Health Consultation

Residual Soil and Indoor Asbestos Assessment

WESTERN MINERAL PRODUCTS SITE

MINNEAPOLIS, HENNEPIN COUNTY, MINNESOTA

EPA FACILITY ID: MNN000508056

Prepared by
The Minnesota Department of Health

FEBRUARY 21, 2012

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

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and ATSDR Division of Regional Operations

FOREWORD

This document summarizes public health concerns related to an industrial facility in Minnesota. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH). For a formal site evaluation, a number of steps are necessary:

- *Evaluating exposure:* MDH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is found on the site, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. Rather, MDH relies on information provided by the Minnesota Pollution Control Agency (MPCA), the US Environmental Protection Agency (EPA), and other government agencies, private businesses, and the general public.

- *Evaluating health effects:* If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. MDH's report focuses on public health— that is, the health impact on the community as a whole. The report is based on existing scientific information.

- *Developing recommendations:* In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure to pollutants. The role of MDH is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including EPA and MPCA. If, however, an immediate health threat exists, MDH will issue a public health advisory to warn people of the danger and will work to resolve the problem.

- *Soliciting community input*: The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the individuals or organizations responsible for the site, and community members living near the site. Any conclusions about the site are shared with the individuals, groups, and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. *If you have questions or comments about this report, we encourage you to contact us.*

Please write to: Community Relations Coordinator
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625 North Robert Street
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(toll free call - press "4" on your touch tone phone)

On the web: http://www.health.state.mn.us/divs/eh/hazardous/index.html

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I. Summary

INTRODUCTION	The Minnesota Department of Health's (MDH) mission is to protect, maintain, and improve the health of all Minnesotans. For communities living near state or federal Superfund sites, MDH's goal is to protect people's health by providing health information the community needs to take actions to protect their health. MDH also evaluates environmental data, and advises state and federal regulatory agencies and local governments on actions that can be taken to protect public health. The Western Mineral Products site in Northeast Minneapolis contains a former insulation products manufacturing plant that processed asbestos-contaminated vermiculite ore shipped from Libby, Montana. Libby asbestos was found and cleaned up on 268 residential properties from 2000-2003. A remediation of Libby asbestos contamination at nearby Gluek Park was completed in 2006. This document summarizes follow-up sampling that EPA completed in 2008 and 2010 to determine if further evaluation and cleanup of site-related asbestos contamination is needed.
OVERVIEW	MDH reached four conclusions in this Health Consultation for the Western Mineral Products site.
CONCLUSION 1	Indoor air and dust from residences that previously had Libby asbestos contamination in their yards is not expected to harm people's health.
BASIS FOR CONCLUSION	The majority of the residences did not have detectable levels of Libby asbestos in indoor air. Approximately 30 percent (14 out of 48) of residences had detectable, but very low concentrations in air. There was no Libby asbestos detected in settled dust samples from any residence.
NEXT STEPS	There is no need for further action.
CONCLUSION 2	Libby asbestos in the soil of homes in Northeast Minneapolis is not expected to harm people's health.
BASIS FOR CONCLUSION	Asbestos was not detected in any soil samples.

NEXT STEPS	There is no need for further action.
CONCLUSION 3	Additional cases of disease may occur in the future due to past exposure to Libby asbestos from vermiculite processing in Northeast Minneapolis.
BASIS FOR CONCLUSION	Latency periods (the lag time between exposure and observable effects) are known to be up to 50 years or greater for asbestos-related diseases.
NEXT STEPS	Resources permitting, MDH will plan an investigation of mesotheliomas in the Northeast Minneapolis Community Vermiculite Investigation (NMCVI) cohort.
CONCLUSION 4	It cannot be concluded whether vermiculite insulation in homes could harm people's health.
BASIS FOR CONCLUSION	It is unknown if exposure to asbestos fibers from disturbed vermiculite insulation in homes is occurring at levels sufficient to cause disease.
NEXT STEPS	MDH will continue to provide information to Northeast Minneapolis residents to increase awareness of vermiculite insulation and ways to reduce exposure.

II. Background

The Western Minerals facility, located at 1720 Madison St. NE in Minneapolis, processed vermiculite ore mined in Libby, Montana, from the late 1930s until 1989. The ore was contaminated with amphibole asbestos and asbestiform minerals of several different types, collectively termed Libby asbestos. Residents of neighborhoods surrounding the facility commonly used waste rock containing Libby asbestos in their yards and driveways.

There is a history of site investigations and community studies to assess the potential impacts of site-related contamination on properties and residents who lived near the site. MDH has written two Health Consultations describing the site and potential for exposure to Libby asbestos (MDH 2001, 2003). From 2000-2003, over 1,600 property inspections were conducted by EPA, MDH, and ATSDR staff. Libby asbestos contamination was found in the soil of 268 properties and cleaned up by EPA. In addition, a report of the Northeast Minneapolis Community Vermiculite Investigation (NMCVI) was completed in 2005 (MDH, 2005). The NMCVI studied asbestos exposures of over 6700 people who lived in the area

surrounding Western Minerals between 1938 and 2001. Most recently, Alexander et al., 2011 describes measurable effects of community exposure to asbestos contaminated vermiculite in a subset of the NMCVI cohort.

At the end of September, 2008, EPA collected air and dust samples from 48 residences that were among the 268 properties that previously had Libby asbestos contamination, and have since been remediated. Four homes where asbestos contamination was not found were also sampled – these are referred to as "reference homes." The sampling was done to determine if site-related asbestos was present in indoor air and dust in homes, and whether amounts found would pose a health concern to residents. In September of 2010, EPA sampled soil from 40 additional properties that did not have prior soil removal to reassess the protectiveness of earlier soil investigation and removal actions.

The purpose of this Health Consultation, which was requested by EPA and ATSDR, is to document and summarize the studies EPA conducted in 2008 and 2010 and to describe and interpret the results.

III. Discussion

Purpose of 2008 air and dust sampling

EPA conducted the 2008 study to determine if asbestos fibers from the former Western Minerals plant were present in air and dust inside homes where asbestos-contaminated soils were previously removed from the property. Because many residents used waste rock from the Western Minerals plant in their yards (e.g., driveway fill, landscape rock, and as a garden amendment), Libby asbestos may have been tracked inside the homes. Homes may also have been affected by asbestos emitted from the plant. The City of Minneapolis has records that indicate dust from the plant was spread over the neighborhood at various times. Asbestos fibers from vermiculite dust could have entered homes directly or may have been tracked inside after being deposited to the ground. Asbestos contaminated vermiculite dust may also have been brought home on clothing or other articles by plant workers, or by other activities involving contact with vermiculite waste.

This sampling was intended to determine if further evaluation of site-related indoor asbestos exposure is needed. EPA stated that the assessment would contribute to knowledge in the following areas:

- If Libby asbestos fibers are in indoor air
- To what extent fibers in household dust become airborne
- Whether data from the test homes can be applied to all homes in the area
- Whether Libby asbestos in indoor air poses a health concern for residents

Air and dust study protocol

On September 16, 2008, EPA held a public meeting in the neighborhood to explain the indoor sampling study to interested residents. To be eligible, residences must have had asbestos contamination in their yard that was subsequently cleaned up by EPA. EPA sent notification letters to eligible residences that were randomly selected to participate. Property owners gave written permission for access to their

homes before sampling began. If an owner chose not to participate, another eligible home was randomly selected. All participants were informed that the results would be public information.

A simple questionnaire was used to gather information about each property, including things such as the type of insulation, the heating and ventilation system, and if known asbestos-containing materials were present in the home. Responses were not verified nor were inspections performed by EPA staff to collect information that the resident didn't know. In two homes, vermiculite insulation was found to be present in either the attic or within walls. However, no asbestos fibers were detected in air or dust samples from either home. Low levels of asbestos were detected in indoor air at several homes where possible asbestos sources may have been present (e.g. exterior siding, heating pipe insulation).

The 2008 study included 48 residences: 19 single family homes and 29 multi-unit dwellings (see Figure 1 for study location). Generally, one air sample was collected at each residence. Air sampling devices were placed in homes at locations where exposure was most likely. The devices sampled the air with vacuum pumps that drew air into a container where microscopic particles were collected on a filter, over a period of about 24 hours. One dust sample was generally collected at each residence as well. These were composite samples from three locations in each residence where dust had settled (Lockheed, 2009). In addition, four homes not affected by asbestos contamination in the yard were sampled as reference sites. Eighteen samples from outdoor (ambient) air were also taken at three different locations. All samples were collected from September 24-30, 2008.

The air and dust samples were analyzed using transmission electron microscopy (TEM). Analytical methods used to detect asbestos have been described previously (MDH, 2001). In brief, TEM involves systematic visual observation of asbestos fibers using a magnification of approximately 20,000 times. TEM analysis is able to detect fibers down to approximately 0.1 micrometer (μm) in width and allows for the determination of the individual fiber type. Another analytical method, phase-contrast microscopy (PCM), is required by the federal Occupational Safety and Health Administration (OSHA) for determining compliance with workplace standards. PCM cannot differentiate asbestos fibers from other fibers, and routinely only detects fibers down to approximately 0.25 μm in width. Specific OSHA method protocols mandate that only those fibers that are ≥ 5 μm in length and have at least a 3:1 length to width ratio are counted using PCM. Because of the difference in detection between the two methods, more short, thin fibers are detected using TEM than PCM. However, since PCM is the method used to assess exposures that are used to calculate health risk, TEM results are often translated into PCM-equivalents (PCME) (EPA, 2008a). PCME refers to fibers identified through TEM that are similar to those that would be identified through PCM. PCME values are compared to health screening values for this assessment.

Results of the 2008 air and dust sampling

Of the 48 residences sampled, 23 had detectable levels of asbestos in the air or dust samples. Very low levels of Libby asbestos (0.0001 to 0.0016 TEM f/cc) was detected in air from 14 residences (EPA, 2011). Libby asbestos contains the following amphibole fiber types (italicized in Table 1); tremolite, actinolite, richterite, and winchite. Amphibole fibers are generally brittle and often have a rod or needle-like shape (ATSDR, 2001). Air samples for several residences where Libby asbestos was not found did detect other

forms of amphibole asbestos fibers. These include anthophyllite and amosite at low levels (0.0001 to 0.0003 TEM f/cc) in four residences, which may have entered the air from the weathering of other sources of asbestos.

Chrysotile asbestos was detected at low levels in air (0.0001 to 0.00057 TEM f/cc) in three residences where Libby asbestos was not found and also in three dust samples (in two additional residences that didn't have any other asbestos). This is the most common form of commercial asbestos –over 99% of commercial asbestos used in the United States is chrysotile (ATSDR 2001). Chrysotile fibers belong to a different family of minerals, called serpentine, which are flexible and curved, unlike amphibole fibers. Libby asbestos does not contain chrysotile fibers; therefore no Libby asbestos was found in any dust sample.

If results of the 14 residences with Libby asbestos in the air are expressed as PCME, Libby asbestos fibers were identified in five homes at concentrations ranging from 0.0001 to 0.0002 PCME f/cc.

Table 1 – Results of the air sampling (14 of the 48 residences had detectable concentrations of Libby asbestos in air)

Residence	Sample #	PCME[2] (f/cc)	Fiber Type (PCME)	TEM-EPA SM (f/cc)	Fiber Type (TEM-EPA SM)
1	51781	--		0.0001	*tremolite*
2	51780	0.0001	*winchite*	0.0002	*winchite*
3	51750	0.0001	*actinolite winchite*	0.0001	*actinolite, winchite*
4	51751	0.0002	*actinolite winchite*	0.0003	*actinolite, winchite*
5	51840	0.0005	anthophyllite	0.001	*winchite*, anthophyllite, *tremolite*
6	51825	--		0.001	*actinolite*
7	51815	--		0.0002	*actinolite*
8	51805	0.0001	*winchite*	0.0001	*winchite*
9	51857	--		0.0001	*winchite*
10	51752	--		0.0001	*actinolite*
11	51753	0.0002	*winchite*	0.0002	*winchite*
12	51806[1]	0.0007	anthophyllite	0.0016	anthophyllite*, tremolite,* amosite
13	51731	--		0.0001	*actinolite*
14	51774	--		0.0002	chrysotile*, actinolite*

f/cc = fibers per cubic centimeter
TEM-EPA SM (Transmission Electron Microscopy-EPA Superfund Method): fibers with lengths ≥ 0.5 µm, widths ≥ 0.1 µm, aspect ratio ≥ 3:1
PCME (Phase-Contrast Microscopy Equivalents): fibers with lengths ≥ 5 µm , widths ≥ 0.25 µm, aspect ratio ≥ 3:1
[1]Due to particulate overloading, an alternative method of analysis was used (indirect method). This may overestimate the fiber concentrations.
[2] PCME refers to fibers identified through TEM that are equivalent to those that would be identified by Phase-Contract Microscopy (PCM). Some fibers detected by TEM wouldn't be detected under PCM, shown above as (--).

Eight indoor air and dust samples were taken at four reference homes. Two homes had an air sample that contained low levels of Libby asbestos – 0.0001 and 0.0003 TEM f/cc (ND-0.0003 PCME f/cc). Table 2 shows the results for samples where Libby asbestos was found in the reference homes.

Table 2 – Reference homes (2 of the 4 homes had detectable concentrations of Libby asbestos in air)

Residence	Sample #	PCME[1] (f/cc)	Fiber Type (PCME)	TEM-EPA SM (f/cc)	Fiber Type (TEM-EPA SM)
1	51854	0.0003	anthophyllite, *actinolite*	0.0003	anthophyllite, *actinolite*
2	51866	--		0.0001	*actinolite*

f/cc = fibers per cubic centimeter
TEM-EPA SM (Transmission Electron Microscopy-EPA Superfund Method) : fibers with lengths ≥ 0.5 µm, widths ≥ 0.1 µm, aspect ratio ≥ 3:1
PCME (Phase-Contrast Microscopy Equivalents): fibers with lengths ≥ 5 µm , widths≥ 0.25 µm, aspect ratio ≥ 3:1
[1] PCME refers to fibers identified through TEM that are equivalent to those that would be identified by Phase-Contract Microscopy (PCM). Some fibers detected by TEM wouldn't be detected under PCM, shown above as (--).

Eighteen outdoor (ambient) air samples were also taken at three different locations between September 25-29, 2008. Actinolite or winchite fibers (which may be from Libby) were detected in three samples at 0.0001 TEM f/cc and chrysotile fibers were detected in three samples, also at 0.0001 TEM f/cc.

Interpretation of results

Background levels

Asbestos fibers in very small quantities are ubiquitous in ambient air (ATSDR 2001). Fibers from the deterioration of many commercial asbestos-containing products (such as vehicle brakes and clutches, insulation, floor and ceiling tiles, and fire-proofing materials) as well as weathering of natural sources of asbestos minerals in the environment make up the majority of fibers found at background levels in ambient air (ATSDR, 2001). Average concentrations of asbestos in outdoor air have been measured at quantities ranging from 0.00000001 to 0.0001 PCM f/cc (ATSDR, 2001).

Results of ambient air monitoring in NE Minneapolis that occurred in 2000 during remediation activities ranged from non-detect to 0.0052 TEM f/cc. Ten of 25 samples collected from 11 locations surrounding the site contained low levels of actinolite/tremolite asbestos fibers (MDH 2001). These results may have been affected by the cleanup of residential properties at that time, and therefore may be higher levels than typical ambient levels in that neighborhood (MDH 2001).

Asbestos concentrations in indoor air can vary over a relatively large range, due to factors such as the presence and condition of asbestos-containing building materials, occupant behaviors, and building operations. A study that measured indoor air in 315 buildings that included mainly schools, commercial

and public buildings, found the average level of asbestos in indoor air was approximately 0.0001 TEM f/cc (Lee et al., 1992). However, no asbestos was detected in approximately 48 percent of the samples. Only two percent of the fibers identified were amphibole; most were identified as chrysotile. Many studies show similar levels of asbestos measured in indoor air (ATSDR 2001). In a 2003 World Trade Center Indoor Environmental Assessment, EPA estimated that the background levels of fibers in residential indoor environments ranges from not detectable to 0.002 PCME f/cc (EPA 2003).

Dust results

Libby asbestos was not detected in settled dust samples from any homes. Where asbestos was detected, only the chrysotile form was found, the most common type of commercial asbestos. Chrysotile asbestos was detected in three of the study residences, and in one reference home. All of these samples had one fiber counted in the sample surface area; this equates to 846 f/cm^2 by TEM. Chrysotile asbestos may come from many sources including duct work or furnace insulation, floor tiles, decorative plaster, electrical panels, ceiling texture, etc.

It is difficult to determine a level of potential health concern of asbestos in settled dust because of the uncertainty in determining how much the dust will become airborne and available to be inhaled. The resuspension of deposited fibers into the air is highly variable, and is affected by activities that disturb the dust (e.g. interior cleaning). Health-based standards for acceptable concentrations of asbestos in indoor dust do not exist. Based on the very low levels of asbestos fibers in the dust samples measured in the Northeast Minneapolis homes, and the assumption that these chrysotile dust results are common background levels from building materials, the health risk is currently considered to be very low.

Air results

EPA determined that asbestos poses a health concern for residents if airborne levels exceed 0.0005 f/cc PCME (EPA 2008b). This level of concern is based on cancer toxicity data derived from EPA and a risk of one additional lifetime cancer case among 10,000 individuals exposed for 30 years. Although MDH typically defines an elevated cancer risk to be one additional cancer case per 100,000 people, the EPA approach is appropriate for two reasons. First, a screening level (asbestos concentration) with an estimated lifetime cancer risk level of 1/100,000 may be less than background concentrations. Furthermore, it is difficult to measure the difference in health risk between typical background exposure and any additional slight increase (ATSDR, 2008). Second, the minimum amount of asbestos that can be measured (the detection limit) using common sampling and analytical protocols is near the 1 in 10,000 risk level. In this study the TEM detection limits for the indoor air and ambient air samples are 0.0003 f/cc, which is just below the health screening level. Indoor and ambient air samples taken for this study are at or near the levels that would be considered background, and therefore are not expected to pose any measurable increased health risk.

The highest concentration detected as PCME (0.0007 f/cc in air) was for an asbestos form called anthophyllite. Since this type of asbestos is not associated with the Libby vermiculite or commonly found in building material, the source of these fibers is unknown. However, the concentration is only slightly above the health-based screening level, and is considered to be of minimal health concern.

However, the finding does point to the potential for asbestos exposure and possible health risks in homes. EPA sent out letters to residents describing the sampling results in June 2009.

Asbestos in Reference Homes

Low levels of the same type of asbestos as is found in Libby vermiculite ore were detected in air samples from two of the four reference homes. While the source of asbestos in those homes is unknown, one home was downwind and nearby the Western Minerals facility and the other home had old wrapping around the heating pipes that could have contained asbestos.

Vermiculite Insulation

Assessing whether the presence of vermiculite insulation in the home had an effect on exposure to asbestos in indoor air was not a specific objective of this study. The property questionnaires asked homeowners if they knew they had vermiculite insulation, but EPA did not inspect attics or wall spaces to confirm the type of insulation. For two homes where vermiculite waste material was detected in the exterior soil, the homeowner knew of the presence of vermiculite insulation in the attic or within wall spaces. However, in both cases, Libby asbestos fibers were not detected in air or dust samples. Since many homeowners did not know the types of insulation in their home, we are not able to make any statements about the potential impact of vermiculite insulation on the sampling results for homes in this area.

From 2001-2003, EPA conducted a pilot study to better understand if homeowners are exposed to asbestos during typical activities that may disturb vermiculite insulation in an attic, such as installing wiring or moving boxes (Versar, 2003). A general conclusion of this study was that undisturbed insulation poses little risk, but residents may be at a risk of exposure if vermiculite insulation is disturbed (Versar, 2003).

It is unknown how many homes in Minnesota may have vermiculite insulation, but EPA officials have reportedly said it could be in more than 10 million homes across the country (Gordon, 2003) or about 10% or more of homes. Federal and state efforts to build awareness about vermiculite attic insulation in homes have recommended that it should not be disturbed, attic use should be limited, and removal should only be done by a professional (EPA 2010, MDH 2001b).

Although typical residential exposure to attic vermiculite insulation may be limited, workers in a number of occupations may be frequently exposed to elevated levels of asbestos. Builders/remodelers, inspectors, electricians, and others who repair homes as a hobby may regularly disturb vermiculite insulation.

Purpose of 2010 soil sampling

The regulatory level EPA uses to define an asbestos-containing material is one percent (1%) asbestos. This threshold was created to ban materials that contain significant amounts of asbestos and to allow the use of materials that either naturally contain asbestos or have less than one percent added to

enhance effectiveness of the commercial product (EPA, 2004). At the time it was first used (1973), one percent was the limit of detection for asbestos fibers using the PCM analytical method (EPA, 2004). Subsequently, the one percent threshold was used as a criterion to determine whether a cleanup is necessary at many EPA sites, including Western Minerals.

In August of 2004, Michael Cook, Director of EPA's Office of Superfund Remediation and Technology Division, wrote a memorandum to Superfund National Policy Managers to clarify asbestos cleanup goals. This policy memo states that staff "should not assume that materials containing less than one percent asbestos do not pose an unreasonable risk to human health" and that staff "should develop risk-based, site-specific action levels to determine if response actions should be taken when materials containing less than one percent asbestos (including chrysotile and amphibole asbestos) are found on a site" (EPA, 2004). The memo goes on to say that EPA has site data providing evidence that "soil/debris containing significantly less than one percent asbestos can release unacceptable air concentrations of all types of asbestos fibers." Levels of airborne asbestos from soil contamination are determined by activities that disturb the soil. Due to this understanding that levels of asbestos in the soil below one percent may be of health concern, EPA decided to return to Northeast Minneapolis to reassess the protectiveness of the previous removal actions (Lockheed 2010).

Soil sampling protocol

Over 1,600 residences were originally inspected in connection with the Western Minerals site, most of which are in Northeast Minneapolis near the former plant site. Soil sampling for asbestos was only done at properties with visually identified Libby asbestos. For the 2010 study, a subset of 95 properties within a ½ mile and downwind from the former plant were identified. Fifty properties were randomly selected for collection of soil samples for asbestos analysis, and 40 properties were actually sampled. Previous soil removal was not conducted at any of the sampled properties. Four of the 40 properties had been previously sampled and Libby asbestos was detected at trace to less than one percent asbestos (Lockheed, 2010).

Soil samples were collected between September 10 - 13, 2010. For each property, 30 small samples (increments) were taken along a systematic grid pattern based on a random starting location. These were then combined in one container and a portion of the combined sample was sent to the laboratory for analysis. This sampling method, called incremental sampling, reduces the chances of missing or underestimating the amount of asbestos that may be present somewhere on each property. This method therefore increases the likelihood of obtaining a sample result that is a good estimation of the mean concentration of Libby asbestos on each property (Lockheed, 2010). Samples were analyzed using polarized light microscopy (PLM) with the California Air Resources Board (CARB) 435 method. This is a specialized method that includes crushing the sample using a mill.

Soil Results

None of the soil samples had detectable asbestos fibers using the CARB 435 PLM method, which has a detection limit of 0.25% asbestos. With any existing soil or bulk material analytical method there may still be a concern about an inhalation exposure resulting from airborne dispersion. To address this issue,

a subset of these samples were tested with the Fluidized Bed Asbestos Segregator. This method is more sensitive for the detection of airborne asbestos fibers. This method vigorously mixes the soil under an air flow and collects an air sample on a filter. The filters are then analyzed using the TEM method. None of the additional five samples tested using the Fluidized Bed Asbestos Segregator method had detectable asbestos fibers. This additional analysis provides additional supporting evidence that the exterior soils near the Western Minerals facility do not contain asbestos fibers that would be a health concern.

Cancer Surveillance

MDH has identified excess disease in Northeast Minneapolis. An excess of lung cancer was seen in males and an excess of mesothelioma was seen in females compared to metro area cancer rates and a similar size and age of the population (MDH 2011). The relationship of these higher rates to operations of Western Minerals is unknown. Further research with the NMCVI cohort may show whether there is in fact an increased occurrence of mesothelioma and/or lung cancer due to Western Minerals operations.

Toxicology and Risk Assessment

Asbestos toxicology has been described previously (MDH 2001). The toxicology of the type of asbestos found in the Libby vermiculite ore is still under investigation. The health-based screening levels used in this document represent the best scientific information available at this time for evaluating risk from cancer that may be associated with asbestos exposure. EPA is currently conducting a toxicity assessment to evaluate the cancer and noncancer respiratory effects of exposure to Libby asbestos, such as asbestosis and pleural disease. A reevaluation of health-based screening levels may be considered based on the findings of the noncancer impacts.

It has long been known through studies of workers in Libby and at vermiculite processing facilities that high levels of exposure to Libby asbestos can lead to structural changes in the lung and pleura (lining of the lung) including pulmonary fibrosis, pleural calcification, and death from nonmalignant (non-cancerous) respiratory disease (ATSDR 2001). Several publications note that adverse pleural changes are the most common consequence resulting from exposure to asbestos (Rohs et al., 2008). The University of Minnesota, with MDH collaboration, has completed a study of pleural changes in the NMCVI cohort (see Appendix 1). The University of Minnesota has found pleural changes in members of the cohort who played on the waste piles or who lived very near the processing plant (Alexander et al., 2011).

One recent epidemiologic study demonstrates that exposure to Libby vermiculite can cause pleural thickening in a dose-response manner at levels that are lower than current acceptable occupational standards over a lifetime (Rohs et al., 2008). This study reevaluated a cohort of vermiculite plant workers to determine the increase in pleural changes 25 years later, which was also 25 years since their last Libby vermiculite occupational exposure. Pleural changes identified increased from 2% of participants when first studied in 1980 to 28.7% of participants in 2005. In addition, pleural changes were shown to be directly related to the amount of exposure (Rohs et al., 2008). In another study, a

large cohort of 6,668 residents and workers in Libby received chest radiographs to assess, in part, the prevalence of pleural abnormalities, which were observed in nearly 18% of the participants (Peipins et al., 2003). A mortality study of Libby workers which was intended to describe mortality over a range of exposures showed significant excess mortality from non-malignant respiratory disease in both workers who were employed for less than one year and those with the lowest cumulative exposure levels (Sullivan et al., 2007).

In September of 2008, EPA published the Framework for Investigating Asbestos-Contaminated Superfund Sites that provides technical and policy guidance on making risk management decisions for asbestos sites (EPA 2008). The document emphasizes that asbestos materials are not hazardous unless asbestos fibers are released into the air and inhaled. However, predicting the amount of fibers that may be released in any one source material is very complex.

Children's Health Considerations

MDH recognizes that the unique vulnerabilities of infants and children are of special concern to communities faced with contamination of their water, soil, air, or food. Children are at a greater risk than adults from certain kinds of exposures to environmental contaminants at waste disposal sites. They are more likely to be exposed because they often play outdoors and bring food into contaminated areas. Children are smaller than adults, which means they breathe dust and heavy vapors that are close to the ground; and children receive higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk-identification and risk-management decisions, housing decisions, and for access to medical care.

In the past, children were more at risk from exposures to Libby asbestos because of behavior, such as playing in waste piles (Alexander et al., 2011). Because of the long latency periods for many asbestos-related health outcomes, the full disease burden may not have occurred yet among persons who were exposed as children (ATSDR, 2001). Currently there are no identified exposures to children above background levels.

IV. Conclusions

From the late 1930s to 1989, vermiculite processing at the Western Minerals plant was a source of asbestos exposure to plant workers and residents in Northeast Minneapolis. Vermiculite-associated asbestos contamination of soils and driveway surfaces at more than 265 properties was cleaned up during 2000-2003. To confirm that the exterior cleanup was sufficient to eliminate exposure to this asbestos, EPA conducted further indoor air and dust sampling in 2008 and soil sampling in 2010.

Levels of Libby asbestos in indoor air in homes, if present, were at levels similar to background concentrations. No Libby asbestos was detected in indoor dust or exterior soil. Therefore, contamination from the Western Mineral plant appears to have been effectively removed from the neighborhood residences and is not expected to harm people's health. Nevertheless, because asbestos-

related diseases often have long latency periods (up to 50 years), disease may continue to occur into the future due to past exposure to Libby asbestos from vermiculite processing in Northeast Minneapolis.

EPA's data collection described in this report does not address vermiculite insulation. It is unknown if exposure to asbestos fibers from vermiculite insulation in homes is occurring at levels that may cause disease.

(Note: MDH has an information sheet about vermiculite insulation on its website: http://www.health.state.mn.us/divs/eh/hazardous/sites/hennepin/western/insulation.html which links to the ATSDR webpage on vermiculite in consumer products.)

V. Recommendations

Given the indoor air, dust, and soil samples results, there is no current exposure of concern to Northeast Minneapolis residents from past vermiculite processing activities at Western Minerals. There is no need for further action.

Federal environmental and public health agencies should consider developing a plan to increase public awareness throughout the country of the presence of asbestos in vermiculite insulation and provide recommendations for how to reduce potential exposure.

VI. Public Health Action Plan

1. Resources permitting, MDH will plan an investigation of cancer in the Northeast Minneapolis Community Vermiculite Investigation (NMCVI) cohort.
2. MDH will continue to provide information to Northeast Minneapolis residents to increase awareness of vermiculite insulation and ways to reduce exposure.

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VIII. Report Preparation

This Health Consultation for the Western Minerals Site was prepared by the Minnesota Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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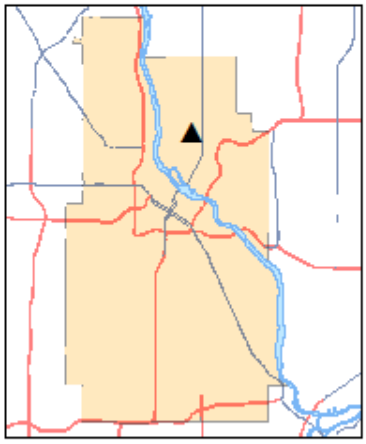
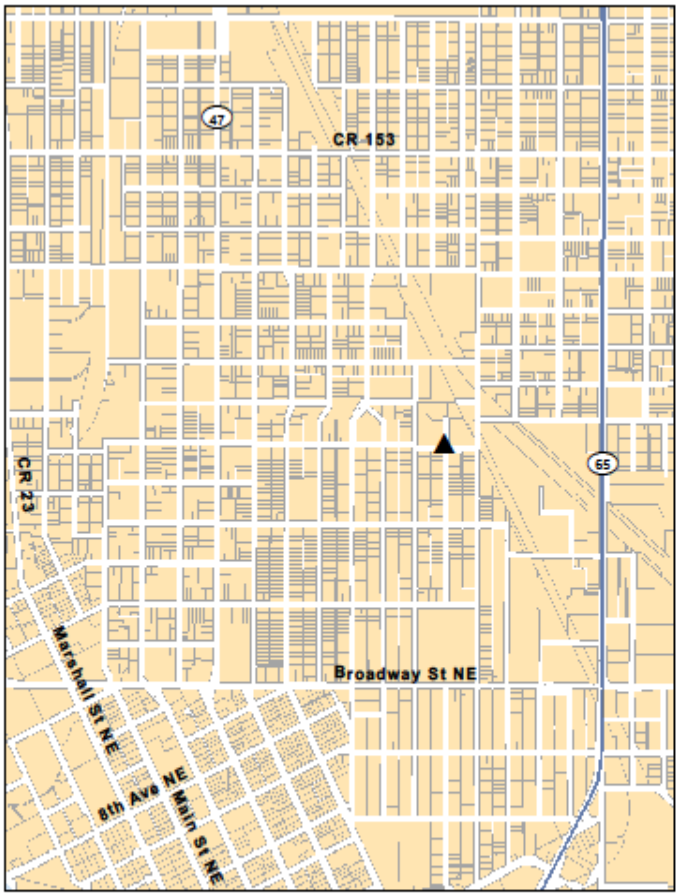
Figure 1: Western Minerals Residential Air and Dust Sampling

State of Minnesota



City of Minneapolis



Western Minerals site
Minneapolis
Major Highways
Highways
Mississippi River

N

Libby asbestos was detected in air at very low levels at 14 of the 48 residences sampled.

All but two residences are within the boundaries of the map.

0.25 0.125 0 0.25 Miles

Appendix 1: Northeast Minneapolis Respiratory Health Study results letter

January 15, 2010

«FIRST_NAME» «MIDDLE_NAME» «LAST_NAME»
«STREET_ADDRESS»
«CITY», «STATE» «ZIP5_CODE»

Dear «FIRST_NAME» «LAST_NAME»:

The Northeast Minneapolis Respiratory Health Study has been completed. I am writing to let you know about the final results of the study. If you attended the clinic and had a chest x-ray for this study, you have already received your individual results.

This study was a joint effort between the University of Minnesota and the Minnesota Department of Health. The goal of this study was to learn if environmental exposure to asbestos in vermiculite from the Western Minerals/WR Grace plant in Northeast Minneapolis affected the lungs of people who lived in the community. There is controversy over how much asbestos exposure is needed to cause lung changes, and whether exposure outside of the workplace is important. This study may help answer these questions.

Ultimately, 461 people attended the clinic and had an x-ray taken. There were 49 people whose x-rays showed measurable changes in the lining of their lungs (the pleura) that could have been caused by asbestos exposure. Using information provided by study participants on their questionnaires, we estimated how much asbestos from the Western Minerals/WR Grace site each person was possibly exposed to from living near the plant and from any direct contact with the waste material. We estimated that people with the measurable changes in their lungs had, on average, about 3 times more exposure to asbestos from the Western Minerals/WR Grace plant or the waste rock.

The long-term health consequences related to these changes in the lung are not clear. However, these results suggest that some people who never worked at the Western Minerals/WR Grace plant were exposed to enough asbestos in the contaminated vermiculite waste to have some effect on their lungs. A brochure is attached that further explains the results.

The results of this study will help scientists and government officials understand the potential impact of environmental asbestos exposure. Answering these questions can only be done with the help of people like you who are willing to participate in these scientific studies. We thank you for your past participation. If there are further opportunities to examine these issues we may be in contact with you.

Sincerely,

Bruce H. Alexander, PhD
Associate Professor
Principal Investigator

Northeast Minneapolis Respiratory Health Study

UNIVERSITY OF MINNESOTA

Division of Environmental Health Sciences

MINNESOTA MDH DEPARTMENT OF HEALTH

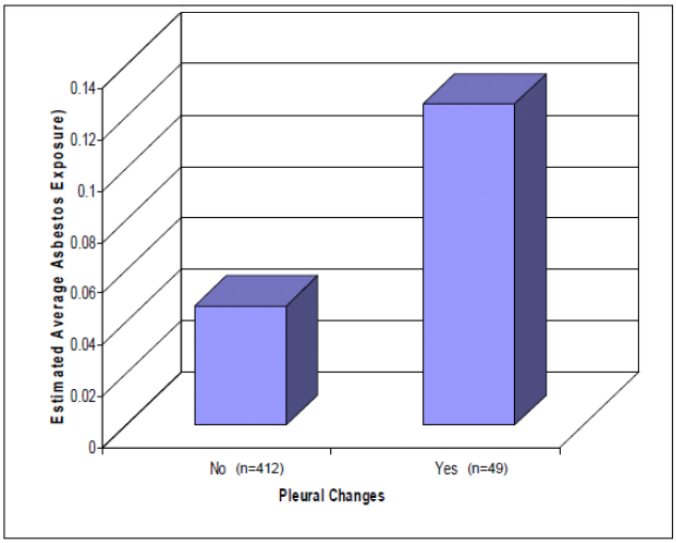
What did the study do?

The goal of the Northeast Minneapolis Respiratory Health Study was to find out if people who did not work at the Western Minerals/WR Grace plant, but may have been exposed to asbestos from the contaminated vermiculite, have changes in their lung health. People who didn't work at the plant may have breathed in asbestos while moving waste from the plant, using waste in their home or yard, installing or removing vermiculite insulation or playing in the waste piles outside of the plant. People who lived in the neighborhood may have also been exposed to asbestos in dust produced by the plant.

We signed up 461 people who went to a clinic for a chest x-ray and a breathing test. We estimated the amount of "asbestos exposure" the participants may have had based on where they lived, and how much and how often they had contact with waste rock from the Western Minerals/WR Grace plant.

What did scientists learn from the study?

- Most people in the study did not have changes in their lungs related to asbestos exposure.
- A total of 49 (of the total 461) people had changes in the lining of their lung (the pleura) that may be linked to asbestos exposure.
- People with these pleural changes had, on average, about 3 times the estimated asbestos exposure compared to people without the pleural changes.



What does this information mean for me?

- Asbestos exposure from contaminated vermiculite is associated with measurable pleural changes in the lungs of people who never worked at the Western Minerals/WR Grace plant.
- People who lived close to the plant or had frequent direct contact with the waste material were more likely to be exposed.
- While scientists agree that pleural changes are a sign of asbestos exposure, the link between these pleural changes and diseases like cancer or asbestosis is unclear.

A collaborative effort between the University of Minnesota School of Public Health and the Minnesota Department of Health

1/2010

About the study participants

All study participants had previously participated in a study conducted by the Minnesota Department of Health in 2001. This study was particularly interested in learning about environmental exposure to contaminated vermiculite. Only people who reported that they never worked at the Western Minerals/WR Grace and had never lived with someone who worked at the plant were recruited for the current study. Because the effects of asbestos exposure take many years to appear, the current study was limited to people who lived in the area around the plant before 1980.

Characteristics of people participating in the study	Number	%
Male	241	52.3
Female	220	47.7
Year of Birth		
≤1940	89	19.3
1941-1950	139	30.2
1951-1960	148	32.1
1960+	85	18.4
Ever a regular smoker	242	52.5
Ever played on waste piles at plant	180	39.0
Ever moved waste material from the plant	51	11.1
Ever used waste at home, lawn or garden	44	9.5
Ever installed/removed vermiculite insulation	44	9.5
Any activities leading to exposure to vermiculite waste	223	48.4
Ever held any asbestos exposed job	129	28.0
All	461	100

What can I do now?

- If you smoke, quit smoking. The risk of developing lung cancer greatly increases for a person who has been exposed to asbestos and also smokes.
- Avoid breathing in asbestos and other dusty situations. Asbestos can be found in many older building materials, like insulation, flooring and ceiling tiles. Avoid disturbing these and if you need to remove them, consult an expert.
- Consult your doctor if you have concerns about lung health.
- Visit the Minnesota Department of Health Web site to learn more about:
    - Asbestos.and health www.health.state.mn.us/divs/eh/asbestos/homeowner/asbinhomes.html .
    - Western Minerals/WR Grace plant site www.health.state.mn.us/divs/eh/hazardous/sites/hennepin/western/workers.html

For more information about health effects of asbestos, please contact Tannie Eshenaur at (651) 201-4873 or by e-mail at Tannie.eshenaur@state.mn.us.

If you have further questions about the study results, please contact the University of Minnesota at 612-625-1151.