Health Consultation

RESPONSE TO PUBLIC COMMENTS

W.R. GRACE DEARBORN PLANT
(a/k/a ZONOLITE COMPANY/WR GRACE)

CITY OF DEARBORN
WAYNE COUNTY, MICHIGAN

OCTOBER 18, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR 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.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR TOLL FREE at
1-888-42ATSDR
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

RESPONSE TO PUBLIC COMMENTS

W.R. GRACE DEARBORN PLANT
(a/k/a ZONOLITE COMPANY/WR GRACE)

CITY OF DEARBORN
WAYNE COUNTY, MICHIGAN

Prepared by:

Michigan Department of Community Health
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

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 United States 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 from 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) recommended 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 that 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.

List of Acronyms and Abbreviations

ACM	asbestos-contaminated material
ATS	American Thoracic Society
ATSDR	Agency for Toxic Substances and Disease Registry
CDC	Centers for Disease Control and Prevention
DMACI	Die, Mold & Automation Components, Inc.
EPA	U.S. Environmental Protection Agency
f/cc	fibers per cubic centimeter
HEPA	high-efficiency particulate air
IR	infrared
IRIS	Integrated Risk Information System
LA	Libby asbestos
MCL	maximum contaminant level
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDPH	Michigan Department of Public Health
NAER	National Asbestos Exposure Review
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCM	phase contrast microscopy
PEL	permissible exposure limit
PLM	polarized light microscopy
RR	railroad
SEM	scanning electron microscopy
TEM	transmission electron microscopy
TWA	time-weighted average
$\mu g/m^3$	microgram per cubic meter
µm	micrometer
WRG	W. R. Grace & Company

I. Summary of Background and History

The former W.R. Grace & Company (WRG) Dearborn plant is located at 14300 Henn Street, Dearborn, Wayne County, Michigan (see Appendix A, Figure 1). Land use in the surrounding neighborhood includes recreational (soccer field across the street), residential, educational, commercial, and industrial. The site is 2.7 acres and has a single 16,000-square-foot building (including roughly 2,000 square feet of office space), which was used to process vermiculite into attic insulation and lightweight concrete aggregate. The original site consisted of a railroad spur, where vermiculite was off-loaded, two storage silos, exfoliation furnaces, and bagging/processing space. Vermiculite processing ended in 1989, when WRG ceased operations at the Dearborn plant.

The current facility on Henn Street was constructed in the late 1940s by National Siding to store manufactured steel siding materials [1]. The Dearborn plant probably started processing vermiculite from Libby, Montana, in the early 1950s, when the Zonolite Company began using the facility. W.R. Grace acquired the Zonolite Company in 1963 and continued to use the Dearborn plant to manufacture attic insulation and lightweight concrete products using vermiculite from Libby. WRG closed the Dearborn plant in 1989 and closed the mine in Libby, Montana, in 1990. The site is currently owned and operated by Die, Mold & Automation Components, Inc. (DMACI), which produces N-Forcer® nitrogen gas springs and wear plates [1]. DMACI had operated their light industrial facility on a site west of WRG, but expanded their operations onto the former WRG property in 1992. The storage silos and exfoliation furnaces that were on the site have been dismantled, and the railroad spur is no longer used.

According to W.R. Grace shipping records, the Dearborn plant processed about 206,055 tons of vermiculite ore from Libby, Montana, from 1966 to 1988. It should be noted that processing of vermiculite from Libby at WRG likely started at least 10 years prior to 1966. Over time, it became known that vermiculite from the Libby mine was contaminated with asbestos fibers, including the amphibole asbestos varieties tremolite and actinolite, as well as the related fibrous asbestiform minerals winchite, richterite, and ferro-edenite. In this document, the asbestos in Libby vermiculite is referred to as “Libby asbestos” (LA).

Studies throughout the 1980s indicated that workers exposed to vermiculite from Libby showed increased rates of asbestos-related respiratory diseases [2–7]. These findings from Libby and from other sites that processed vermiculite from Libby provided the impetus for investigating the Dearborn site and other sites across the nation that received asbestos-contaminated vermiculite from the Libby mine. The asbestos exposures documented in the Libby community, however, are in many ways unique. These exposures will not collectively be present at other sites that processed or handled vermiculite from Libby. The WRG Dearborn plant is being studied as part of the National Asbestos Exposure Review (NAER) Phase 1 investigation because of the high volume of vermiculite processed there and the high levels of LA fibers likely released during the exfoliation process.

Vermiculite Processing

Vermiculite is a nonfibrous, platy, weathered mica mineral type used in many commercial and consumer products. Raw vermiculite is used in gypsum wallboard, cinder blocks, and many other products. Exfoliated vermiculite ("popped" vermiculite) is formed by heating the vermiculite to approximately 2,000 degrees Fahrenheit, which explosively vaporizes the water contained within the mineral structure and causes the vermiculite to expand by 10 to 15 times. Among other uses, the expanded vermiculite is used as loose fill insulation (mainly for attics), as a fertilizer carrier, and as an aggregate in lightweight concrete.

According to interviews with former workers and a local trucking firm, Fairall Trucking, the waste material, called "stoner rock," was hauled off the site in roll-off boxes and dumped at the Riverview Landfill from the early 1980s until the WRG facility closed in 1989. However, there is no documentation concerning the disposal practices of the waste product prior to that time. Interviews with former workers report that employees had the opportunity to take popped vermiculite home for private use, typically as fill material in driveways or yards. Employees also took the stoner rock waste product home. Interviews with local residents have indicated that there were large piles of silvery gray material in the southeast corner of the facility near the railroad tracks during the early-to-mid 1960s. It was reported that children would play in these piles and that some would load wagons with the material to take home. Other residents described a gondola-like structure located near the office of the facility that was loaded with bags of silvery material that people could pick up and take home to use at their residences. Given the description of the material and the detection of LA in the surface soil near these locations on the facility, it is likely that the material that children played in and the material brought to their residences was the waste stoner rock from the vermiculite exfoliation process.

WRG reportedly cleaned the Dearborn plant in 1990, collecting four air samples inside the building and one outside the building to document the effectiveness of their cleanup [8]. Sample results, presumably from phase contrast microscopy (PCM) analysis, indicated airborne fiber levels at 0.0005 fibers per cubic centimeter (f/cc), which is well below the current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) of 0.1 f/cc asbestos. More information on analytical techniques and asbestos regulations is included in Appendix D.

Off-Site Migration of Plant Materials

The vermiculite exfoliation process is known to produce large amounts of aerosolized particulate matter or dust [9]. If Libby vermiculite is exfoliated, the dust may contain asbestos species consistent with the Montana ore (including tremolite and actinolite). People in the Dearborn community had indicated that dust from the WRG Dearborn operation frequently migrated off the site. This off-site migration of fugitive materials has been documented in several inspection reports and complaint cards filed through the Wayne County Air Quality Management Division from 1983 through 1990 (see Appendix B).

A letter from the City of Dearborn to the Michigan Department of Public Health (now the MDCH)* provides additional documentation of dust migrating off the site. The subject line of the letter is "Manufacturer of Insulating Product (Vermiculite), Releasing Product into Surrounding Neighborhood." The complainant, a carpenter working in the area, reported that his crew became ill after "ingesting the airborne product." The complainant described symptoms such as bitter taste, coughing, and vomiting.

Site Visits and Sampling

EPA inspected former vermiculite processing plants throughout the United States in 2000 to ascertain whether these sites still contained asbestos-contaminated vermiculite or related waste materials (Appendix C, EPA Preliminary Inspection Report, 2000). EPA staff members visited the former WRG Dearborn plant on February 25, 2000, to conduct a Phase 1 field inspection and owner interview. The resulting Preliminary Inspection Report, dated March 8, 2000, concluded that "no visual evidence of vermiculite from the Libby, Montana, mine was observed anywhere on the property." The WRG Dearborn plant was classified by EPA as "No Further Action Necessary," and, therefore, no Phase 2 site assessment was mandated. These initial assessments have been revised based on more recent investigations and information.

On September 27, 2002, staff members from ATSDR and MDCH visited the DMACI facility as part of ATSDR's National Asbestos Exposure Review (NAER). During this visit, staff members observed vermiculite on the ground near the railroad spur on the north side of the property, where the vermiculite was off-loaded from railroad cars into nearby storage silos (the silos have since been removed). Staff members also observed material consistent with stoner rock behind the wooden slats of an interior wall in the main DMACI building. Small amounts of this material had spilled out from the wall into the room through a narrow gap between the floor and the wooden slats (see Appendix A, Figure 4).

These findings led ATSDR to ask EPA to test the wall cavity material, the indoor air of the room where the material was located, and several on-site soil samples for asbestos. On January 14, 2003, EPA contractors collected four composite and two grab soil samples from around the property as well as two air samples from the work area and one grab sample of material from the interior wall space inside the main building on the site. All of these samples were tested for asbestos (results are reported in Table 1). Analysis of the on-site composite surface soil samples (taken from five separate locations 0–2 inches below the surface) showed concentrations of tremolite and actinolite asbestos species ranging from nondetectable (<1%) to 3%. The material in the wall cavity was found to contain asbestos at levels of 5% to 6.9%, depending on the analytical method used. The detection limit of <1% is not a health-based standard, but represents the detection limit of the two methods used for the composite and grab samples.

The soil and bulk material samples were analyzed using polarized light microscopy (PLM) and transmission electron microscopy (TEM). Each method has distinct strengths and weaknesses. The PLM method allows for examining a larger portion of the sample with less effort than the TEM method. The PLM method is therefore useful and cost-effective for screening large

* On April 1, 1996, the Michigan Department of Public Health (MDPH) Division of Health Risk Assessment was absorbed into the newly-formed Michigan Department of Community Health (MDCH).

numbers of samples or for screening samples that contain relatively higher levels (>1%) of Libby asbestos. The TEM method has higher magnification and greater sensitivity, which enables detection of smaller fibers and, when coupled with electron diffraction analysis, enables identification of fiber type. In general, the TEM approach is a more accurate method for fiber identification and quantification at low sample concentrations. It should be noted that at low sample concentrations, a sufficient number of grids must be counted or TEM may miss fibers that would otherwise be visible at a lower magnification. A detailed description of the types of asbestos, laboratory methods of analysis, and health implications is included in Appendix D.

Table 1. Summary of January 14, 2003, EPA Composite and Grab Soil Sampling

Soil Sample	Location	Asbestos Concentration (%)		Asbestos Type	Additional Material
		PLM*	TEM†		
SPT-011403-SC1	Composite 1, railroad spur, north side of site	<1	<1.0	tremolite/actinolite	90% mica
SPT-011403-SC2	Composite 2, parking lot near RR ties	2	<1.0	tremolite/actinolite	
SPT-011403-SC3	Composite 3, near RR line, east side of site	<1	1.9	tremolite/actinolite	5 % mica
SPT-011403-SC4	Composite 4, grassy area, south side of site	2	<1.0	tremolite/actinolite	
SPT-011403-GB1	Grab Sample 1, east side of parking lot	<1	2.6	tremolite/actinolite	
SPT-011403-GB2	Grab Sample 2, SW corner of parking lot	3	<1.0	tremolite/actinolite	2% cellulose
SPT-011403-GB3	Grab Sample 3, interior space of west interior wall of DMACI building	5	6.9	tremolite/actinolite	95% mica

* Polarized light microscopy, EPA 600/R-93/116 method
† Transmission electron microscopy, EPA CFR Part 763 Final Rule

Indoor air samples were taken to evaluate potential exposures to DMACI workers who may have operated machinery in the area where the asbestos-containing materials (ACM) were found. The samples were analyzed by both phase contrast microscopy (PCM) and by TEM. The PCM method is commonly used by the Occupational Safety and Health Administration (OSHA) to characterize potential indoor workplace exposures to airborne fibers, which may include asbestos species. PCM analysis of the indoor air samples collected from the work area showed 0.003 fibers per cubic centimeter (f/cc) at a sample location that was 4 feet from the wall and 0.002 f/cc in the room's center (results reported in Table 2). Disturbance of the stoner rock material, through cleaning or work activities, could increase airborne fiber concentrations [10].

The OSHA permissible exposure limit (PEL), the occupational standard for asbestos, is 0.1 f/cc for those fibers >5 micrograms (μm) in length and with an aspect ratio (length:width) greater than 3:1, as determined by PCM. This PEL is a time-weighted average (TWA) concentration that is not to be exceeded during any 8-hour work shift of 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.

The most recent clean-up activity at the DMACI facility was an indoor remediation project initiated by the property owner and performed in December 2003. This work was not performed under a plan reviewed by EPA or by MDEQ, and efforts are underway to verify effectiveness of this work. According to the property owner, the ACM was removed by a vacuum equipped with a high-efficiency particulate air (HEPA) filter, the area was sealed with additional boards and caulking, and the material was bagged and disposed of by a licensed contractor. A representative of MDCH conducted a follow-up site visit in February 2004 and, in addition to other activities, assessed the extent of security fencing on the property. During the site visit, the property owner showed the representative that the indoor ACM had been removed, reported that the remediation was done by a certified contractor, and provided limited evidence of post-remedial air sampling. One air sample was taken of the indoor work area in December 2003. Although the method of quantification is not yet known, analysis of the sample indicated that it contained 0.002 fibers per cubic centimeter (f/cc) [11]. The February 2004 site visit did confirm both the absence of visible ACM in the indoor work area and the presence of intact security fencing surrounding the railroad spur area.

Table 2. Summary of January 14, 2003, EPA Indoor Air Sampling

Interior Air Sample	Location	Asbestos Concentration		Asbestos Type
		PCM* (fibers/cc)	TEM† (structures/cc)	
ATP-011403-WS1	NE side of work area inside site building	0.002	0.0036	tremolite/actinolite
ATP-011403-WS2	SW corner of work area inside site building	0.003	<0.0009	tremolite/actinolite

***** Phase contrast microscopy, NIOSH Method 7400, issue 2, 4th edition, 08/15/1994
† Transmission electron microscopy, EPA CFR Part 763 Final Rule

II. Discussion

The vermiculite processed at this site originated from a mine in Libby, Montana. The ore from the mine is now known to be contaminated with asbestos. Studies conducted in the Libby community describe health impacts that are associated with asbestos exposure [2–4,12,13]. (Additional information on asbestos exposure is provided in Appendix D.) The findings at Libby provided the impetus for investigating this site and other sites across the nation that received asbestos-contaminated vermiculite from the Libby mine. The investigation at the Dearborn plant is part of a national effort (the National Asbestos Exposure Registry or NAER) to identify and evaluate potential asbestos exposures that may be expected at these sites.

Asbestos Health Effects

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

Malignant mesothelioma—Cancer of the membrane (pleura) that encases the lungs and lines the chest cavity. 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); 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].

Not enough evidence is available to determine whether inhalation of asbestos increases the risk of cancer at sites other than the lungs, pleura, and abdominal cavity [14].

In general, ingestion of asbestos causes little or no risk of noncancer effects. However, some evidence indicates 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 and MDCH consider the inhalation route of exposure to be the most significant exposure route in the current evaluation of sites that received Libby vermiculite. Exposure scenarios that are protective of the inhalation route of exposure should be protective of dermal and oral exposures.

The American Thoracic Society (ATS) has published criteria to help clinicians diagnose and initial management of nonmalignant asbestos-related disease (e.g. asbestosis, asbestos-related pleural thickening, fibrosis, etc.; see Appendix G) [15].

Exposure Assessment and Toxicologic Evaluation

Evaluating the health effects of exposure to LA requires knowledge of exposure pathways and toxicity data. The toxicologic information currently available is limited and therefore the exact level of health concern associated with different sizes and types of asbestos is still under investigation. Site-specific exposure pathway information is also limited or unavailable.

- Information is limited on past concentrations of LA in air in and around the plant. Also, significant uncertainties exist in the methods used to analyze asbestos (described further

in Appendix D). This makes it hard to estimate the levels of LA to which people may have been exposed in the past.
- Not enough information is available about the magnitude of the releases of the LA from the plant over the years of operation. This information is necessary to estimate quantitative doses of exposure.
- Not enough information is available about how some exfoliation materials, such as waste rock, were handled or disposed of. This makes it difficult to identify and assess both past and present potential exposures. Interviews with former workers and residents of the area, however, have provided important information about the ways that many persons may have come into contact with this material.

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

Exposure Pathways

Exposure pathways are the means by which a person is exposed to hazardous substances originating from a source of contamination. An exposure pathway consists of the following five elements: (1) a source of contamination; (2) media, such as air or soil, through which the contaminant is transported; (3) a point of exposure where people can come into contact with the contaminant; (4) a route of exposure by which the contaminant enters or contacts the body; and (5) an exposed 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 elements 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 are 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 exposure.

On the basis of information available from Montana and from facilities that processed vermiculite ore from Libby, the NAER team has identified likely exposure pathways for vermiculite processing facilities. All pathways have a common source (LA-contaminated vermiculite ore from Libby) and a common route of exposure (inhalation). Although asbestos ingestion and dermal exposure pathways may exist, health risks from these pathways are minor in comparison to those resulting from inhalation exposure to asbestos and will not be evaluated.

The exposure pathways considered for each site are listed in Table 3. Additional information on the pathways can be found in Appendix E. Not every pathway identified will be a significant source of exposure for a particular site. The following paragraphs provide an evaluation of the exposure pathways for the WRG Dearborn plant. Definitions of the health hazard categories

("past public health hazard," "indeterminate hazard," etc.) used throughout this document can be found in Appendix H.

Occupational (past) – WRG records indicate that workers were exposed to high levels of LA in the air at the Dearborn plant. Potential exposures for employees from a 1976 analysis by WRG showed time-weighted averages (TWAs) ranging from 3.99 f/cc to 6.35 f/cc. A peak concentration of 20.12 f/cc was reported for one employee who loaded Libby ore into storage bins; however, the analysis did not report whether this value was calculated as a TWA or a simple average over the 17-minute sampling period. All of the TWAs are higher than the current OSHA limit of 0.1 f/cc (OSHA limits were 2.0 f/cc in 1976, with a ceiling limit of 10 f/cc). Although workers had access to personal protective equipment, the use of such equipment is undocumented and could not be well established through interviews conducted with former employees. In addition, there is anecdotal evidence that improper respiratory protection may have been used at the WRG facility. As a result of all these factors, occupational exposure was determined to be a significant exposure pathway at the WRG Dearborn plant and a past public health hazard.

Delivery workers and visitors to the site could have been exposed briefly to LA. These exposures were generally of short duration and are thus much less likely to lead to health effects than the long-term, high-level exposures experienced by plant workers. It should be noted that brief high-intensity exposures among workers have been documented to cause significant health effects, but even this exposure duration (approximately 6 months) is likely much longer than the exposure that may have been experienced by delivery workers and other visitors to the facility [16].

Occupational (present/future) – Asbestos-containing material was found inside an interior wall of the main building during the 2002 site visit. Any disturbance of this material could have resulted in exposure to current workers and visitors of the DMACI facility. Two indoor air samples collected near this interior wall in January 2003 showed fiber levels of 0.002 f/cc to 0.003 f/cc. These airborne levels are below the OSHA PEL of 0.1 f/cc. However, grab samples taken of the bulk material revealed concentrations of 5%–6.9% asbestos (Table 1). At the time of sampling, the material had not been significantly disturbed.

Table 3. Inhalation Pathways Considered for the WRG Dearborn, Michigan, Site

Pathway Name	Exposure Scenario	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	Complete	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 on-site piles of contaminated vermiculite or waste rock	Complete	Eliminated	Eliminated
On-Site Soil	On-site workers, contractors, or community members disturbing contaminated on-site soil (residual contamination, buried waste)	Complete	Potential	Potential
Ambient Air	Community members or nearby workers exposed to airborne fibers from plant emissions during handling and processing of contaminated vermiculite	Complete	Eliminated	Eliminated
Residential: Outdoor	Community members who were using contaminated vermiculite or waste material at home or who were exposed by windborne deposition from the facility	Potential	Potential	Potential
Residential: Indoor	Community members disturbing household dust containing Libby asbestos that came from plant emissions or from waste rock brought home for personal use	Potential	Potential	Potential
Consumer Products	Community members, contractors, and repairmen disturbing consumer products containing contaminated vermiculite	Potential	Potential	Potential

The recent remediation activity (December 2003) at the DMACI facility most likely eliminated this exposure pathway. Although an approved work plan was not received, post-remediation confirmatory sampling reported airborne concentrations lower than occupational levels of concern. Currently, this exposure pathway represents no apparent public health hazard to workers; however, this characterization may be revised based on current efforts to verify the effectiveness of the remediation. The presence of this ACM in the DMACI warehouse in the past represents an indeterminate public health hazard for workers.

Household contacts (past/present) – Persons who lived in households of former workers could have inhaled airborne LA from contaminated clothing or hair of workers who returned home from work without changing clothes or showering. Information from former workers indicated that although the plant operations were dusty and disposable suits and on-site showers were available, many employees did not shower and change before going home. (In fact, one former worker claims he kept a towel in his car to remove dust and particles upon leaving his shift at the WRG facility.) Although insufficient information is available on the personal hygiene and personal protective equipment practices of all employees at the Dearborn plant, the exposure pathway for past household contacts represents a past public health hazard.

The presence of ACM inside an interior wall of the main building is considered a complete pathway of exposure for past exposure, but this ACM was removed in December 2003. Present and future exposure pathways from ACM inside the building may have been eliminated; however, verification of this is still needed. It is possible that household contacts of current

DMACI workers could have been exposed to airborne LA prior to December 2003. However, the measured airborne concentrations were quite low, and this exposure pathway is less significant than other historical pathways of exposure.

Under current conditions, this material poses no apparent public health hazard to household contacts of current workers at the facility. The exposure pathway for household contacts of workers before the cleanup in December 2003 is considered to be an indeterminate public health hazard.

Waste piles (past) – The exposure pathway for community members (particularly children) playing in or otherwise disturbing on-site piles of contaminated vermiculite or waste rock at the facility is considered a complete past exposure pathway. Waste rock from the Dearborn plant was temporarily stockpiled on site and accessible to children and other community members. Ongoing interviews with former workers and neighbors indicate that child recreation among the waste piles was more common than originally thought. In addition, ongoing interviews indicate that children carried this waste material off the site in wagons and that bags of silvery material (likely exfoliation process waste) were available for the public to pick up from a gondola-like structure near the facility's office.

Waste materials (primarily stoner rock) from the operation were reportedly taken off the site for disposal by a contractor. Exposure to the truck driver and to pedestrians or persons in vehicles along the truck route would depend on precautions taken to prevent materials being blown off during transport, such as covering the load with a tarp. Exposures to vehicle occupants and pedestrians are likely to have been of short duration and at irregular intervals. Landfill workers and truck drivers hauling and handling the waste material from the plant could have been routinely exposed to asbestos. Although no sampling results exist, significant exposures may have occurred, depending on the waste handling practices at the landfill.

Past exposure to asbestos in the on-site waste piles is considered a complete pathway and represents a past public health hazard. Given the long latency period between time of childhood exposure and possible onset of disease, the health effects from this past exposure pathway may become more apparent in the future.

On-site soil (past/present) – On-site soil can be characterized as either railroad (RR) spur soil or non-RR soil. The soil in and around the RR spur (located north of the main building and previously used to off-load raw ore into the WRG facility) contains visible quantities of unprocessed (raw) vermiculite. Likewise, composite and grab samples taken of non-RR soil were shown to contain asbestos at levels greater than "trace amounts" [1]. Mechanical disturbance of this raw vermiculite could release airborne asbestos fibers, and disturbing soil with even trace amounts of LA can result in airborne fibers at levels of concern [10]. Because of the anecdotal evidence concerning handling and off-site transport of the stoner rock and the existence of waste piles on top of on-site soil in the past, the exposure pathway for on-site soil in the past is determined to be complete. Even today, due caution against aggressively disturbing any on-site soil is warranted.

Currently, only workers have unobstructed access to the railroad spur. Indications are that worker access to this area is sporadic and the area is largely undisturbed. The February 2004 site visit revealed that the RR spur area is used for long-term storage of unused equipment and for temporary storage of nonhazardous liquid and solid waste. In addition, access to the RR spur is restricted by a security fence. However, given the industrial nature of the work conducted at the facility, significant disturbance and resultant exposure is a possibility for workers and more information is needed about the nature of the ongoing work at the DMACI facility. On-site contamination of the railroad spur with unprocessed vermiculite ore is, therefore, an indeterminate public health hazard.

Currently, there are no access restrictions to the non-RR spur portion of the property and both workers and visitors to the site could be exposed to asbestos by way of the vermiculite-contaminated soil on the site. Although non-RR soil was generally well vegetated, visible bundles of tremolite and some areas of bare soil were observed during the September 2002 site visit. Present and future exposure to vermiculite in on-site soil in the non-RR area represents an indeterminate public health hazard. If methods were instituted to reduce potential exposure, then no public health hazard would exist from vermiculite in on-site soil. These methods could include restricting access to the non-RR portion of the DMACI facility, removing soil contaminated with vermiculite, or covering these contaminated areas of soil with an impermeable barrier (such as asphalt or concrete).

Ambient air (past) – Area residents and nearby workers may have been previously exposed to LA fibers via ambient air. These fibers were released into the air from fugitive dust or furnace stack emissions during operation (which was 24 hours per day during certain periods of high plant productivity). However, detailed information concerning emissions from the plant is not available, so the magnitude of asbestos concentrations in the ambient air is unknown. Although complaint records (see Appendix B) indicate that nearby residents were exposed to fugitive dust emissions from the WRG Dearborn plant site, quantification of this exposure is not possible without better data. Exposure to nearby residents from past ambient air emissions is, therefore, an indeterminate health hazard. Current and future exposure via ambient air would only be possible if significant quantities of on-site soil containing vermiculite are disturbed. This exposure can be prevented by continuing outreach and education and by instituting methods to reduce exposure.

Residential outdoor (past) – Asbestos fibers may have been deposited in residential yards as a result of the airborne dust from the former WRG site or when workers brought home waste material or popped vermiculite for use in their yards or gardens. Exposure may have occurred whenever activities such as gardening, play, or landscaping brought residents close to contaminated soil or fill material. The known degree to which windborne deposition may have occurred is limited due to lack of data; however, attempts are being made to characterize this phenomenon. Limited sampling of soil at the Dearborn plant has shown areas of asbestos contamination, but this result is expected because the contaminated vermiculite was handled there. As yet, no off-site soil sampling, in the surrounding neighborhood or in the yards of past workers, has been conducted. Therefore, past residential outdoor exposure is an indeterminate public health hazard.

Residential outdoor (present/future) – Any significant airborne deposition of asbestos fibers onto residential yards is expected to have lessened when the Dearborn plant closed in 1989. Although mechanical disturbance of vermiculite-bearing soil is expected to liberate some asbestos fibers, the amount released is much less than the amount of fibers released as a result of exfoliation. Current residents living near the site or visitors to areas near the site may come into contact with asbestos-contaminated soil (a soccer field is directly across the street from the WRG facility). Asbestos exposure from this source could occur during any activity that places the resident in close proximity to newly disturbed soil, such as gardening or landscaping. Current residents could be exposed if they garden or otherwise disturb the soil in areas where popped vermiculite or stoner rock was used. No soil tests have been conducted to date to confirm or eliminate the possibility of asbestos-contaminated soil in the surrounding area; therefore, the present residential outdoor exposure pathway is an indeterminate public health hazard. Plans to perform soil sampling in the surrounding neighborhood are ongoing and may lead to a re-evaluation of this pathway.

Residential indoor (past) – Residents could have inhaled LA fibers from household dust, either from plant emissions which infiltrated into homes or from dust brought home by workers. Those neighborhood properties where stoner rock or popped vermiculite were used for gardening or landscaping purposes might have had asbestos in indoor house dust (since house dust originates from outdoor soil and often contains the same contaminants). No data are available to estimate past fiber levels in ambient air, but residential exposures in the past seem possible given the documented history of fugitive dust emissions and the anecdotal evidence that workers often went home covered with asbestos-containing dust and particles. Without data to characterize the degree, duration, or nature of these exposures, the past residential indoor exposure pathway remains an indeterminate public health hazard.

Residential indoor (present/future) – Current residents in the area surrounding the Dearborn plant are unlikely to inhale significant concentrations of LA in their homes; however, the likelihood would be increased if asbestos is in residential property soil or if there is a significant disturbance of contaminated soil on DMACI property. Vermiculite exfoliation operations at the plant ended in 1989. Therefore, any LA-contaminated dust from the plant, whether it had been transported into the homes on workers' clothing or had otherwise infiltrated into the homes from plant operations, would likely have been cleaned or removed through natural or assisted means. The presence of vermiculite in the on-site soil is still cause for concern and still poses potential for off-site migration until it is removed or contained; thus, it is still a potential exposure pathway. Similarly, those properties where stoner rock and popped vermiculite were used for gardening or landscaping purposes might have asbestos in indoor house dust. It should be noted that any small amounts of contaminated soil that may migrate off the site will most likely impact only those properties immediately next to the former exfoliation plant site. Indoor residential exposure to LA for current residents living near the Dearborn plant is considered an indeterminate public health hazard. Plans to perform soil sampling in the surrounding neighborhood are ongoing and may lead to a re-evaluation of this pathway.

Consumer Products – Products that contain Libby vermiculite (such as home insulation or vermiculite gardening products) were not evaluated as that was not within the scope of this project. People who used products that contain Libby vermiculite may have been exposed to

asbestos fibers. Studies have shown that disturbing or using these products can result in airborne fiber levels higher than levels of concern [10, 17]. Additional information on consumer products has been developed by EPA, ATSDR, and the National Institute for Occupational Safety and Health (NIOSH) and is available through the Michigan Department of Community Health or on the Internet at http://www.epa.gov/asbestos/insulation.html.

Health Impacts

The concern about exposure to LA-containing material is based in part on health impacts in the community of Libby, Montana, where significantly elevated numbers of deaths from asbestos-related diseases were recorded, especially among persons who worked in the vermiculite mine and their household contacts [12]. Former workers and their household contacts also showed higher rates of pleural (the pleura line the chest cavity and cover the lungs) abnormalities, indicating higher exposure and a higher risk for developing asbestos-related disease. Limited past data indicate that fiber levels in the processing areas of the WRG Dearborn plant were similar to those in Libby, suggesting that worker exposure may have been similar. Therefore, it is probable that former workers at the WRG Dearborn facility and their household contacts have an increased risk of developing asbestos-related disease.

Determining a quantitative risk of health effects from exposure to LA is difficult for several reasons. Information on past concentrations of LA in air in and around the plant is limited. Information concerning the type, duration, and frequency of potential past exposures is also lacking. Even if this information were available, significant uncertainties remain in the methods used to characterize asbestos exposure, particularly in the past. Furthermore, the level of health concern for different sizes and types of asbestos is controversial due to limitations in the toxicologic information currently available.

ATSDR worked with MDCH staff members in the Vital Records and Health Data division to conduct a health statistics review (HSR) for the Dearborn site. The HSR is a statistical analysis of existing health outcome data (cancer registry and death certificate records) that investigates whether people in the community near the Dearborn site have gotten cancer or died from a particular disease more often than people in a comparison population. Finding an excess of asbestos-related cancer or disease in the community would alert ATSDR and MDCH to the possibility that workers or community members might have been exposed to asbestos as a result of the facility's handling or processing of vermiculite from Libby. However, not finding an excess of asbestos-related disease does not mean that the people in the community were not potentially exposed to asbestos from the Libby vermiculite.

The HSR analyses suggest that the occurrence of known asbestos-related diseases (i.e., mesothelioma, asbestosis, and lung cancer) in the Dearborn population do not appear to be higher than expected compared to the rest of the country. Further information on the methods, limitations, and conclusions of the HSR are included in Appendix F.

Child Health Considerations

In communities faced with environmental contamination, infants and children are often more vulnerable to exposure than adults. Because children depend completely on adults for risk identification and management decisions, MDCH is committed to evaluating their special interests at this 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 exposure because they are more likely to disturb indoor dust or fiber-laden soil while playing. Children also breathe air that is closer to the ground and be more likely to inhale airborne fibers from contaminated soil or dust.

Furthermore, exposed children could be more at risk of actually developing asbestos-related disease than people exposed later in life because of the long latency period between the time of exposure and onset of asbestos-related respiratory disease. Adults who are exposed may actually die of another cause prior to the observation and diagnosis of asbestos-related health effects.

Exposure in the past associated with on-site waste piles and soil, fugitive plant emissions, and waste rock brought home and used in the yard are all potential pathways that cannot be quantitatively evaluated due to the lack of data. However, anecdotal evidence suggests that past on-site childhood exposures may have been more likely than was originally thought. Because some areas of the site are not secured or fenced, current exposure to on-site materials is possible (and more likely in the eastern half of the property). Furthermore, children who were exposed in the past to contaminated vermiculite in the waste piles could represent a subpopulation of significant interest.

III. Conclusions

On the basis of data reviewed for the WRG Dearborn plant, MDCH concludes the following for *workers and their household contacts*. Definitions of the health hazard categories ("past public health hazard," "indeterminate hazard," etc.) used throughout this document can be found in Appendix H.

- **Former workers at the WRG Dearborn plant were exposed to airborne levels of LA above current occupational standards.** Consistent and repeated exposure to airborne LA at these elevated levels would increase the risk for asbestos-related disease and therefore posed a public health hazard to former employees.
- **Former workers may have exposed household members to asbestos fibers if they did not shower or change clothes before leaving work.** Although data are insufficient with regard to household contact exposure, it is likely that these contacts were also exposed. This pathway therefore represents a past public health hazard. This conclusion is generally supported by patterns seen at other sites processing Libby vermiculite.
- The presence of asbestos-contaminated material (ACM) within the main building posed an indeterminate public health hazard to current workers at the Dearborn site before the ACM was removed in December 2003. Likewise, exposure of household contacts of current DMACI workers before December 2003 posed an indeterminate public health

hazard. It should be noted that airborne concentrations were found to be quite low and that the magnitude of this pathway is lower than that of other historical pathways of exposure. **Currently, it is likely that this pathway has been eliminated and therefore represents no apparent health hazard to workers or their household contacts; however, efforts are ongoing to verify this conclusion.**

- **Areas of residual LA contamination remain in the soil on the site of the former WRG facility.** Exposure of workers, visitors, trespassers, and contractors to LA-contaminated soil on the site poses an indeterminate public health hazard. Changes in the condition or use of the property may exacerbate on-site exposure.

MDCH concludes the following for *the community surrounding the Dearborn site*.

- **The people in the community around the site during the time the Dearborn plant processed Libby vermiculite could have been exposed to LA fibers** by disturbing or playing in on-site soil or waste piles, from plant emissions, from waste rock brought home for personal use, or from indoor household dust that contained Libby asbestos from one or more outside sources. Insufficient information is available to determine if these exposures occurred, how often they may have occurred, or what concentrations of airborne Libby asbestos may have been present during potential exposures. This information may never be available. Because critical information is lacking, these past exposure pathways for community members are considered to be indeterminate public health hazards. Plans to perform sampling in the surrounding neighborhood are ongoing and may lead to a re-evaluation of this hazard category as appropriate.
- **The Dearborn plant no longer processes vermiculite at the site.** The pathways for current or future community exposure to airborne Libby asbestos from facility emissions and to on-site waste piles have been eliminated, yet there remains an indeterminate health hazard from on-site soil. A small but potential risk still exists from residual vermiculite contamination in the on-site soil, either from off-site migration of the soil or from resident exposure to unrestricted areas of the DMACI property. Plans to perform sampling in the surrounding neighborhood are ongoing and may lead to a re-evaluation of this hazard category.
- Residential indoor exposure to household dust containing Libby asbestos fibers from past plant emissions or waste rock brought home for personal use is considered no apparent health hazard for present and future community members. **There is a small but potential risk that still exists from off-site migration of the residual vermiculite contamination in the on-site soil.** Plans to perform sampling in the surrounding neighborhood are ongoing and may lead to a re-evaluation of this hazard category.
- Currently, individuals in the community could be exposed to airborne Libby asbestos from waste rock used as fill material, for gardening, or for paving driveways. This exposure pathway is an indeterminate public health hazard because insufficient information is available to determine the extent of the use of waste material in the community. Ongoing interviews and data collection from the neighborhood may lead to a re-evaluation of this hazard category.

IV. Recommendations

- Provide former workers and their household contacts with health education materials and encourage medical monitoring.
- Provide current workers who were employed prior to December 2003 and their household contacts with health education materials and encourage medical monitoring.
- Provide health education materials and encourage medical monitoring for individuals who may have been exposed to the on-site waste piles in the past when they were children.
- Verify that areas of contaminated vermiculite remaining inside the DMACI building, have been appropriately cleaned up. Verify remediation results with post-cleanup indoor air sampling or other appropriate techniques.
- Characterize the extent and magnitude of remaining vermiculite contamination in on-site soil, including soil beneath the parking lot. Based on the results of the characterization, develop a plan to eliminate or reduce future exposure.
- Characterize the degree and magnitude of remaining contamination in off-site soil in the neighborhood immediately surrounding the former WRG facility.
- Review site-specific information as it becomes available and utilize any new information to re-evaluate indeterminate exposure pathways.
- Review ongoing initiatives and data collection efforts at other sites that processed Libby vermiculite ore as they becomes available and use any new information to re-evaluate indeterminate exposure pathways.

V. 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 EPA, ATSDR, MDCH, 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 and MDCH will also follow up on the plan to ensure implementation of the public health actions.

Actions completed

- EPA conducted a site visit in February 2000 and collected environmental samples at the site in January 2003. ATSDR and MDCH staff members conducted a site visit in September 2002 and accompanied EPA representatives during sample collection at the site in January 2003. MDCH staff members conducted a site visit in February 2004.
- Remediation of the current DMACI facility (which consisted of removal of asbestos-containing material from the work area) was performed in December 2003.
- MDCH and ATSDR have completed a fact sheet that summarizes the findings of this health consultation. This fact sheet is available at www.michigan.gov/mdch-toxics or through MDCH (call 1-800-MI-TOXIC or 1-800-648-6942).
- Fact sheets on vermiculite attic insulation have been developed by ATSDR, NIOSH, and EPA and are available at www.epa.gov/asbestos/insulation.html or through MDCH. EPA has begun implementing a consumer awareness campaign for vermiculite attic insulation.

Actions ongoing

- EPA is considering actions to characterize and potentially remediate contaminated soil. (Lead agency: EPA; support agencies: ATSDR, MDCH, MDEQ)
- ATSDR is conducting health statistics reviews (HSRs) for selected sites across the nation that received asbestos-contaminated vermiculite from Libby, Montana. The results of these reviews will be published in a separate summary report. See Appendix F for the HSR conducted for the Dearborn site. (Lead agency: ATSDR)
- ATSDR and MDCH are collecting information as it becomes available from former workers and/or neighborhood residents. This information will be used (as applicable) to update any indeterminate public health hazards associated with the former WRG facility. (Lead agency: ATSDR; support agency: MDCH)
- ATSDR has developed an integrated Communication and Education Plan for the national project, and components of this plan are currently being tailored for use at the Dearborn site as appropriate. (Lead agency: ATSDR; support agency, MDCH)

Actions planned

- EPA, ATSDR, MDCH, and MDEQ will coordinate efforts for any additional environmental sampling, possibly to include neighboring off-site areas. This information will be used (as applicable) to update any indeterminate public health hazards associated with the former WRG facility. (Lead agency: EPA; support agencies: ATSDR, MDCH, MDEQ)
- EPA, ATSDR, MDCH, and MDEQ will consider the use of air dispersion modeling to characterize past off-site fiber migration. This information could be used (as applicable) to update any indeterminate public health hazards associated with the former WRG facility, in addition to focusing future off-site environmental sampling. (Lead agencies: MDCH, MDEQ; support agencies: ATSDR, EPA)
- MDCH and ATSDR will review any new site-related data to gauge health risks, if any, to workers and nearby residents. (Lead agency: MDCH; support agency: ATSDR)
- MDCH and ATSDR will review any new data from other sites around the country that processed Libby vermiculite ore to gauge health risks, if any, to workers and nearby residents. (Lead agency: ATSDR; support agency: MDCH)
- ATSDR and MDCH are researching and determining the feasibility of conducting worker and household contact follow-up activities in a collaborative manner. Childhood exposures via waste piles will also be addressed through this process. (Lead agency: ATSDR; support agency: MDCH)
- Former workers, current workers employed prior to December 2003, and household contacts of both worker cohorts will be provided with health education materials by MDCH and encouraged to seek long-term medical monitoring for asbestos-related disease. (Lead agency: MDCH; support agency: ATSDR)
- MDCH will make the American Thoracic Society guidelines for diagnosis and initial management of nonmalignant asbestos-related disease available online (and as on-request printed copies to healthcare providers) at http://www.michigan.gov/vai (see Appendix G).

Preparers of the Report

Michigan Department of Community Health
Division of Environmental and Occupational Epidemiology

Erik R. Janus, M.S., Toxicologist

Linda Dykema, Ph.D., Toxicologist

Authors of Asbestos Overview (Appendix D)
Barbara Anderson, P.E.
Jill Dyken, Ph.D., P.E.
John Wheeler, Ph.D., DABT
ATSDR Division of Health Assessment and Consultation

Author of Health Statistics Review (Appendix F)
Kevin Horton, MSPH
Epidemiologist
ATSDR Division of Health Studies

ATSDR Regional Representative

Mark Johnson
Regional Services, Region 5
Office of the Assistant Administrator

ATSDR Technical Project Officer

Alan Yarbrough
Division of Health Assessment and Consultation
Superfund Site Assessment Branch

References

1. Roy F. Weston, Inc. N-Forcer Site; Dearborn, Wayne County, Michigan; Site Assessment. Prepared for EPA under contract No 68-W-00-119. November 25, 2003.
2. Amandus HE, Wheeler R, Jankovic J, Tucker J. The morbidity and mortality of vermiculite miners and millers exposed to tremolite-actinolite: part I. Exposure estimates. Am J Ind Med 1987;11(1):1-14.
3. Amandus HE, Wheeler R. The morbidity and mortality of vermiculite miners and millers exposed to tremolite-actinolite: part II. Mortality. Am J Ind Med 1987;11(1):15-26.
4. Amandus HE, Althouse R, Morgan WK, Sargent EN, Jones R. The morbidity and mortality of vermiculite miners and millers exposed to tremolite-actinolite: part III. Radiographic findings. Am J Ind Med 1987;11(1):27-37.
5. Lockey JE, Brooks SM, Jarabek AM, Khoury PR, McKay RT, Carson A, et al. Pulmonary changes after exposure to vermiculite contaminated with fibrous tremolite. Am Rev Respir Dis 1984;129(6):952-8.
6. McDonald JC, McDonald AD, Armstrong B, Sebastien P. Cohort study of mortality of vermiculite miners exposed to tremolite. Brit J Industr Med 1986;43:436-44.
7. McDonald JC, Sebastien P, Armstrong B. Radiologic survey of past and present vermiculite miners exposed to termolite. Brit J Industr Med 1986;43:445-9.
8. Marriam RR. (Remedium Group, Inc., subsidiary of W.R. Grace and Company). Memorandum to B. Anderson of ATSDR. W.R. Grace & Company documents supplied to ATSDR. Memphis, Tennessee. March 10, 2003.
9. JRB Associates. Draft final level II materials balance—vermiculite. Washington: U.S. Environmental Protection Agency; January 19, 1982.
10. Weis CP. Memorandum to P. Peronard of EPA. Amphibole mineral fibers in source materials in residential and commercial areas of Libby pose an imminent and substantial endangerment to public health. Denver: U.S. Environmental Protection Agency; December 2001.
11. Facsimile to P. Martin, LA Martin, Inc., from M. Melvin, EKS Environmental Consulting & General Contracting. January 8, 2004.
12. Agency for Toxic Substances and Disease Registry. Health consultation on mortality in Libby, Montana. Atlanta: U.S. Department of Health and Human Services; August 2002.
13. Peipins LA, Lewin M, Campolucci S, Lybarger JA, Miller A, Middleton D, et al. Radiographic abnormalities and exposure to asbestos-contaminated vermiculite in the community of Libby, Montana. Environ Health Perspect 2003;111(14): 1753-9.
14. Agency for Toxic Substances and Disease Registry. Toxicological profile for asbestos (update). Atlanta: U.S. Department of Health and Human Services; September 2001.
15. American Thoracic Society. Diagnosis and initial management of nonmalignant diseases related to asbestos. Am J Respir Crit Care Med 2004;170:691–715.
16. Wright RW, Abraham JL, Harber P, Burnett BR, Morris P, West P. Fatal asbestosis 50 years after brief high intensity exposure in a vermiculite expansion plant. Am J Respir Crit Care Med 2002;165:1145-9.
17. U.S. Environmental Protection Agency. Sampling and analysis of consumer garden products that contain vermiculite. Seattle: U.S. Environmental Protection Agency, Region 10; August 2000.

Certification

This **W.R. Grace Dearbron Plant** Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures. Editorial review was completed by the cooperative agreement partner.

Technical Project Officer, Cooperative Agreement Team (CAT), Superfund Program Assessment Branch (SPAB), Division of Health Assessment and Consultation (DHAC), ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

for RGR

Team Leader, CAT, SPAB, DHAC, ATSDR

Appendix A. Photos and Maps

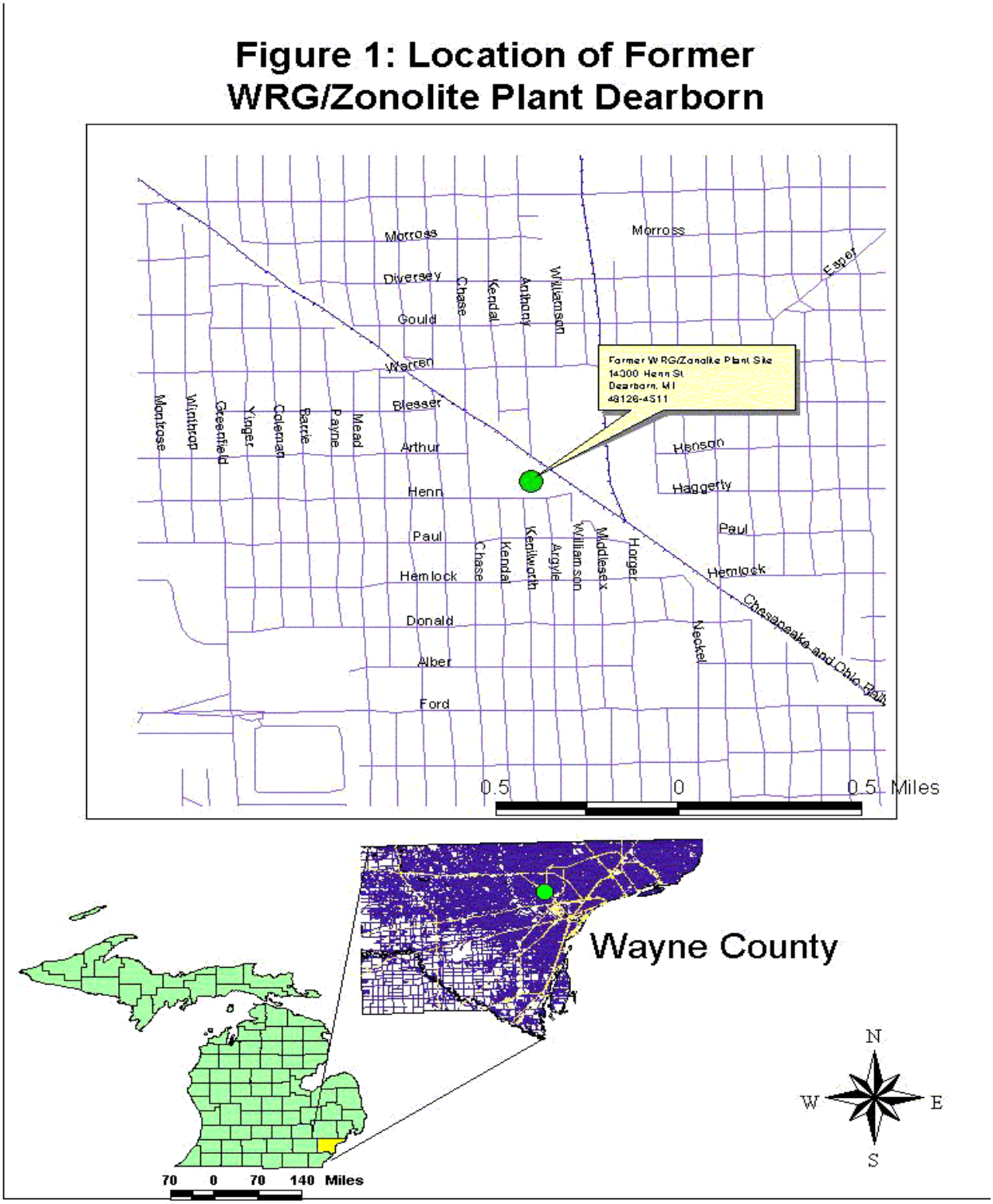

Figure 1. Location of former WRG Dearborn plant at 14300 Henn Street, Dearborn, Michigan.

Figure 2. Aerial photo of site (shaded blue). Visible are the soccer field immediately south of property and the school bus garage to the east. Approximate scale: 1″ = 0.10 miles.

Figure 3. View of site, facing northeast. The railroad line is visible in the background. When the plant was active, this railroad line would transport vermiculite from Libby, Montana, into the facility for processing.

Figure 4. Looking down toward floor with slat wall in background. Libby asbestos-contaminated material (grayish substance) is visible at the bottom of the wall. Material escapes from the wall cavity through a gap between the lowest slat and the concrete floor.

Appendix B

Excerpts from reports and complaint cards from the Wayne County Air Quality Management Division, 1983–1990. [Note: Excerpts are printed as received.]

Complaint cards

July 22, 1983: Recd. call from Dearborn Police who said they recd. complaints of foul odors from [Zonolite] company.

July 25, 1983: Smoke and ashes flying over the area. Fine ash being created. Wind scattering ash.

June 27, 1988: Ongoing since Spring. West wind blows residuals of mfg. process. Smells terrible. Coming in the house. Has unbagged material lying all over the facility.

Inspection reports

June 27, 1988: Fugitive dust from co. manufactured materials as well as odors in area....Upon completion of touring the facility...it was determined that the somewhat lax housekeeping (vermiculite materials on floor) was conducive to allowing fugitive materials to be blown off the plant premises. Material build-up on floor is being tracked to outside by foot and forklift traffic and wind blowing through the building via open doorways. This material as well as spillage on pallets left outside is likely to be picked up by winds and deposited off the plant site.

July 5, 1988, follow-up visit: Plant interior in better condition but still unacceptable regarding fugitive materials. Also fresh spillages in outdoor forklift trafficking areas and other build-up outdoor plant areas.

July 29, 1988, follow-up visit: Facility inside and out (out of doors w/ potential to be carried offsite) was found to be much cleaner than on previous visits. [The plant manager] showed [the inspector] receipts for repairs to the sweeper (motorized) which is used for this clean up. He also assured [the inspector] that continued efforts will be made to keep the fugitives cleaned up as required. Will remonitor in a couple months.

October 4, 1988, follow up visit: The inspection revealed that the co. is performing housekeeping at a much higher level than has been the case in the past. Only very minor accumulations of vermiculite were found both inside and outside the plant which would be expected from normal material handling practices. Contact assured [the inspector] these accumulations are handled on a daily basis with any more significant spill handled more promptly when and if they occur.

June 19, 1990: Somebody also shut off the rotary air lock causing a back pressure which blew the product and dust into the ambient.

Appendix C. EPA Preliminary Inspection Report

March 8, 2000

PRELIMINARY INSPECTION REPORT

FORMER: ZONOLITE COMPANY/W.R. GRACE
14300 HENN STREET
DEARBORN, MICHIGAN

CURRENTLY: N-FORCER
DIE, MOLD & AUTOMATION COMPONENTS, INC.
PLANT #1 14300 HENN STREET
DEARBORN, MICHIGAN

Attendees:

U.S. EPA On-Scene Coordinator (OSC) Kurt Grunert
N-Forcer Company, President, Paul Martin

Purpose:

The purpose of this inspection was to determine the current operating status of Former *Zonolite Company/W.R. Grace*, located in Dearborn, Michigan and if the company had utilized raw ore vermiculite from the W.R. Grace mine located in Libby, Montana in its exfoliation process. The former *Zonolite Company/W.R. Grace* has now been out of operation since 1990. OSC Grunert conducted a plant tour with the current owner of the 14300 Henn Street property. U.S. EPA also performed photodocumentation during the tour of the facility.

Discussions with the N-Forcer (current owner/operator) President:

On February 25, 2000, a site visit and an interview was conducted with the company president, Mr. Paul Martin. According to Mr. Martin, *Zonolite Company/W.R. Grace* stopped plant operations at the 14300 Henn Street property in 1990. In 1992, Mr. Martin purchased the property at 14300 Henn Street property from *Zonolite Company/W.R. Grace*. Mr. Martin stated that following cleanup by *Zonolite Company/W.R. Grace* a Phase I Environmental Audit was conducted at the property prior to purchase by Mr. Martin.

During the tour of the facility, Mr. Martin explained that all of the original buildings had been remodeled to suit the needs of company's operation. No evidence of vermiculite was observed in any of the structures on site. The property is adjacent to a set of railroad tracks from which a railroad spur enters the property from the east. The spur is not used at this time with N-Forcer. Mr. Martin stated during the interview that nearby residents during the operation of Zonolilte Company/W.R. Grace used to complain about the materials being emitted from the plant.

On March 7, 2000, OSC Grunert had to re-photograph the facility due to problems with the film. Mr. Martin was asked by the OSC to provide the U.S. EPA with a copy of the environmental

audit conducted between 1990-1992. Mr. Martin told U.S. EPA that he would look through his files to provide us with a copy. Will have to follow up in the next two to three weeks.

Conclusion:

Based on the interview with Mr. Martin, and tour of the property, no visual evidence of vermiculite from the Libby, Montana mine was observed anywhere on the property.

Current Facility Contact Information:

N-Forcer (Nitrogen Gas Springs)
Die, Mold & Automation Components, Inc.
Plant #1- 14300 Henn Street
Dearborn, Michigan 48126

(313) 581-3444 ext. 12

President: Mr. Paul Martin

Memo

To: Jim Augustyn
From: Kurt Grunert 3/7/00
Date: March 7, 2000
Subject: Vermiculite Property Inspections- Dearborn Facility

The property is now a company called N-Forcer-Die, Mold and Automation Components, Inc. and occupies the former W.R. Grace Property- Zonolite Company. On February 25, 2000, OSC Grunert inspected the property and interviewed the current owner of the property. Mr. Paul Martin, N-Forcer, purchased the property from W.R.Grace in 1992. Since the transaction, Mr. Martin has remodeled the facility. No evidence of any vermiculite was observed anywhere on the property. Mr. Martin did mention that a Phase I Environmental Audit was conducted on the property following cleanup by W.R. Grace. A walk-thru of the property showed no evidence of the exfoliation process anywhere on the property. Mr. Martin did mention that during the last couple of years of operation by W.R. Grace, residences across the street did compliant of operation (burning of the materials). Something we may want to look into. Photographs were taken of the outside and inside of the property.

N-FORCER® Nitrogen Gas Springs
DIE, MOLD & AUTOMATION COMPONENTS, INC
Plant #1 - 14300 Henn St.
Dearborn, MI 48126
(313)581-6510 Fax (313)945-0435

D.D.C., Inc Wear Plates
DEARBORN DIE COMPONENTS, INC
Plant #2 - 13105 Prospect St.
Dearborn, MI 48126
(313)846-1330 Fax (313)846-9448

PAUL MARTIN
(313)581-3444 EXT. 12
(313)793-5326 PAGER

FIELD INSPECTION CHECKLIST

Vermiculite Processing Sites

CURRENTLY: N-FORCER COMPANY

PHASE I - Initial Site Visit

Facility Name / Address: FORMER: ZONOLITE CO. / W.R. GRACE 14300 HENN ST. DEARBORN, MI

Property Recently Redeveloped / Original Exfoliation Building

Site Access - Contact owner or local Police/Fire if necesssary (Have written access agreement)
* MET W/ CURRENT OWNER: MR. PAUL MARTIN

List of Attendees: KURT GRUNERT - OSC

Primary Contact Name / Phone: MR. PAUL MARTIN - 313-581-3444 EXT. 12

Company Owner / Address / Phone (if operating facility): SAME AS ABOVE

Property Owner / Address / Phone: SAME AS ABOVE

Is state background information available? YES / NO

Are environmental assessment reports available? (YES) / NO TALK TO OWNER ABOUT GETTING A COPY OF PHASE I AUDIT.

Any historical use of vermiculite on site? ~~(YES)~~ / (NO) JUST BUILDING - OWNER PROPERTY / FACILITY HAS BEEN REMODELED SINCE W/R GRACE.

Are there any additional facilities associated with this site? YES / (NO)

Presence of vermiculite on site? If NO, then photograph property If YES, photograph and procede to Phase II.

PHASE II - Site Assessment

Is vermiculite present?: YES / NO

What was the source of the vermiculite? Libby Mine?

Describe storage practices:

Describe current operation on site:

Describe dust control / worker safety precautions of current operation:

Was vermiculite landfilled on site? YES / NO_____

GPS Location: Lat_____ Long_____

Bulk Sampling of suspected ACM
Composite or Grab
Location of samples:_____

Laboratory Name / Address:_____
Analytical Method: PLM or TEM

Photographs
Document photo locations on site sketch.
Photograph current operation and vermiculite storage, handling, and processing if applicable

Describe potential threats pose by the vermiculite if determined to be ACM:

Appendix D: 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: crocidolite, amosite, and the fibrous forms of tremolite, actinolite, and anthophyllite. Other unregulated amphibole minerals, including winchite, richterite, and others, can also exhibit fibrous asbestiform properties [1].

Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water or evaporate into the air, although individual asbestos fibers can easily be suspended in the air. Asbestos fibers do not move through soil. They are resistant to heat, fire, and chemical and biological degradation. As such, they can remain virtually unchanged in the environment over long periods of time.

Vermiculite that was mined in Libby, Montana, contains amphibole asbestos, with a characteristic composition including tremolite, actinolite, richterite, and winchite; this material will be referred to as Libby asbestos. The raw vermiculite ore was estimated to contain up to 26% Libby asbestos as it was mined [2]. For most of the mine's operation, Libby asbestos was considered a by-product of little value and was not used commercially. The mined vermiculite ore was processed to remove unwanted materials and then sorted into various grades or sizes of vermiculite that were 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) [2].

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

A number of different analytical methods are 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 with lengths greater than 5 micrometers (>5 µm) and with an aspect ratio (length to 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 less than 0.25 (<0.25) µm in diameter and the inability to distinguish between asbestos and nonasbestos fibers [1].

Asbestos content in soil and bulk material samples is commonly determined using polarized light microscopy (PLM), a method which 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 approximately 1 µm (~1 µm), widths greater than ~0.25 µm, and aspect ratios (length-to-width ratios) 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 that 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 determining asbestos concentration in soil and other bulk material is difficult [1].

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 between TEM mass and PCM fiber count of 30 micrograms per cubic meter per fiber per cubic centimeter ($\mu g/m^3$)/(f/cc) was adopted as a conversion factor, but this value is highly uncertain because it represents an average of conversions ranging from 5 to 150 ($\mu g/m^{3)}$/(f/cc) [3]. 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 [3]. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular air sample.

Asbestos Health Effects and Toxicity

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

Malignant mesothelioma—cancer of the membrane (pleura) that encases the lungs and lines the chest cavity. This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure [1].

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 [1].

Noncancer health 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; 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 [1].

Not enough evidence is available to determine whether inhalation of asbestos increases the risk of cancer at sites other than the lungs, pleura, and abdominal cavity [1].

Ingestion of asbestos causes little or no risk of noncancer effects. However, some evidence indicates 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 [1].

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

The scientific community generally accepts the correlations of asbestos toxicity with fiber length as well as fiber mineralogy. Fiber length may play an important role in clearing the materials from the body, 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 to review fiber size and its role in fiber toxicity in December 2002 [4]. The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths <5 µm are essentially nontoxic in terms of association with mesothelioma or lung cancer promotion. However, fibers with lengths <5 µm may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to definitively reach this conclusion.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly because physical differences allow chrysotile to break down and to be cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue [5]. 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 [5]. However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, as both types increase the risk of disease [6]. EPA's Integrated Risk Information System (IRIS) assessment of asbestos also currently treats mineralogy (and fiber length) as equipotent.

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 as fiber type to the observed variation in risk [7].

Counting fibers using the regulatory definitions (see below) does not adequately describe risk of health effects. Fiber size, shape, and composition contribute collectively to risk in ways that are still being elucidated. For example, shorter fibers appear to deposit preferentially in the deep lung, but longer fibers may disproportionately increase the risk of mesothelioma [1,7]. 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 µm–5 µm are considered above the upper limit of respirability (that is, too large to inhale), and thus do not

contribute significantly to risk. Methods to assess the risk posed by varying types of asbestos are being developed and are currently awaiting peer review [7].

Current Standards, Regulations, and Recommendations for Asbestos

In industrial applications, asbestos-containing materials are defined as any material with >1% bulk concentration of asbestos [8]. 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 soil containing <1% amphibole asbestos, however, can suspend fibers at levels of health concern [9].

Friable asbestos (asbestos which is crumbly and can be broken down to suspendible fibers) is listed as a hazardous air pollutant on EPA's Toxic Release Inventory [10]. This classification requires companies that release friable asbestos at concentrations >0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to-Know Act.

OSHA's permissible exposure limit (PEL) is 0.1 f/cc for asbestos fibers with lengths >5 µm and with an aspect ratio (length:width) >3:1, as determined by PCM [6]. This value represents a time-weighted average (TWA) exposure level based on 8 hours per day for a 40-hour work week. In addition, OSHA has defined an "excursion limit," which stipulates that no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes [6]. 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 exposure for community members, because the PEL was developed as an occupational exposure for adult workers.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in buildings 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, EPA, CDC's National Center for Environmental Health, the National Institute for Occupational Safety and Health (NIOSH), the New York City Department of Health and Mental Hygiene, the New York State Department of Health, OSHA, and other state, local, and private entities. The work group set a re-occupation level of 0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure at this level [11]. In 2002, a multiagency task force headed by EPA was formed specifically to evaluate indoor environments for the presence of contaminants that might pose long-term health risks to residents in Lower Manhattan. The task force, which included staff from ATSDR, developed a health-based benchmark of 0.0009 f/cc for indoor air. This benchmark was developed to be protective under long-term exposure scenarios, and it is based on risk-based criteria that include conservative exposure assumptions and the current EPA cancer slope factor. The 0.0009 f/cc benchmark for indoor air was formulated on the basis of chrysotile fibers and is therefore most appropriately applied to airborne chrysotile fibers [12].

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 [13]. The American Conference of Government Industrial Hygienists has also adopted a TWA of 0.1 f/cc as its threshold limit value [14].

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7,000,000 fibers longer than 10 µm per liter, on the basis of an increased risk of developing benign intestinal polyps [16]. 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's IRIS model calculated an inhalation unit risk for cancer (cancer slope factor) of 0.23 per f/cc of asbestos [3]. This value estimates additive risk of lung cancer and mesothelioma 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 the slope factor above this concentration might differ from that stated [3]. 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 their asbestos quantitative risk methodology given the limitations of the IRIS model currently used and the knowledge gained since this model was implemented in 1986.

References

1. Agency for Toxic Substances and Disease Registry. Toxicological profile for asbestos (update). Atlanta: U.S. Department of Health and Human Services; September 2001.
2. Midwest Research Institute. Collection, analysis, and characterization of vermiculite samples for fiber content and asbestos contamination. Kansas City: report prepared for the U.S. Environmental Protection Agency Office of Pesticides and Toxic Substances; September 1982.
3. U.S. Environmental Protection Agency. Integrated risk information system (for asbestos). Accessed on July 31, 2002, at: http://www.epa.gov/iris/subst/0371.htm.
4. Agency for Toxic Substances and Disease Registry. Report on the expert panel on health effects of asbestos and synthetic vitreous fibers: the influence of fiber length. Atlanta: U.S. Department of Health and Human Services; 2003. Available at: (http://www.atsdr.cdc.gov/HAC/asbestospanel/index.html).
5. Churg A. Asbestos-related disease in the workplace and the environment: controversial issues. In: Churg A, Katzenstein AA. The lung: current concepts (Monographs in pathology, no. 36). Philadelphia: Lippincott, Williams, and Wilkins; 1993. p. 54-77.
6. Occupational Safety and Health Administration. Federal Register 59:40964-41162, Aug 10, 1994; Federal Register 60:33973-34002, June 29, 1995.
7. Berman DW, Crump K. Methodology for conducting risk assessments at asbestos Superfund sites. Part 2: Technical background document (interim version). Prepared for the U.S. Environmental Protection Agency Region 9. San Francisco: February 15, 1999.
8. U.S. Environmental Protection Agency. Guidelines for conducting the AHERA TEM clearance test to determine completion of an asbestos abatement project. Washington: U.S. Environmental Protection Agency, Office of Toxic Substances, NTIS No. PB90-171778. 1989.
9. Weis CP (EPA). Memorandum to P. Peronard of U.S. Environmental Protection Agency, Amphibole mineral fibers in source materials in residential and commercial areas of Libby pose an imminent and substantial endangerment to public health. Denver: U.S. Environmental Protection Agency; December 20, 2001.
10. U.S. Environmental Protection Agency. Toxic air pollutants Web site. Accessed on October 29, 2002, at: http://www.epa.gov/air/toxicair/newtoxics.html.
11. Agency for Toxic Substances and Disease Registry. World Trade Center response activities. Close-out report. September 11, 2001–April 30, 2003. Atlanta: U.S. Dept. of Health and Human Services; May 16, 2003.
12. U.S. Environmental Protection Agency. World Trade Center indoor environment assessment: selecting contaminants of potential concern and setting health-based benchmarks. New York: EPA Region 2; May 2003.
13. National Institute of Occupational Safety and Health (NIOSH). Online NIOSH pocket guide to chemical hazards. Accessed on July 16, 2002, at: http://www.cdc.gov/niosh/npg/npgd0000.html.
14. American Conference of Government Industrial Hygienists. 2000 Threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati; 2000.
15. U.S. Environmental Protection Agency. National primary drinking water regulations. Accessed on July 16, 2002, at: http://www.epa.gov/safewater/mcl.html

Appendix E. Exposure Pathways for Vermiculite Processing Facilities

Source for all pathways: Libby asbestos (asbestos-contaminated vermiculite from Libby, Montana)

Pathway Name	Environmental Media and 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	On site	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	On site, at waste piles	Inhalation	Community members, particularly children	Past, present, future
On-Site Soil	Suspension of Libby asbestos fibers into air from disturbing contaminated material remaining in on-site soil (residual soil contamination, buried waste)	At areas of remaining contamination at the site or around the site	Inhalation	Current on-site workers, contractors, 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
Residential: Outdoor	Suspension of Libby asbestos fibers into air by disturbing contaminated vermiculite brought off the site for personal use (gardening, paving driveways, traction, fill)	Residential yards or driveways	Inhalation	Community members	Past, present, future
Residential: Indoor	Suspension of household dust containing Libby asbestos from plant emissions or waste rock brought home for personal use	Residences	Inhalation	Community members	Past, present, future
Consumer Products	Suspension of Libby asbestos fibers into air from using or disturbing insulation or other consumer products containing Libby vermiculite.	At homes where Libby asbestos-contaminated products were/are present	Inhalation	Community members, contractors, and repairmen	Past, present, future

Appendix F. Health Statistics Review for Populations Near the W.R. Grace Dearborn Plant in Dearborn, Michigan

Background

Through an analysis of mortality records, ATSDR and the Montana Department of Public Health and Human Services detected a statistically significant excess of asbestos-related disease (asbestosis) among residents of Libby, Montana [1]. Rates of asbestosis were 60 times higher than the national rates, and this difference was highly unlikely due to natural fluctuations in the occurrence of this disease. This discovery led to several follow-up activities in Libby to address the health impacts on the community [2, 3]. Another follow-up activity is a nationwide effort to screen for a similar impact on the health of communities near facilities that processed or received vermiculite ore from the mine in Libby. As part of this activity, ATSDR is currently working with 25 state health departments (including the Michigan Department of Community Health [MDCH]) to conduct health statistics reviews (HSR) on sites that may have received the asbestos-contaminated Libby ore. HSRs are statistical analyses of existing health outcome data (e.g., cancer registry data and/or death certificate data) that help provide information on whether people living in a particular community have gotten selected diseases more often than a comparison population (i.e., people living in the rest of the country). Finding an excess of asbestos-related diseases in a community through an HSR analysis would inform ATSDR and MDCH to the possibility that workers and/or community members might have been exposed to Libby asbestos from the vermiculite ore. Participating state health departments are conducting HSRs for communities near vermiculite facilities in their states, regardless of whether it is known that the community was exposed to Libby asbestos through the processing or handling of vermiculite from the Libby mine. The methodology of the HSR used for the Zonolite Company/W.R. Grace site in Dearborn, Michigan, and other vermiculite sites across the United States was developed by ATSDR [4].

Methods

Both cancer registry data and mortality data were used for this analysis. For both analyses, the same target area was used. The target area consisted of people who died and/or were diagnosed with potential asbestos-related diseases while residing within the city limits of Dearborn (population 89,015 according to 1990 U.S. Census data). The city of Dearborn was chosen because it contains the Zonolite Company/W.R. Grace site located at 14300 Henn Street. In addition, the city of Dearborn was chosen because it represents the smallest geographic area surrounding the site that is electronically coded on Michigan cancer registry records and death certificates.

Cancer Registry Data

The analysis period used was from 1986 to 1995. This period was used by MDCH because (1) it is consistent with ATSDR's standardized nationwide protocol; (2) it corresponds to an approximate latency period in which initial exposure occurred and onset of disease would be expected; and (3) it allows for enough years worth of data for meaningful analyses. There were eight disease groupings used for this cancer incidence analysis (Table A). Of these eight

groupings, the three of greatest interest to ATSDR were the ones that have a known association with asbestos exposure. These three include malignant neoplasm of peritoneum, retroperitoneum, and pleura [ICD-0-2 C480:C488, C384, excluding type M-9590:9989], mesothelioma [ICD-0-2 M-9050:9053], and malignant neoplasm of lung and bronchus [ICD-0-2 C340:C349, excluding type M-9590:9989]. The other five disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the target area.

Sex-specific, age-standardized incidence ratios (SIRs) were calculated for cases of asbestos-related cancer. These SIRs are measures of whether the number of people who got cancer in the city of Dearborn is the same as, lower, or higher than the number of people we would expect to find if the occurrence of cancer in Dearborn were the same as the occurrence of cancer in a comparison population. The comparison population used in this analysis was the population registered in the National Cancer Institute's Surveillance, Epidemiology, and End Results Program [5]. If the number of people getting cancer in Dearborn is the same as the number we would expect to find, the SIR will equal 1. If the number of Dearborn citizens getting cancer is less than one would expect, the SIR will be between 0 and 1. If the number of Dearborn citizens getting cancer is more than one would expect, the SIR will be greater than 1. Chance variation can cause a study area's rates to be higher or lower. The 95% confidence interval (CI) was used to evaluate the probability that the SIR may have been less than or greater than 1 due to chance alone. A confidence interval with a lower bound greater than 1 is possible evidence of an elevated rate. The 95% CIs were calculated to assess statistical significance using Byar's approximation [6].

Mortality Data

The mortality analysis period was from 1979–1998. This period was chosen because (1) it covered the most recent 20 years of mortality data available at the time the analysis began; (2) it corresponded to an approximate latency period in which initial exposure occurred and death would be expected; and (3) no overlapping of ICD revisions occur. There were 12 disease groupings used for this mortality analysis (Table B). Of the 12 groupings, the 3 of greatest interest to ATSDR were the ones that have a known association with asbestos exposure. These three include asbestosis (ICD9 501); malignant neoplasm of peritoneum, retroperitoneum, and pleura (ICD9 158, 163, which includes mesothelioma); and malignant neoplasm of lung and bronchus (ICD9 162.2–162.9). The other nine disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the analysis areas.

Sex-specific, age-standardized mortality ratios (SMRs) were calculated for asbestos-related deaths. An SMR is a measure of whether the number of people who died from a selected diseases in a specific area is the same as, lower, or higher than the number of people we would expect to find in a comparison population. The comparison population data came from national death certificate data received from the National Center of Health Statistics [7]. If the number of persons who died from selected diseases in Dearborn is the same as the number we would expect to find, the SMR will equal 1. If the number of Dearborn citizens who died from selected diseases is less than one would expect, the SMR will be between 0 and 1. If the number of

Dearborn citizens who died from selected diseases is more than one would expect, the SMR will be greater than 1. Again, 95% CIs were calculated to assess statistical significance using Byar's approximation [6].

Results

Tables A and B show, for each disease group analyzed (1) whether past studies have shown a link between asbestos exposure and that type of disease; (2) the number of people in the Dearborn target area who developed or died from the specified disease; (3) the number of people we would expect to develop the specified disease if the community had the same occurrence of disease (or death rate) as the rest of the country; (4) the SIR/SMR; and (5) the 95% confidence interval for the SIR/SMR.

Cancer Registry Data Findings

For the time period 1986–1995, four of the eight disease groupings for the Dearborn target area had SIRs greater than one. These four groupings included *malignant neoplasm of digestive organs, all malignant neoplasms, malignant neoplasm of female breast,* and *malignant neoplasm of prostate*.

Of these four disease groupings, three were within the normal range of what would be expected (Table A). The disease grouping that had a statistically significant excess was for *all malignant neoplasms* (Table A).

Mortality Data Findings

For the time period 1979–1998, two of the 12 disease groupings for the Dearborn target area had SMRs greater than one: *malignant neoplasm of digestive organs* and *malignant neoplasm of female breast*, However, these two disease groupings were both within the normal range of what would be expected (Table B).

Discussion and Limitations

The main goal of conducting these HSRs is to help determine whether communities near facilities that received Libby vermiculite have higher than expected occurrences of asbestos-related diseases. The SIR and SMR analyses suggest that the occurrence of known asbestos-related diseases (i.e., mesothelioma, asbestosis, lung cancer) in the Dearborn population does not appear to be higher than expected compared to the rest of the country. While the disease grouping *all malignant neoplasms* was significantly higher than expected, this grouping was mainly used in this analysis to evaluate reporting/coding anomalies in the study area. Because cancer is made up of hundreds of different diseases, each cancer type has different risk factors. For this reason, it is better to focus on a specific cancer site of concern (i.e., leukemia) when calculating rates.

There are many limitations to using existing data sources to examine the relationship between environmental exposures and chronic diseases (a chronic disease is one that develops over a long

period of time). Some of the major limitations in this analysis include, but are not limited to exposure misclassification, population migration, lack of control for confounding factors (i.e., smoking status data), overstated numerators/under-estimated denominators, large study areas, small numbers of cases/deaths, and under-reporting of cancer cases to the state registry. Most of these limitations would make it less likely (as opposed to more likely) that this type of analysis would identify a higher than expected occurrence of asbestos-related cancers/deaths among people who lived near the Zonolite Company/W.R. Grace site in Dearborn, Michigan, during its years of operation.

References

1. Dearwent S. Mortality in Libby, Montana, 1979–1998, health consultation. Atlanta: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; December 2002.
2. Lybarger J, Lewin M, Miller A, Kess S. Preliminary findings of medical testing of individuals potentially exposed to asbestoform minerals associated with vermiculite in Libby, Montana: an interim report for community health planning. Atlanta: U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; February 2001.
3. Lybarger J, Lewin M, Miller A, Kess S. Report to the community: medical testing of individuals potentially exposed to asbestoform minerals associated with vermiculite in Libby, Montana, from July through November, 2000. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; August 2001.
4. Horton DK, Kaye WE. Health statistics review protocol for U.S. communities that received asbestos-contaminated vermiculite from Libby, Montana. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry; April 2001.
5. Surveillance, Epidemiology, and End Results (SEER) Program. SEER cancer incidence public-use database, 1973–1997, SEER*Stat 3.0, April 2000. National Cancer Institute; 2000.
6. Breslow NE, Day NE. Statistical methods in cancer research, Vol. 2 - The design and analysis of cohort studies. New York: Oxford University Press, International Agency for Research on Cancer; 1989.
7. National Center of Health Statistics. Unpublished data, 2000. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2000.

Table A. Cancer registry data findings for selected cancer cases diagnosed in close proximity to the Zonolite Company/W.R. Grace in Dearborn, Michigan

Selected Cancer	Past studies have shown a link to asbestos exposure?	Number of persons diagnosed	Expected number of cases*	SIR†	95% Confidence Interval (CI)‡	
					Lower	Upper
nant neoplasm of digestive organs (ICD-0-2 C150:C218, C260:C269, excluding type M – 9590:9989)	Weak link	899	843.2	1.07	1.00	1.14
Malignant neoplasm of respiratory system and intrathoracic organs (ICD-0-2 C320:C399, excluding type M –9590:9989)	No	831	832.7	1.00	0.93	1.07
Malignant neoplasm of lung and bronchus§ (ICD-0-2 C340:C349, excluding type M – 9590:9989)	Yes	757	764.4	0.99	0.92	1.06
Malignant neoplasm of peritoneum, retroperitoneum, and pleura§ (ICD-0-2 C480:C488, C384, excluding type M – 9590:9989)	Yes	16	19.1	0.84	0.48	1.36
Mesothelioma§ (ICD-0-2 M – 9590:9989)	Yes	8	12.3	0.65	0.28	1.28
All malignant neoplasms (ICD-0-2 C000:C809)	No	5,653	5,191.9	1.09	1.06	1.12
Malignant neoplasm of female breast (ICD-0-2 C500:C509, excluding type M – 9590:9989)	No	764	736.1	1.04	0.97	1.11
Malignant neoplasm of prostate (ICD-0-2 C619, excluding type M – 9590:9989)	No	899	810.3	1.11	1.04	1.18

* Calculated using national cancer registry data received from the Surveillance, Epidemiology, and End Results Program [5].
† The standardized incidence ratio (SIR) equals the number of people who got the disease divided by the expected number of cases.
‡ The 95% CIs were calculated to assess statistical significance using Byar's approximation [6].
§ Have known associations with asbestos exposure. The other disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the target area.

Table B. Mortality data findings for residents who died from selected diseases in close proximity to the Zonolite Company/W.R. Grace facility in Dearborn, Michigan

Selected Disease	Past studies have shown a link to asbestos exposure?	Number of persons who died	Expected number of deaths*	SMR†	95% Confidence Interval‡	
					Lower	Upper
Malignant neoplasm of selective digestive organs (ICD-9 150-154, 159)	Weak link	819	785.1	1.04	0.97	1.12
Malignant neoplasm of respiratory system and intrathoracic organs (ICD-9 161-165)	Weak link	1,173	1,305.1	0.90	0.85	0.95
Malignant neoplasm of lung and bronchus§ (ICD-9 162.2-162.9)	Yes	1,133	1,261.3	0.90	0.85	0.95
Malignant neoplasm of peritoneum, retroperitoneum, and pleura (includes mesothelioma)§ (ICD-9 158, 163)	Yes	9	9.6	0.93	0.43	1.77
Malignant neoplasm without specification of site (ICD-9 199)	No	255	297.3	0.86	0.76	0.97
Diseases of pulmonary circulation (ICD-9 415-417)	No	84	112.8	0.74	0.59	0.92
Chronic obstructive pulmonary disease (ICD-9 490-496)	No	589	826.3	0.71	0.66	0.77
Asbestosis§ (ICD-9 501)	Yes	1	2.4	0.41	0.01	2.29
Other diseases of respiratory system (ICD-9 510-519)	No	112	146.7	0.76	0.63	0.92
All malignant neoplasms (ICD-9 140-208)	No	4,508	4,606.8	0.98	0.95	1.01
Malignant neoplasm of female breast (ICD-9 174)	No	401	370.8	1.08	0.98	1.19
Malignant neoplasm of prostate (ICD-9 185)	No	266	292.9	0.91	0.80	1.02

* Calculated using mortality data received from the National Center of Health Statistics (unpublished data) [7].

† The standardized mortality ratio (SMR) equals the number of people who died divided by the expected number of deaths.

‡ The 95% CIs were calculated to assess statistical significance using Byar's approximation [6].

§ Have known associations with asbestos exposure. The other disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the target area.

Appendix G: Responses to Public Comments

Comment (C) received regarding the MDCH/ATSDR Health Consultation "W.R. Grace Dearborn Plant (a/k/a Zonolite Company/WR Grace)," and response (R) to comment:

Comment Directed to MDCH

C: The only comment I have are [sic] that it would be good if it were modified slightly to reflect the American Thoracic Society's medical effects criteria that were published in September [2004]. They're considered to be exhaustive and authorative [sic].

R: The document to which the commenter refers is the American Thoracic Society (ATS) "Diagnosis and initial management of nonmalignant disease related to asbestos" official statement, adopted on December 12, 2003, by the ATS Board of Directors. It is available for free online in Adobe Portable Document Format (PDF) at the ATS Web site (see http://www.thoracic.org/adobe/statements/asbestos.pdf).

MDCH proposes the following actions in response to this comment:

1) MDCH will place this PDF document on the agency's Internet Web page devoted to the former W.R. Grace facility in Dearborn, Wayne County, Michigan. This can be accessed at http://www.michigan.gov/vai.
2) MDCH will provide printed copies of this document to any healthcare provider who contacts us, should they be unable to access the document through other channels. MDCH can be contacted via our toll-free "Toxics & Health Hotline" at 1-800-MI-TOXIC (648-6942).

Appendix H: Definitions of exposure pathways and health hazard categories.

Exposure pathways

An exposure pathway is the way in which an individual comes into contact with a contaminant. An exposure pathway consists of the following five elements: (1) a *source* of contamination; (2) a *medium* 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 **potential** exposure pathway indicates that exposure to a contaminant could have occurred in the past, could be occurring currently, or could occur in the future. A potential exposure exists when information about one or more of the five elements of an exposure pathway is missing or uncertain. An **incomplete** pathway is missing one or more of the pathway elements and it is likely that the elements were never present and are 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 exposure.

Public health hazard categories

ATSDR uses public health hazard categories to describe whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are defined as follows.

No public health hazard

A category used in ATSDR's assessments for sites where people have never been and will never be exposed to harmful amounts of site-related substances.

No apparent public health hazard

A category used in ATSDR's assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

Indeterminate public health hazard

The category used in ATSDR's assessments documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Public health hazard

A category used in ATSDR's assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances that could result in harmful health effects.

Urgent public health hazard

A category used in ATSDR's assessments for sites where short-term exposure (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.