time period after pollution control equipment and other dust suppression measures were typically installed (in the early 1970s). It is assumed that workers were exposed to even higher fiber concentrations in previous years. On the basis of anecdotal information from former workers of other exfoliation facilities, use of personal protective equipment such as respirators by workers was not universal. Therefore, the past occupational pathway is considered the most significant exposure pathway for the site.

No record of cleaning the facility's buildings for asbestos exists, suggesting that Minot City Parks Department workers, especially those who swept out the buildings in 1993, may have been exposed to elevated levels of asbestos. The exposure of these workers is likely to have been less frequent and of shorter duration than exposure of the vermiculite processing workers. Therefore, this exposure is less likely to lead to health effects. Because their activities may have brought them in contact with asbestos contaminated areas, all Minot City Parks workers employed before remediation are considered part of the past occupational exposure pathway.

The former processing buildings were demolished and removed in fall of 2002, and the site has been cleaned up. Therefore, no present risk exists to workers at or around the site.

Household contact (past and present)—In the past, persons living with workers could have been exposed to Libby asbestos coming off of dirty clothing or hair of workers returning home from work. Information from former workers at other vermiculite processing facilities indicated that the plant operations were dusty, disposable suits were not generally worn, and workers did not shower or change clothes before going home. If this was true for the Robinson Insulation plant in Minot, the household contact pathway was likely to have been significant in the past.

Because the present occupational pathway is not expected to result in any Libby asbestos exposure to workers, the present household contact pathway is considered incomplete and of no further concern.

Waste piles (past and present)—No documentation was available on storage or disposal of waste rock (stoner rock) from the process. The waste was reportedly stored onsite in piles before it was removed. This storage method was used at other facilities of this type [12]. Children could have inhaled Libby asbestos fibers if they played on the piles. People handling the waste could also have inhaled Libby asbestos fibers. Contact with waste piles is a potential past pathway of exposure. The site has now been cleaned up, and therefore this pathway does not present a current risk.

Ambient air (past)—Community members could have been exposed in the past to Libby asbestos fibers released into the ambient air from fugitive dusts or the furnace stack while the plant was running. Available wind rose data from a monitoring station 3 miles from the site, shown in Figure 4, suggest that winds in the mid-1970s were predominantly from the west and northwest, generally towards some of the residences that were near the site. However, no estimate of risk from this exposure pathway can be made. It is unlikely that sufficiently detailed plant-specific emission information will ever be available, and if it was, it would still be difficult to reconstruct past exposures, given the lack of knowledge of such factors as past weather patterns or people's activity patterns. EPA's sampling results which showed asbestos contamination to be concentrated around the former exfoliation buildings and the railroad spur suggest that asbestos fibers did not travel in high concentrations into the surrounding neighborhoods. The lack of concrete information results in the past ambient air pathway being characterized as an indeterminate public health hazard. However, due to dispersion and changing wind patterns, the level of exposure from the ambient air would be much lower than the high-level exposure experienced by former plant workers and thus less likely to lead to adverse health effects.

Residential outdoor (past and present)—Whether people ever hauled contaminated materials away for personal use is unknown; if they did, people could be exposed to asbestos from those sources. Available information indicates that people living in the community around the plant face minimal risk of asbestos exposure from general soils in their yards, either in the past or currently. Soil sampling showed asbestos contamination to be concentrated around the former exfoliation buildings and the railroad spur, and all soils around the site have been cleaned up.

Residential indoor (past and present)— Residents could have inhaled LA fibers from household dust, either from plant emissions that infiltrated into homes or from dust brought inside from waste products brought home for personal use. There is no information on past levels of contamination in ambient air; however, it is unlikely that past ambient air emissions would have been high enough to infiltrate significantly into houses. This assumption is based on the fact that asbestos fiber levels in soil were highest only right around the processing buildings and the railroad spur and fell to non-detect levels around the edges of the site; therefore, detectable levels of asbestos in soil around houses off the site are highly unlikely. No information has been gathered about community members using waste materials in their yards. There is not enough information to determine the significance of this exposure pathway.

Onsite (present)—The site has been completely cleaned up. Although very small amounts of residual asbestos could still be present, very little potential for exposure exists.

Consumer products—People who purchased and used vermiculite products may be exposed to asbestos fibers from using those products in and around their homes. At this time, determining the public health implication of commercial or consumer use of vermiculite products (such as home insulation or gardening products) is beyond the scope of this evaluation. However, studies have shown that disturbing or using these products can result in airborne asbestos fiber levels higher than occupational safety limits [22,30]. Additional information for consumers of vermiculite products has been developed by EPA, ATSDR, and NIOSH and provided to the public (see www.epa.gov/asbestos/insulation.html).

Future Pathways—Because the site cleanup is complete and no offsite pathways were determined, no future pathways of exposure are anticipated at this site.

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).

According to information from similar exfoliation facilities across the United States, workers at the Robinson Insulation Minot Plant site were likely exposed to levels of contamination consistent with the development of adverse health effects. According to anecdotal reports, some former workers at the plant in Minot have contracted asbestos-related diseases [10,11]. The ATSDR Division of Health Studies has funded some states to review health outcome data to determine if any of the areas near facilities that processed Libby vermiculite are associated with higher disease rates. At the time of this report, North Dakota was not reviewing health outcome data for the Minot site. Because the plant employed few workers and because people living near the site were unlikely to experience substantial exposures, the small number of potentially affected people could make it difficult to detect community-level health effects if this review were conducted.

In Libby, Montana, the number of recorded deaths associated with asbestos-related diseases was significantly elevated (as compared with the state or the nation as a whole), especially among former workers of the vermiculite mine and their household contacts [31]. Former workers and their household contacts also showed higher rates than expected of pleural (lung lining) abnormalities, indicating higher exposure and a higher risk for developing asbestos-related disease [32]. Limited past data indicate that fiber levels in the processing areas of Libby and in exfoliation plants around the country were similar, suggesting that worker exposures might have also been similar [28,29]. Therefore, it is likely that former workers at the site and their household contacts have an increased risk of developing asbestos-related disease.

Summary of Removal and Remedial Actions Completed and Proposed

- The former processing buildings and an abandoned house across the street were demolished and removed.
- Equipment stored in the former processing buildings was decontaminated, if possible, or else discarded.
- Soils that contained trace levels of asbestos, or higher, were cleaned up by removing topsoil down to the non-detect level (12–18 inches), and replacing it with fresh fill.

ATSDR considers these cleanup actions to be protective of public health.

Child Health Considerations

ATSDR recognizes that infants and children might be more vulnerable than adults to exposure in communities faced with environmental contamination. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

The effects of asbestos on children are thought to be similar to the effects on adults. However, children could be especially vulnerable to asbestos exposures because they are more likely to disturb fiber-laden soils or indoor dust while playing. Children also breathe air that is closer to the ground and may thus be more likely to inhale airborne fibers from contaminated soils or dust.

Furthermore, children who are exposed could be more at risk of actually developing asbestos-related disease than people exposed later in life because of the long latency period between exposure and onset of asbestos-related respiratory disease.

The most at-risk children are those who were household contacts of workers at the time the plant was operating. In addition, if children played on any waste piles existing onsite in the past, they would be at significant risk. The entire site and surrounding areas have now been cleaned up. Therefore, it is unlikely that children today are exposed to vermiculite contaminated with Libby asbestos.

Conclusions

- Workers at the Robinson Insulation Minot Plant were exposed to hazardous levels of Libby asbestos in the past. Workers' household contacts are likely to have been exposed to Libby asbestos from returning workers' clothing or hair in the past. In the past, Parks Department workers may have also been exposed to asbestos, though the exposure would have been much less than for the vermiculite processing workers. The occupational and household contacts pathways represent a past public health hazard.
- Not enough information is available to determine the extent to which people living in the neighborhood of the plant were exposed to Libby asbestos in the past from the ambient air, residential, or waste piles pathways. These pathways pose an indeterminate public health hazard. However, the risk of adverse health effects from these past pathways would be small compared to the past occupational and household contacts pathways.
- Clean up of the site and surrounding areas has eliminated the possibility of substantial current or future exposures to Libby asbestos. Although clean up to the zero fiber level is not possible, the site currently poses no apparent public health hazard.

Recommendations

- Identify former workers and their household contacts for possible evaluation of health effects associated with Libby asbestos exposure.
- Research the feasibility of performing a health statistics review for the community around the site.
- Contact former workers and request more detailed information about waste disposal and operating practices at the facility to assist in exposure analysis.

Public Health Action Plan

The purpose of the public health action plan is to ensure that public health hazards are not only identified, but also addressed. The public health action plan for this site describes actions that ATSDR and/or other government agencies plan to take at the site to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. ATSDR will also follow up on the plan to ensure implementation of the following public health actions:.

- EPA demolished and removed the contaminated buildings, decontaminated or discarded equipment stored in the buildings, and replaced contaminated soil in the area with clean fill.

The following are the public health actions still to be implemented.

- ATSDR will study the feasibility of conducting worker and household contact follow-up activities.
- ATSDR will combine the findings from this health consultation with findings from other health consultations on facilities that processed vermiculite from Libby, and the agency will

develop a national summary report of the overall conclusions and strategies for addressing the public health implications, as needed.

- ATSDR will provide educational materials and references, upon request, to community members concerned about products containing vermiculite.
- ATSDR will review information that becomes available to determine appropriate site-specific public health actions.
- ATSDR will publish annual reports summarizing results of health statistics reviews conducted on vermiculite processing sites.

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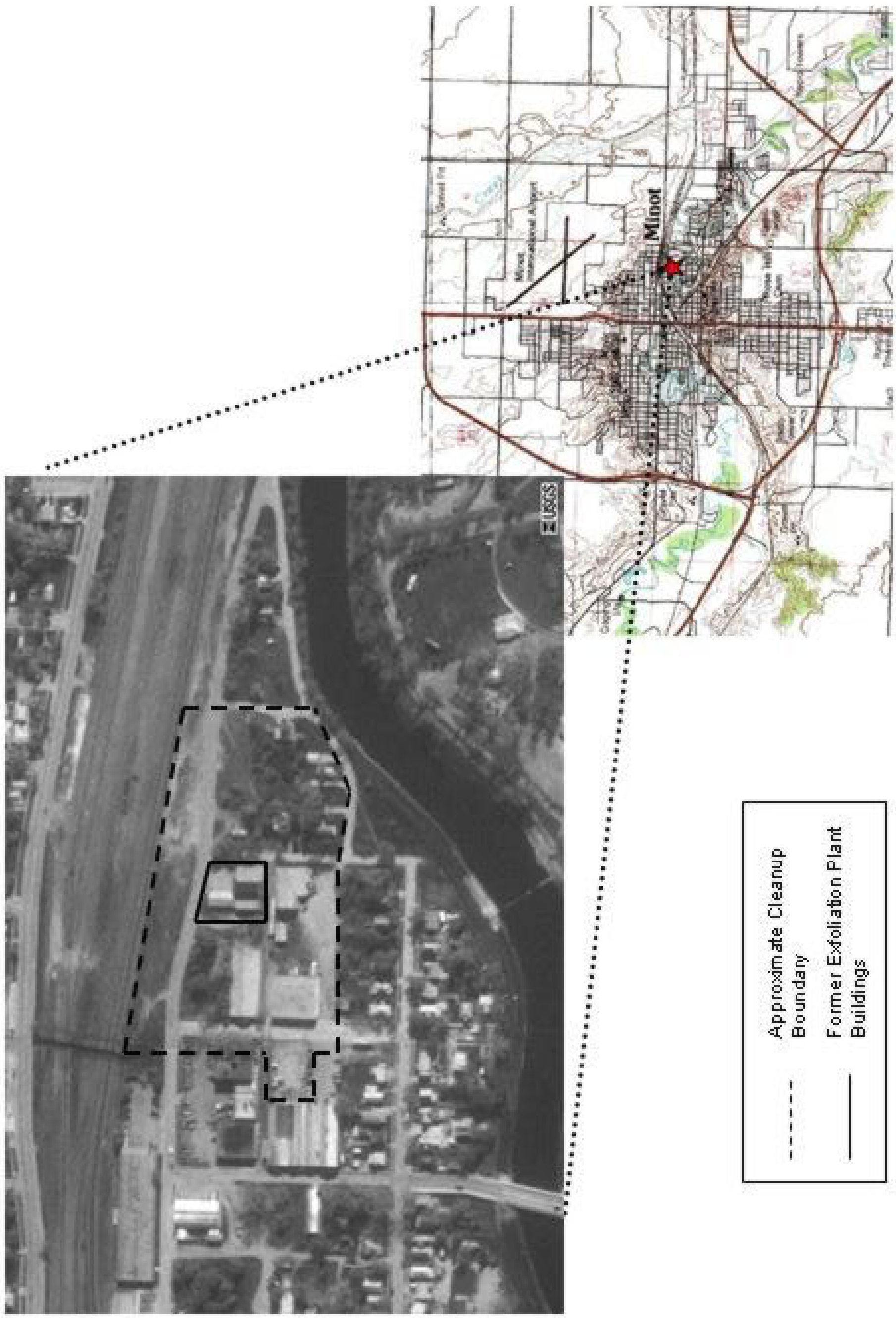
Figure 1. Robinson Insulation, Minot, North Dakota



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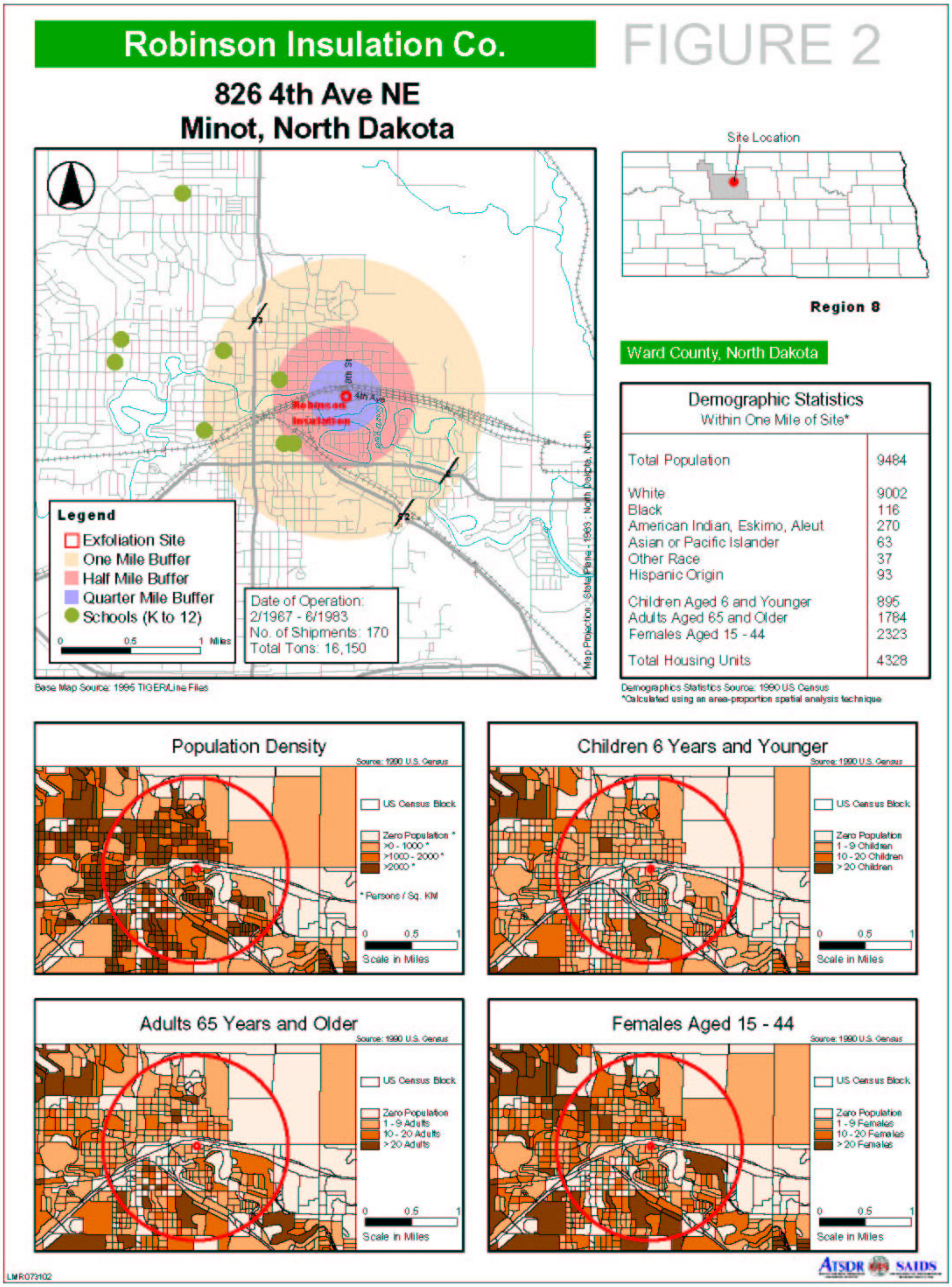
Robinson Insulation Co.
FIGURE 2
826 4th Ave NE
Minot, North Dakota
Site Location
Region 8
Ward County, North Dakota
Demographic Statistics
Within One Mile of Site*
Total Population 9484
White 9002
Black 116
American Indian, Eskimo, Aleut 270
Asian or Pacific Islander 63
Other Race 37
Hispanic Origin 93
Children Aged 6 and Younger 895
Adults Aged 65 and Older 1784
Females Aged 15 - 44 2323
Total Housing Units 4328
Demographics Statistics Source: 1990 US Census
*Calculated using an area-proportion spatial analysis technique
Robinson Insulation
Legend
Exfoliation Site
One Mile Buffer
Half Mile Buffer
Quarter Mile Buffer
Schools (K to 12)
0 0.5 1 Miles
Date of Operation: 2/1967 - 6/1983
No. of Shipments: 170
Total Tons: 16,150
Base Map Source: 1995 TIGER/Line Files
Population Density
Source: 1990 U.S. Census
US Census Block
Zero Population *
>0 - 1000 *
>1000 - 2000 *
>2000 *
* Persons / Sq. KM
Scale in Miles
Children 6 Years and Younger
Source: 1990 U.S. Census
US Census Block
Zero Population
1 - 9 Children
10 - 20 Children
> 20 Children
Scale in Miles
Adults 65 Years and Older
Source: 1990 U.S. Census
US Census Block
Zero Population
1 - 9 Adults
10 - 20 Adults
> 20 Adults
Scale in Miles
Females Aged 15 - 44
Source: 1990 U.S. Census
US Census Block
Zero Population
1 - 9 Females
10 - 20 Females
> 20 Females
Scale in Miles
LMR073102
ATSDR SAIDS

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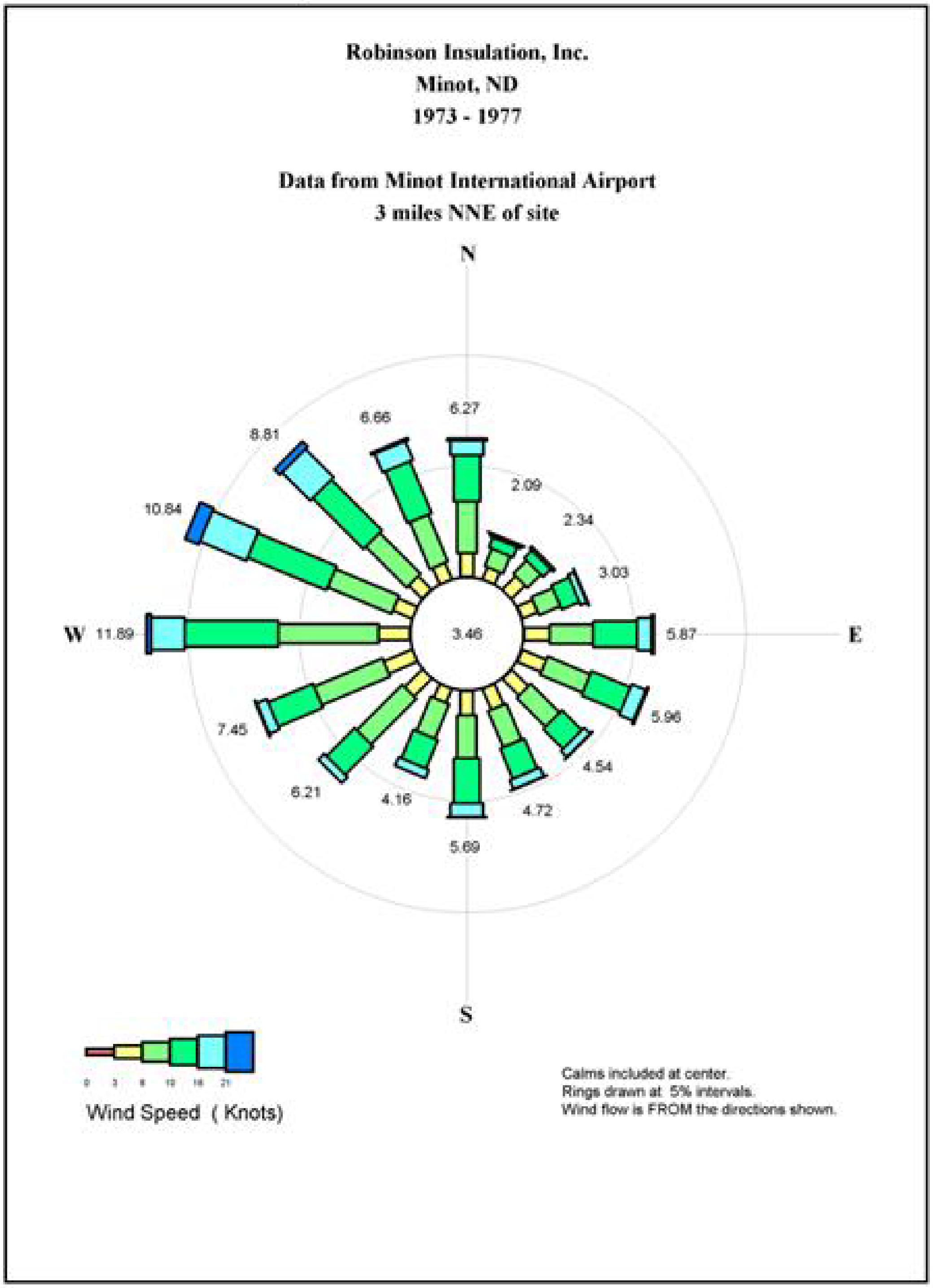
Figure 3. Figure 4-1 from [1].

Figure 4. Wind Rose Data



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APPENDIX A. EXPOSURE PATHWAYS- VERMICULITE PROCESSING FACILITIES

SOURCE FOR ALL PATHWAYS: Libby Asbestos-contaminated Vermiculite from Libby, Montana

PATHWAY NAME	ENVIRONMENTAL MEDIA & TRANSPORT MECHANISMS	POINT OF EXPOSURE	ROUTE OF EXPOSURE	EXPOSURE POPULATION	TIME
Occupational	Suspension of Libby asbestos fibers or contaminated dust into air during materials transport and handling operations or during processing operations	Onsite	Inhalation	Former workers	Past
	Suspension of Libby asbestos fibers into air from residual contamination inside former processing buildings	Inside former processing buildings	Inhalation	Current workers	Present, future
Household Contact	Suspension of Libby asbestos fibers into air from dirty clothing of workers after work	Workers' homes	Inhalation	Former and/or current workers' families and other household contacts	Past, present, future
Waste Piles	Suspension of Libby asbestos fibers into air by playing in or otherwise disturbing piles of vermiculite or waste rock	Onsite, at waste piles	Inhalation	Community members, particularly children	Past, present, future
Residential Outdoor	Suspension of Libby asbestos fibers into air by disturbing contaminated vermiculite brought offsite for personal uses (gardening, paving driveways, traction, fill)	Residential yards or driveways	Inhalation	Community members	Past, present, future
Residential Indoor	Suspension of household dust containing Libby asbestos fibers from plant emissions, or residential outdoor waste	Residences	Inhalation	Community members	Past, present, future
Ambient Air	Stack emissions and fugitive dust from plant operations into neighborhood air	Neighborhood around site	Inhalation	Community members, nearby workers	Past
Onsite Soils	Suspension of Libby asbestos fibers into air from disturbing contaminated material remaining in onsite soils (residual soil contamination, buried waste)	Areas of remaining contamination at or around the site	Inhalation	Current onsite workers, contractors, community members	Present, future
Consumer Products	Suspension of Libby asbestos fibers into air from using or disturbing insulation or other consumer products containing Libby vermiculite.	Homes where LA-contaminated products were/are present	Inhalation	Community members, contractors and repairmen	Past, present, future