Health Consultation

FORMER ZONOLITE COMPANY/
W.R. GRACE EXFOLIATING PLANT

TOWN OF BRUTUS, CAYUGA COUNTY
NEW YORK

EPA Facility ID: NYXCRA819000

Prepared By:

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TABLE OF CONTENTS

Foreword:
ATSDR's National Asbestos Exposure Review

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

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

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

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

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

- The US Environmental Protection Agency (US EPA) mandated further action at the site based upon contamination in place, or

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

The former Zonolite Co./ W.R. Grace exfoliating facility site in Brutus, New York was selected for Phase 1 review as estimates suggest the facility imported 148,485 tons of Libby vermiculite during operation.

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

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

BACKGROUND AND STATEMENT OF ISSUES

The New York State Department of Health (NYS DOH) prepared this health consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The objectives of this document are to summarize the information known about the former Zonolite Co./ W.R. Grace site in Brutus, New York, and to evaluate the public health implications of any potential past, present, or future pathways of human exposure to Libby amphibole asbestos.

A. Site Description and History

The former Zonolite Co./ W.R. Grace facility was on a 1.6-acre plot of land on Dunn Road in the town of Brutus, New York. Homes and a farm border the property to the north, a railroad line to the south, a NYS Thruway entrance/exit ramp to the west, and undeveloped property to the east (US EPA, 2002a). The Village of Weedsport, the closest village, lies approximately 0.25 miles southwest. The facility was commonly known as and will be referred to in this document as the Weedsport facility. The general area is of mixed land use, including agricultural, undeveloped, and residential properties (Appendix A).

The site was formerly owned by the Lehigh Valley Railroad Company and was transferred to a private owner in 1955 (US EPA 2002a). In 1963, two buildings and four silos were erected on the site. From 1963 through 1989, Zonolite Co./ W.R. Grace Corporation leased the property and used the buildings for processing vermiculite (US EPA 2002a). Former employees and residents indicated that the undeveloped property east of the site was used by Zonolite Co./ W.R. Grace for disposal purposes.

Vermiculite mined by W.R. Grace in Libby, Montana contained amphibole asbestos, with characteristic composition that includes winchite, richterite, and tremolite as defined by Leake et. al. 1997; this characteristic material will be referred to as *Libby amphibole asbestos* (Leake et. al. 1997; Meeker et. al. 2003). Amphibole asbestos fibers are friable (breakable) and can become airborne. Amphibole asbestos is not generally broken down and can remain in the environment for long periods of time (ATSDR 2001a). In this document, soil sample results reported as "tremolite asbestos" or "tremolite-actinolite" indicate the presence of Libby amphibole asbestos. However, the sample results do not necessarily quantify the other asbestiform minerals that may be present but are not regulated forms of asbestos, including winchite and richterite.

In Libby, the vermiculite ore was processed to remove waste rock, segregated by size, and then shipped to exfoliating plants. The Weedsport facility received most of its processed vermiculite ore, known as concentrate, from Libby. The facility heated the vermiculite concentrate, causing the material to expand. This expansion process, called *exfoliation*, created a material with diverse uses.

Vermiculite is used in products for domestic and industrial applications, including construction materials, potting soil, insulation, fireproofing materials, and friction products (TVA 2002).

The processing conducted in Libby reduced the amount of asbestos in the ore, but did not eliminate it. Estimates of asbestos concentrations in the Libby concentrate vary. According to an ATSDR summary of the Midwest Research Institute (MRI) study conducted in 1982, the vermiculite concentrate from Libby contained 0.3%-7% by weight asbestiform amphibole identified as tremolite-actinolite (Atkinson et. al. 1982). A 1984 study conducted by W.R. Grace determined that the Libby concentrate contained 0.4% to 1.0% asbestiform amphibole (US DHHS 2001). These estimates may not account for richterite and winchite, which may have also been present. The inclusion of these two additional asbestiforms may have increased the percentage of total asbestos in the Libby concentrate. This report only focuses on two regulated forms of asbestos, tremolite-actinolite.

In 1989, W.R. Grace terminated operations at the Weedsport site. Following closure, the four silos were removed, but the processing building was cleaned and left intact (US EPA 2002a). W.R. Grace had a consultant collect four air samples within the processing building and a silo to verify that the on-site structures were clean in June 1989. The air sample results were below the Occupational Safety and Health Administration's (OSHA) action level of 0.1 fiber per cubic centimeter (f/cc) for an 8-hour time weighted average (TWA). In addition, all measured concentrations were below 0.004 f/cc, which was the minimum concentration of fibers that the laboratory could detect and report (Marriam 2003). W.R. Grace provided the results to the property owner in 1992. While no fibers were identified in the samples collected, the samples were likely analyzed with Phase Contrast Microscopy (PCM), which has limitations in the identification of fibers. The PCM results may overestimate or in other instances underestimate the asbestos fibers present. These limitations are described in greater detail in Appendix E.

In June 2001, the US Environmental Protection Agency (US EPA), Region 2, conducted soil sampling in Brutus at the former Zonolite Co./ W.R. Grace site and neighboring properties as part of a national evaluation of facilities that received vermiculite ore from Libby, Montana. Three of the 54 soil samples collected and analyzed by Polarized Light Microscopy (PLM) contained concentrations of tremolite-actinolite asbestos greater than 1% by weight (US EPA 2002b). The remaining samples contained concentrations of tremolite-actinolite asbestos ranging from non-detect to 0.75% by weight.

The current owner and operator of the site is Crossroads Industrial Park, Inc. In the recent past, the main building was leased to a company that produced mulch from cocoa husks. The company left the site in 2001 (US EPA 2002a). The site is currently unoccupied and available for lease/sale.

B. Demographics

NYS DOH used data from the 1970 US Census to assess past potential exposures. Demographic data from 1970 was used to represent the community that existed during exfoliating operations before the facility implemented several dust suppression technologies. To evaluate past potential exposures, this report uses two populations: residents within one-mile of the site (Table 1.0) and the entire Village of Weedsport.

NYS DOH used the one-mile radius in identifying the population that lived near the former exfoliating plant in accordance to the health statistics review, which is currently underway (NYS DOH 2002a.).

Table 1.0

1970 Demographic Statistics	
Within One-Mile of Zonolite Co./ W.R. Grace Weedsport Site*	
Total Population	1277
Race:	
Percent of Population White	99
Percent of Population Black	1
Age:	
Percent of Population under 18	38
Percent of Population 62 years and over	15
Total Housing Units	412

*Data collected from the US Bureau of the Census, 1970 Census of Housing: Block Statistics for Selected Areas in New York. 1972.

The following table (Table 1.1) presents the demographic data for the Village of Weedsport:

Table 1.1

1970 Demographic Statistics	
Village of Weedsport**	
Total Population	1900
Race:	
Percent of Population White	99
Percent of Population Black and other Race	<1
Age:	
Median Age	28.8
Percent of Population under 18	39
Percent of Population over 65	12
Total Housing Units	579

**Data collected from the US Bureau of the Census, 1970 Characteristics of the Population: New York. Part 34, Section 1. 1970.

NYS DOH used data from the 1990 US Census to characterize the population living near the former Zonolite Co./ W.R. Grace site after exfoliating operations terminated. A one-mile radius was used to define this population (Table 1.2). The demographic data are presented in the following table.

Table 1.2

1990 Demographic Statistics	
Within One-Mile of Former Zonolite Co./ W.R. Grace Weedsport Site* **	
Total Population	1267
Race:	
Percent of Population White	98
Percent of Population Asian or Pacific Islander	1
Percent of Population of Other Race	1
Age:	
Percent of Population under 19	30.6
Percent of Population over 65	13.3
Total Housing Units	465

***Results from MapInfo Query using US Bureau of the Census, 1990 Census Block Data: New York.

The population within one-mile of the former W.R. Grace facility from 1970 to 1990 did not change significantly in terms of number of people, age distribution, or ethnicity.

C. Former Zonolite Co./ W.R. Grace Exfoliation Operations

The Zonolite Co./ W.R. Grace facility in Brutus operated 24-hours a day, seven days a week. The on-site exfoliating operations were primarily enclosed. The vermiculite concentrate was brought to the site in 100-ton hopper ore cars via Zonolite's rail line. The site contained a rail siding or spur allowing ore cars to enter the site from the main railroad line, which was formerly owned by Lehigh Valley Railroad Company but currently owned by Conrail. According to data presented in Appendix B, the total tons of vermiculite concentrate received at the Weedsport facility from the Libby mine, with the exception of imports from 1981 for which data are unavailable, were 77,185 tons (US EPA 2002b). US EPA conducted a rough evaluation of shipping records from Libby invoices and estimated that the Weedsport facility imported 148,485 tons of vermiculite concentrate (US EPA 2001). The larger estimate is based on a more complete compilation of records, which the US EPA expects to be more accurate.

The operation unloaded approximately one 100-ton hopper car per week. The vermiculite concentrate was unloaded onto an enclosed screw conveyor. The conveyor moved the material to a bucket elevator, which transferred the vermiculite concentrate into four enclosed silos. The facility had four emission points regulated by the New York State Department of Environmental Conservation (NYS DEC). The first of these points was the vermiculite concentrate unloading and storage area. Local residents indicated that wind generated by the train in transport stirred up dust at the site.

A series of enclosed conveyors transferred the vermiculite concentrate from the silos to the feed hopper. The conveyor drop points vented to a high capacity air pollution control system, known as the cyclone, which was the second emission point (NYS DEC Files, 1970-1989).

The vermiculite concentrate then moved into the expanding furnace at a rate of 2,000 pounds per hour (lbs./hr). The emissions generated from the furnace depended on the exfoliating process. There were two types of processes used at the facility. The first method involved heating the material until water trapped in the vermiculite concentrate boiled, causing the vermiculite to expand. The second method involved the same heating and expansion process with the application of an asphalt emulsion, which was sprayed on the hot vermiculite. The second method waterproofed the expanded vermiculite and accounted for about 30% of the product output (NYS DEC Files, 1970-1989). The asphalt emulsion produced a light smoke and an odor. In 1970, the plant temporarily replaced its asphalt emulsion process with a silicone spray to reduce odors. The asphalt emulsion process resumed in 1977, but terminated again later that year due to community complaints. The furnace was vented to the cyclone and was the third regulated emission point.

Some of the vermiculite was transferred from the furnace to a mixer, where gypsum and dupinol (an anti-condensation liquid) was added to the vermiculite to fireproof the product. According to a former mixer operator, this process known as Monokote, required the addition of plaster, soap, ore, and a substance that appeared to be asbestos. The source and type of asbestos that was used in the Monokote process at the site is unknown. According to information provided by the US EPA, asbestiform chrysotile was often used in the Monokote process (US EPA 2005). The Monokote fireproofing product was formulated with the addition of 10-19% chrysotile asbestos and this type of Monokote production was discontinued by W.R. Grace in 1973 (US EPA unpublished data in ATSDR files, 2005). The Monokote process conducted at the Weedsport site vented to the cyclone and was the final regulated emission point. The vermiculite then dropped from the furnace/mixer into a product elevator that moved the vermiculite over an inclined vibrating screen to eliminate unexpanded materials referred to as “stoner rock” from the product (NYS DEC Files, 1970-1989). A detailed diagram of the facility's processes is in Appendix C.

Dust emissions from the conveyer drop points, furnace, and mixer were reduced by venting them first to the cyclone and then to a wet scrubber, which was installed prior to 1967 (NYS DEC Files, 1970-1989). The facility periodically operated without the wet scrubber in use. NYS DOH could not find information regarding the disposal of liquid waste produced from the wet scrubber. According to former employees and nearby residents, liquid wastes were dumped and buried in drums on the leased property and the wooded property east of the site. In 1973, Zonolite Co./ W.R. Grace replaced the wet scrubber with a different air pollution control device called a “bag house” in accordance with Clean Air legislation (NYS DEC Files, 1970-1989). The bag house was installed to reduce odor and dust emissions. The various dust emission controls used were not designed specifically to eliminate asbestos emissions. The facility was not considered an asbestos processor and did not have to comply with air emission regulations for the asbestos industry.

Most of the Libby amphibole asbestos in the concentrate was lost during processing and became part of the waste known as "stoner rock." According to mineral analyses conducted by W.R. Grace, the stoner rock contained between 2% to 10% tremolite asbestos (MDH 2001). Until the 1970's, stoner rock was considered non-hazardous. Once separated from the waste, the vermiculite product went directly to bagging machines that placed the product in bags of various capacities. The bagging process was an unregulated source of dust emissions, which discharged directly outside the south building wall. In 1973, the bag spout was vented to the bag house to reduce emissions (NYS DEC Files, 1970-1989). The vermiculite product may have contained residual asbestos ranging from 0.5%-3% (EPA 2000a.).

Waste materials from the facility were disposed in the Seneca Meadows Landfill in Seneca Falls, Seneca County; at an unknown private landfill in Port Byron, Cayuga County; on-site and on the property east of the site (US EPA 2002a). A document provided voluntarily by Remedium Group, Inc. a subsidiary of W.R. Grace described waste handling and disposal operations at the private landfill in Port Byron (Marriam 2003). This document states that stoner rock and other waste materials from the cyclone and baghouse were bagged on-site. The bags of waste were then piled onto a truck, covered, and dumped into the Port Byron landfill. The bags may have been leveled by a compactor operator, which would have generated dust (Marriam 2003). The leveled waste may have been covered with other material. According to a former Zonolite Co./ W.R. Grace employee, waste was often stored in piles and bulldozed on-site. Whether the bulldozed material was buried or covered with soil remains unknown. Former employees and residents near the site reported liquid waste was disposed on the property east of the site.

Records indicate that vermiculite waste materials were used on three private farm/residential properties; two properties located in Port Byron and on a private farm near the site.

D. Site Visit: Current Status

Representatives from NYS DOH, Cayuga County Department of Health, US EPA, and ATSDR met in September 2002 at the former Zonolite Co./ W.R. Grace site in Brutus. Participants took photographs of the site during the visit (Appendix D). The participants made the following observations:

- The site was enclosed with a fence to limit entry. The fence varied in height and structure and in some locations, including the portion along Dunn Road, may not be a significant deterrent to trespassers.
- The former processing building was present.
- The site was covered with thick vegetation, which was not mowed or maintained.
- The site was for lease/sale by the owner.
- The area surrounding the site consisted of mixed land use including a strip of houses to the north and southeast, forested properties to the northeast and south, and farmland to the northwest (NYS DOH 2002b.).

DISCUSSION

A. Environmental Sampling Data

In June 2001, US EPA collected surface and subsurface soil samples at the former Zonolite Co./ W.R. Grace site and from nearby residential properties. Before sampling, researchers established a grid on-site with 100 feet (ft) by 100 ft squares. Surface soil samples were collected at 37 nodes of the sampling grid (US EPA 2002b). Additional surface and subsurface soil samples were collected in expected areas of contamination on-site, at off-site residential locations, and within a wooded area east of the site. US EPA observed one small area containing a material resembling stoner rock. This area was sampled for further analysis. In addition, US EPA identified and sampled five areas on-site containing visual evidence of exfoliated vermiculite (US EPA 2002b). A total of 54 samples were collected and analyzed for asbestos including 50 surface soil samples and four subsurface soil samples.

The samples were analyzed using Polarized Light Microscopy (PLM) and Transmission Electron Microscopy (TEM). The TEM method has higher magnification and greater sensitivity, allowing the detection and characterization of smaller fibers. The PLM method analyzes a larger portion of the sample than the TEM method. A detailed description of the types of asbestos, laboratory methods of analysis, and health implications is included in the Appendix E.

The PLM analysis conducted was designed to identify the six types of regulated asbestos, which are chrysotile, amosite, anthophyllite, tremolite, actinolite, and crocidolite. The majority of surface soil samples collected on-site contained trace amounts of asbestos too small to quantify (<0.25% asbestos) according to the PLM analytical results. Of the 45 surface soil samples collected on-site and analyzed by PLM, two samples contained >1% asbestos, two samples contained between 0.25% and 1%, 28 samples contained concentrations below the analytical detection limit (<0.25%), and 13 samples did not contain detectable levels of asbestos (US EPA 2002b). Of the three on-site subsurface samples analyzed by PLM, two samples contained between 0.25% and 1%, and one sample result was below the analytical detection limit (<0.25%) (US EPA 2002b). Consequently, low-levels of asbestos were detected over a large portion of the property. Overall, the sample results indicated the presence of Libby amphibole. Asbestos fibers were generally not detected in soil collected from the northern perimeter of the site near Dunn Road.

One surface and one subsurface soil sample was collected from the property east of the site and both were analyzed by PLM. The surface soil sample contained 0.75% asbestos by weight, and the subsurface soil sample contained 1.50% asbestos.

The Asbestos Hazard Emergency Response Act (AHERA) classifies any mineral containing >1% asbestos, by weight, as an Asbestos Containing Material (ACM) (Addison, 1994). AHERA adopted this percentage in the early 1980's, when laboratory and analytical methods limited asbestos fiber quantification and identification. This percentage was not based on health risks.

Three of the soil samples contained levels of asbestos >1%. These samples were collected from the following locations (See Appendix F):

- surface soil between the inactive railroad tracks and the north side of the former processing building near the hopper car unloading area
- surface soil from the east end of the inactive railroad tracks
- subsurface soil from the woods directly east of the site (US EPA 2002b).

The surface soil sample collected between the inactive railroad tracks and the former processing building contained 3.35% asbestos, the highest concentration measured. This area of asbestos contamination is most likely associated with former vermiculite concentrate unloading activities (US EPA 2002b). The limited number of samples containing >1% asbestos suggests only isolated areas of higher contamination.

Seventeen soil samples including 13 surface and four subsurface samples were analyzed for fiber length distribution. Of the 17 soil samples, 15 of the samples contained fibers >5µm (US EPA 2002b).

Four surface soil samples were collected from nearby residential properties. One surface soil sample contained trace amounts of asbestos too small to quantify (<0.25% asbestos). The remaining three samples did not contain detectable levels of asbestos (US EPA 2002b). The limited residential soil data do not suggest that there is significant Libby amphibole asbestos contamination off-site. Several residents were concerned that the off-site sample locations were collected in areas that would not represent current conditions. These concerns are discussed later in this document.

In September 2002, US EPA conducted a visual site investigation at the two off-site private properties in Port Byron that contain vermiculite waste. The waste was used on two local knolls and as fill in a gully. US EPA returned to these two private properties in September 2003 and collected 115 soil samples within the areas of vermiculite waste disposal. All 115 soil samples were analyzed for asbestos by PLM, 26 samples were analyzed by TEM, and ten soil samples were analyzed by Scanning Electron Microscopy (SEM). The TEM results detected asbestos in one soil sample. The concentration of asbestos present was below the detection limit of <0.1% asbestos and was too small to quantify. The laboratory report notes that the detected fibers were of Libby amphibole, which include richterite and winchite asbestiforms. The PLM and SEM analytical methods did not detect asbestos in any of the soil samples analyzed. The detection limit achieved for PLM was 0.25%, and the limit for SEM was not reported (Weston Solutions 2004).

B. Exposure Pathways

An exposure pathway consists of five elements: a source of contamination, a transport mechanism, a point of exposure, a route of exposure, and a receptor population (that is, the people who actually come into contact with the substance). All five of these elements must be present for an exposure to a contaminant such as asbestos to occur. During the 26-years of exfoliating operation, there were several potential pathways of concern. The potential for current and future exposures has been greatly reduced since the time the plant was active. A general table containing potential exposure pathways was developed by ATSDR to include in all health consultations developed for facilities that processed vermiculite from the W.R. Grace Libby mine. The table is included in the Appendix G.

The pathways of exposure most relevant to this site, based on the type of operations, practices that occurred, and the environmental sampling are examined in this section. The pathways are divided into the following groups: *Occupational, Household Contacts, Community,* and *Consumer Products*. In addition, the various potential pathways are subdivided within each group and listed in the order of likely importance.

Occupational

1. Inhalation of Libby amphibole asbestos fibers by former employees of the Zonolite Co./ W.R. Grace exfoliating facility in Brutus.
2. Inhalation of Libby amphibole asbestos fibers by former employees of the landfills that received Zonolite Co./ W.R. Grace stoner rock and other waste materials.
3. Past and future inhalation of residual Libby amphibole asbestos contamination in the former processing building.

Household Contacts

4. Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on former Zonolite Co./ W.R. employee clothing, skin, and hair.
5. Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on the former employees of the landfills that received stoner rock and other waste materials from Zonolite Co./W.R. Grace.
6. Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on former employees of the mulch company.

Residential

7. Past inhalation of Libby amphibole asbestos fibers from dust emissions (i.e. stack and other emissions) transported off-site.
8. Past, present, and future inhalation of Libby amphibole asbestos fibers from the disposal or use of vermiculite waste on residential properties.
9. Past inhalation of Libby amphibole asbestos fibers from storage piles of waste rock material.
10. Past, present, and future inhalation of Libby amphibole asbestos by residents near the Seneca Falls and the Port Byron landfills that disposed Zonolite Co./ W.R. Grace stoner rock and other waste materials.
11. Past and present inhalation of Libby amphibole asbestos fibers from on-site areas of soil contamination.
12. Future inhalation to on-site Libby amphibole asbestos from disturbance of contaminated soil as land use changes.
13. Past incidental ingestion of Libby amphibole asbestos for residents in the area consuming homegrown vegetables or through other ingestion activities.

Consumer Products

14. Past, present and future inhalation to Libby amphibole asbestos from the handling or disturbance of asbestos-containing insulation or other products.

Occupational

1. Inhalation of Libby amphibole asbestos fibers by former employees of the Zonolite Co./ W.R. Grace exfoliating facility in Brutus.

Past employees have stated that dust associated with their jobs was considerable (US EPA 2000b). Employee responsibilities at the plant included shoveling vermiculite ore, cleaning the silos, maintaining the furnace, working with the finished product, and bagging and disposing waste materials. NYS DOH obtained air sample results from sampling events conducted at the Weedsport facility in 1976, 1982, 1986, 1987 and 1988. Several employees wore personal air samplers, and additional air samplers were dispersed at several locations in the plant. The samples were analyzed for fibers. The laboratory reports suggest that PCM was used to analyze the samples. PCM analytical techniques cannot detect fibers less than 0.25 μm in diameter and cannot distinguish between asbestos and non-asbestos fibers. Consequently, PCM results that indicate the presence of fibers provides evidence that asbestos was present due to the nature of work conducted at this facility, but the results do not provide definitive data quantifying the asbestos present. A detailed description of PCM is in Appendix E. In 1976 and 1982, the analytical results of the personal samplers were consistently less than 2 fibers per cubic centimeter (f/cc), which was the occupational standard at the time (W.R. Grace 1976, 1982). In 1976, a total of thirteen personal air samples were collected from employees. Approximately 92% of the sample results were below the 1976 occupational standard but exceeded the current standard of 0.1 f/cc established in 1994 (OSHA 1994). The remaining 8% of the samples were below 0.1 f/cc (W.R. Grace 1976, 1982). In 1982, sixty-one personal air samples were collected from employees at the Weedsport facility. Approximately 85% of the sample results were below the 1982 occupational standard but exceeded the current standard; 7% equaled 0.1 f/cc and the remaining 8% were below the current standard (W.R. Grace, 1976, 1982). It must be noted that the sample analytical forms from 1976 and 1982 do not specify the source of vermiculite processed at the time of sampling, but it was likely from Libby. In 1986, 1987, and 1988, the personal air samples collected were all below 0.1 f/cc (Marriam 2003). The sample analytical forms from the three later years specify that Libby concentrate was processed during the sampling events (Marriam 2003).

Four personal air samples were collected in 1980 from two W.R. Grace employees responsible for disposal operations. Two samples were collected simultaneously while an employee covered waste materials loaded in a truck, drove to a Port Byron landfill, and dumped the waste in the landfill. The sample results averaged 0.27 f/cc for 43-minute samples (Marriam 2003). Two additional samples were collected from another employee who assisted in covering the waste material in the truck and sat as a passenger on the way to the landfill. The sample results averaged 0.04 f/cc for 43-minute samples (Marriam 2003). The sample analytical form from the 1980 sample event did not specify the source of vermiculite waste; however, it was likely associated with Libby concentrate. In 1983, another personal air sample was collected during hauling and disposal operations of vermiculite waste from an unspecified source. The sample result was 0.26 f/cc. for a 69-minute sample (Marriam 2003). The sample results provide evidence that exposure to asbestos may have occurred during disposal operations.

Samples collected in 1986, 1987, and 1988 from areas in the facility including near the vibrating screen that removed stoner rock from the product, within a silo and near the bag house consistently contained results that exceeded the current standard of 0.1 f/cc. For example, in 1986 five out of the seven indoor air samples collected were equal to or exceeded 0.1 f/cc (Marriam 2003). The maximum amount of fibers detected was 1.14 f/cc from within the silo in 1987.

The fiber concentrations measured in personal samplers and within the facility provide evidence that former employees were exposed to asbestos during plant operations. Former employees at this facility may have been exposed to Libby amphibole asbestos at levels exceeding the current workplace standard.

NYS DOH recommended that people who were likely exposed to asbestos-contaminated vermiculite, including people who worked with vermiculite in the past at the facility, be examined by a physician with expertise in asbestos–related lung disease. Several people who had a history of working with vermiculite were evaluated by their physician and/or in an occupational health clinic and were diagnosed with asbestos related disease (Personal Communication with Central New York Occupational Health Clinic, 2004). Although these data are limited, this information indicates that some former employees were exposed to levels of asbestos that pose a health hazard.

2. *Inhalation of Libby amphibole asbestos fibers by former employees of the landfills that received Zonolite Co./ W.R. Grace stoner rock and other waste materials.*

Employees at the landfills that received stoner rock and other waste materials from the Zonolite Co./ W.R. Grace facility were likely exposed to Libby amphibole asbestos during disposal and leveling activities. The PCM result for a personal air sample collected in 1983 from a compactor operator at a landfill that received vermiculite waste from another W.R. Grace exfoliating facility contained 0.26 f/cc for a 24-minute sample. The sample was collected from an employee within the enclosed cab compartment during vermiculite waste leveling activities. The sample result provides evidence of exposure for a short period of time (Marriam 2003). The exposures could vary significantly between landfills depending on the quantity of waste handled and on the disposal practices used. If the measured exposure lasted for an extended period of time in a given day, employees at the landfill may have been exposed to asbestos exceeding the current workplace standard of 0.1 f/cc.

3. *Past and future inhalation of residual Libby amphibole asbestos contamination in the former processing building.*

Zonolite Co./W.R. Grace cleaned the former exfoliating building following closure and conducted an industrial hygiene evaluation in 1989 to confirm that on-site structures were clean. Grace personnel collected four air samples inside the facility and one sample outside the facility. The samples collected were not aggressive; meaning that dust was not intentionally disturbed around the sample pump to re-suspend any residual fibers during sampling. All measured concentrations were below the detection limit of 0.004 f/cc (Marriam 2003), and the results are well below the current occupational standard of 0.1 f/cc.

The available data suggests that it is unlikely that occupants of the former processing building were exposed to hazardous levels of Libby amphibole asbestos. If workers at the site were exposed to residual asbestos fibers, these exposures were likely minimal. The data collected have some limitations and further indoor air sampling could be used to confirm the conclusion that no residual asbestos sources are present.

The on-site building is currently vacant, but may be utilized in the future.

Household Contacts

4. *Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on former Zonolite Co./ W.R. employee clothing, skin, and hair*.

Former employees may have transported Libby amphibole asbestos fibers on their clothing, skin, and hair to their vehicles and homes, potentially exposing their families to asbestos. Several studies have associated household contact exposure with the development of asbestos-related diseases among family members of workers exposed to asbestos on the job (NIOSH 1997).

The risks associated with household contact exposure depend on the extent of employee contact with contaminated dust (i.e. take-home levels of asbestos) and personal hygiene habits such as removing work shoes at the door, changing out of work clothes, and showering promptly after work. Several wives of former employees recalled shaking out their husbands' dusty work clothes before laundering them on a daily basis. This activity could have lead to repeated exposure to asbestos. Since employees of the Zonolite Co./W.R. Grace facility were likely exposed to levels of Libby amphibole asbestos that exceeded current workplace standards, their household contacts were also likely exposed although the frequency and concentration of exposure are unknown.

5. *Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on the former employees of the landfills that received stoner rock and other waste materials from Zonolite Co./W.R. Grace*.

Exposures to Libby amphibole asbestos may have occurred to household contacts of former landfill workers. Former employees may have transported asbestos fibers on their clothing, skin, and hair to their cars and homes, exposing household contacts. Employee contact with the waste material was likely indirect (i.e. compactor machines) and infrequent (i.e. occurred during limited hours during the day and limited days during the week). Household contacts may have periodically been exposed to Libby amphibole asbestos.

6. *Past inhalation by household contacts of Libby amphibole asbestos fibers that left the site on former employees of the mulch company.*

Since aggressive sampling did not occur in the former processing building, we can not rule out that employees of the mulching company may have been exposed to low level residual Libby amphibole asbestos contamination and transported asbestos fibers to their cars and homes. The amount of asbestos contamination brought home by these workers was likely low. Residual asbestos fibers did not likely present a significant exposure to employees and even less to their household contacts, if any.

Residential

7. *Past inhalation of Libby amphibole asbestos fibers from dust emissions (i.e. stack and other emissions) transported off-site*.

Considerable time elapsed between the first community complaint of dust emissions from the former exfoliating facility in 1964 and the implementation of effective industrial controls in 1973 (NYS DEC Files, 1970-1989). There are reports of dust settling on clothes hanging on outdoor lines, collecting in backyard pools and coating local vegetation (NYS DEC Files, 1970-1989). Residents in the immediate vicinity of the site recalled sweeping every day and mopping frequently to manage the dust in their homes that they attributed to the exfoliation plant. In 1973, Zonolite Co./ W.R. Grace replaced the wet scrubber with a bag house. The plant modifications implemented in 1973 helped reduce off-site emissions, but did not eliminate them. Moreover, modifications did not reduce dust emissions from vermiculite unloading activities and other processes at the plant.

In 1968 and 1970, stack tests were conducted at the facility. The results of these stack tests quantified total particulate emissions from the stack during the sampling events, but did not differentiate between non-asbestos particulates and asbestos fibers. Results from the 1968 stack test, projected an emission rate of 120 grams of the particulate matter per hour at maximum processing capacity. According to the 1970 stack tests, 6.01 lbs. particulate matter were released per hour at maximum processing capacity (Marriam 2003). Several limitations impact the interpretation of these emission rates, including lack of documentation for sample collection methods, field and operational conditions, and laboratory analytical methods. Nevertheless, the results indicate particulate matter was released from the facility and likely contained Libby amphibole asbestos.

The extent of asbestos transport depended on a number of parameters including wind speed and direction. The prevailing winds are out of the west as displayed by the wind rose in Appendix H. In 1970, approximately 70 people lived within one-mile to the east of the facility. The former exfoliating facility was approximately 150-feet from the closest residential property boundary. The nonresidential areas surrounding the plant created a spatial buffer between the facility and the community.

Libby amphibole asbestos may have entered homes through open windows, on clothing and on pets, where it would have settled on household surfaces. Activities such as sweeping or vacuuming could have re-suspended the asbestos fibers. Household dust may have served as a continuing source of asbestos exposure. The degree of exposure to Libby amphibole asbestos in the community would have depended on a number of domestic factors. For example, mopping a floor instead of sweeping could have reduced the re-suspension of fibers in the air.

There is not enough information to quantify potential exposures to Libby amphibole asbestos at the homes surrounding the site. Recent sampling of residential soil did not show evidence of significant off-site transport. Community members have stated that the soil sample locations on the residential properties were not representative of current soil conditions since the samples were collected in a horseshoe pit and where a pool once stood. Low-levels of asbestos were detected over a large portion of the site at concentrations too small to quantify. Asbestos fibers were generally non-detect at the northern perimeter of the site near Dunn Road and were <0.25% at the southern perimeter near Tow Path Road. If asbestos (associated with past dust emissions)

is present on off-site residential properties, the concentrations would likely be lower than those detected on-site.

8. Past, present and future inhalation of Libby amphibole asbestos fibers from the disposal or use of vermiculite waste on private properties (excluding licensed landfills).

Vermiculite waste material was reportedly disposed on three local residential/farm properties and on the property east of the site. The waste was used on two farmed properties and as fill in a gully. Some local residents also claimed that they used the material as a soil additive in gardens on their properties and for other applications such as kitty litter. Transporting and distributing the waste on the properties may have led to the suspension of Libby amphibole asbestos fibers and an inhalation exposure. The individuals in direct contact with the material were at the highest risk for exposure. Recreational use of the property east of the site by hunters, hikers, and ATV riders could lead to exposure if asbestos contamination is present in surface soils. The duration of contact and the concentration of asbestos in the vermiculite waste would have determined the extent of exposure.

US EPA collected samples from the disposal areas on two of the private properties in September 2003. Asbestos was only detected in one of 115 soil samples collected. The concentration of asbestos detected in the single sample was too small to quantify (Weston Solutions 2004). These areas are not considered a current risk to the community.

NYS DEC and NYS DOH are working together to investigate the property east of the site.

9. Past inhalation of Libby amphibole asbestos fibers from storage piles of waste rock material.

An anecdotal account alleged that stoner rock waste material was stored in waste piles and frequently bulldozed on-site. The temporary storage of stoner rock waste material in piles on-site was a common practice at exfoliating plants. These waste piles were not restricted and were accessible to the community including neighborhood children. Prolonged contact with the stoner rock may have resulted in exposure. Contact with on-site waste materials could have resulted in inhalation exposure to Libby amphibole asbestos.

Trespassers, former employees and neighborhood pets that entered the site may have tracked asbestos off-site. Wind could have blown asbestos from uncovered piles of stoner material to nearby properties. However, soil samples collected from the perimeter of the site and on residential properties did not show evidence of significant off-site transport. Community exposure to Libby amphibole asbestos associated with this pathway were likely limited.

10. Past, present and future inhalation of Libby amphibole asbestos by residents near the Seneca Falls and the Port Byron landfills that disposed Zonolite Co./ W.R. Grace stoner rock and other waste materials.

Individuals near the Seneca Falls Landfill and the unknown landfill in Port Byron that received Zonolite Co./ W.R. Grace waste may have been exposed to Libby amphibole asbestos in disposal related dust. The amount of dust generated would have depended heavily on disposal and

landfill characteristics, including if the disposal occurred in a pit or on a hill, and depended on waste leveling and containment practices. In addition, the likelihood of past exposure resulting from disposal operations would have depended on the distance between the landfills and occupied houses or buildings. NYS DOH received minimal information regarding off-site disposal operations.

Current and future exposure to Zonolite Co./ W.R. Grace waste materials from the landfills are improbable as waste material is covered and contained.

11. Past and present inhalation of Libby amphibole asbestos fibers from on-site areas of soil contamination.

Three soil samples collected on-site during the June 2001 US EPA soil sampling event contained levels of asbestos greater than 1% (US EPA 2002b). The highest concentration of asbestos was found in a surface soil sample containing 3.35% asbestos (US EPA 2002b). Otherwise, the concentrations of asbestos found on-site were low or below laboratory detection levels. Since the Libby amphibole asbestos at the site is mixed with the soil and covered with vegetation, the health risks associated with the contamination are likely low. Entrance restrictions on-site limit the potential for tracking contaminated soils off-site.

12. Future inhalation to on-site Libby amphibole asbestos from disturbance of contaminated soil as land use changes.

A change in land use at the former site could result in potential future exposures to Libby amphibole asbestos. Developers, construction workers, trespassers and off-site residents could be exposed if asbestos containing soils become exposed through excavation or other activities conducted on-site. The implementation of engineering controls during site development could minimize the potential for exposure.

13. Past incidental ingestion of Libby amphibole asbestos for residents in the area consuming homegrown vegetables or through other ingestion activities.

Residents in the immediate vicinity of the site reported dust collecting on off-site vegetation and other surfaces. Residents may have ingested low levels of Libby amphibole asbestos on homegrown vegetables. The amount of asbestos settling on the edible portion of a plant would be a function of the exposed surface area of a plant. For example, corn would have a low exposed surface area because the corn is enclosed in the husk, whereas the surface of a leafy vegetable like lettuce is entirely exposed. In addition, preparation of homegrown vegetables such as washing, cooking, and peeling may have removed dust containing asbestos. While ingestion is recognized as a potential route of exposure, this exposure route was likely limited and toxicologically not relevant when compared to the potential inhalation hazard.

Consumer Products

14. Past, present and future inhalation to Libby amphibole asbestos from the handling or disturbance of asbestos-containing insulation or other products.

People who purchased and used products that contain Libby vermiculite, such as home insulation or vermiculite gardening products, may have been exposed to Libby amphibole asbestos from using those products in and around their homes (US EPA 2002c). Additional information for consumers of vermiculite products have been developed by the US EPA, ATSDR, and NIOSH and provided to the public (see www.epa.gov/asbestos/insulation.html).

C. Toxicological and Epidemiological Evaluation for Adult and Children Health Issues

The major health concern associated with asbestos is inhalation exposure. Average inhalation rates vary from 4,500 liters of air per day (L/day) for infants to 17,000 L/day for adult males (US EPA 1997). The respiratory system has several mechanisms that control foreign particles from entering or remaining in the lungs. Amphibole asbestos fibers of specific diameters, lengths and aspect (length to diameter) ratios show varying success in both entering the lungs and producing a toxic response. There is general acceptance in the scientific community of correlations between asbestos toxicity and fiber length as well as fiber mineralogy. Fiber length may play an important role in clearance and mineralogy may affect both fiber persistence in the body and surface chemistry. Clearance mechanisms in the lung are highly effective for short fibers (<5μm), but become decreasingly successful with increasing fiber length (HSE 1996). In addition, larger fibers tend to be filtered in the upper airway and nasopharynx before entering the lung. For more information regarding toxicity characteristics associated with fiber size and mineralogy, see Appendix E.

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

Malignant mesothelioma – Cancer of the lining of the chest (pleura) and other internal organs. This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure (ATSDR 2001c).

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 (ATSDR 2001c).

Noncancer effects – These include asbestosis, scarring and reduced lung function caused by asbestos fibers lodged in the lung; pleural plaques, localized or diffuse areas of thickening of the pleura (lining of the chest); 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 (ATSDR, 2001c).

There is not enough evidence to conclude whether inhalation of asbestos increases the risk of cancers at sites other than the lungs, pleura, and abdominal cavity (ATSDR 2001c).

ATSDR notes that, "The health effects from swallowing asbestos are unclear. Some groups of people who have been exposed to asbestos fibers in their drinking water have higher-than-average

death rates from cancer of the esophagus, stomach, and intestines. However, it is very difficult to tell whether this is caused by asbestos or by something else. Animals that were given very high doses of asbestos in food did not get more fatal cancers than usual…" (ATSDR, 2001c). Ingestion of asbestos causes little or no risk of noncancer effects. However, there is some evidence that acute oral exposure might induce precursor lesions of colon cancer (ATSDR 2001c).

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

Counting fibers using regulatory definitions does not adequately characterize risk of health effects, since fiber size, shape, and composition contribute collectively to risks in ways that are still being evaluated. For example, shorter fibers appear to preferentially deposit in the deep lung, but longer fibers might disproportionately increase the risk of mesothelioma (Berman et al 1999). Fiber diameters greater than 2 μm are considered above the upper limit of respirability and do not contribute significantly to risk (Berman et al 1999). Some of the unregulated amphibole minerals, such as winchite present in Libby amphibole asbestos, can contribute to risk. Methods are being developed to assess the risks posed by varying types of asbestos and are currently awaiting peer review (Berman et al 1999).

Most of the information on the health effects of asbestos comes from studies of people who were exposed in the past to high levels of asbestos fibers in confined settings for long periods of time such as air in a workplace. Asbestos exposures of the magnitude and duration found in the workplace are usually not encountered by the general public in everyday life where levels of asbestos fibers in the air are much lower. A study of 512 employees at a facility that exfoliated vermiculite primarily from the Libby, Montana mine documented increased pleural changes among workers involved in vermiculite expansion (Lockey et al 1984). A recent case analysis documented a man who died as a result of exposure to asbestos-contaminated vermiculite during two consecutive summers (1951-1952) of work at a vermiculite exfoliating facility in Southern California (Wright et al 2002).

Evidence from Libby, Montana indicates that exposures much lower than workplace levels (household contacts) can lead to significant increases in disease. Exposure to asbestos resulting in asbestos related diseases in family members of asbestos industry workers have been documented (Anderson et al 1976, Kilburn et al 1985). In Libby, Montana, an elevated prevalence of pleural abnormalities was observed in the household contacts of workers employed at the mine and associated vermiculite processing facilities (ATSDR 2001b). Exposures to household employees at this site were likely.

On the basis of the information available, former employees involved with the processing and disposal of vermiculite, employee's household contacts, past occupants of the site and residents near the site could have been exposed in the past to asbestos from the Zonolite Co./ W.R. Grace facility. However, we have no reliable or precise information on the magnitude, duration and frequency of these possible past exposures, and, therefore, cannot make quantitative estimates of the health risks associated with them. The NYS DOH health statistics review will assist in evaluating if there is an increase in asbestos-related disease among people living near the site.

D. Community Health Concerns

During the twenty-six year period of Zonolite Co./ W.R. Grace exfoliating operation in Brutus, there were several complaints reported to the NYS DEC from members of the local community. Community members complained of excessive dust and odor releases and inquired about the health affects associated with exposure to these emissions. US EPA's soil sampling event in June 2001 generated a few inquiries from nearby property owners.

Following the release of the Public Comment Draft of this health consultation, NYS DOH and Cayuga County Department of Health received several phone calls and letters from concerned residents in the Weedsport area, former employees, and household contacts of former employees. Health department staff provided information related to the site and asbestos exposure and provided recommendations to the callers. When appropriate, health department staff forwarded some of the calls to ATSDR and US EPA. Public comments submitted in letters are addressed in the Response to Comments section later in this document.

The public comment period ran from March 1, 2004 to April 1, 2004; the public comments that were submitted in writing to NYS DOH are addressed in Appendix I.

E. Health Outcome Data

NYS DOH recommended that people at risk for exposure to asbestos-contaminated vermiculite, including people who had worked with vermiculite in the past, their household contacts, and people who had repeated contact with vermiculite waste or product, be examined by a physician with expertise in asbestos-related lung disease. As a result, several people were evaluated by their physician and/or in an occupational health clinic. Of those, a few people who had a history of working with vermiculite were diagnosed with asbestos-related disease. Those who were examined that were potentially exposed to vermiculite in a non-occupational setting, such as through contact with Zonolite insulation in their homes or through living near the facility, did not show signs of asbestos-related disease (Personal Communication with Central New York Occupational Health Clinic, 2004). These data are limited to people who volunteered to be examined and may not be a representative cross-section or a thorough evaluation of the population.

NYS DOH Bureau of Environmental & Occupational Epidemiology, in cooperation with the ATSDR Division of Health Studies, is conducting a health statistic review of the population living in the Village of Weedsport and the remaining residents within one-mile of the site. The health statistics review is a method of comparing rates of specific adverse health outcomes in this community with national or statewide rates to evaluate whether any unusual patterns in the rates of these health outcomes exist (NYS DOH 2002a.). Cancer incidence data are being evaluated for the years 1986 to 1995 and mortality data are being reviewed for the years 1979 to 1998. ATSDR will release annual reports summarizing health statistics review findings for selected sites for which data have been received. A preliminary report, released by ATSDR in 2003, found that most communities analyzed to date did not appear to have elevated occurrence of asbestos-related

diseases when compared to the rest of the country. However, several areas did show higher than expected rates of asbestos-related disease which may need further investigation (ATSDR, 2003).

The health outcomes reviewed include incidence of cancers related to asbestos exposure and mortality for asbestos related diseases of the respiratory system (NYS DOH, 2002a.). The health statistics review will evaluate whether residents who lived near the former exfoliating site at the time of diagnosis of cancer or at the time of death had elevated rates of asbestos-related cancer or mortality. The health statistics review cannot prove a causal relationship between potential exposure and health outcomes, but it may indicate whether additional studies are needed. NYS DOH expects to release a report containing the results of the health statistics review to the public in 2006.

F. Child Health Considerations

ATSDR and NYS DOH recognize that infants and children might be more vulnerable to exposures than adults in communities faced with environmental contamination. Because children depend completely on adults for risk identification and management decisions, ATSDR and NYS DOH are committed to evaluating citizen's special interests at the site.
The effects of asbestos on children are thought to be similar to adults. However, children may be especially vulnerable to asbestos exposures for the following reasons:

- Children may be more likely to disturb fiber-laden soils or indoor dust while playing;
- Children are closer to the ground and thus more likely to breathe contaminated soils or dust;
- Exposed children could be more at risk of developing asbestos-related disease than people exposed later in life because of the long latency period between exposure and onset of asbestos-related disease. Adults, more advanced in age, have less chance of living long enough for asbestos-related illnesses to develop.

The most at-risk children are those who were household contacts of former workers while the facility was operating. Past exposures related to contact with on-site waste piles, plant emissions, and stoner rock used in the yard are all pathways through which exposures may have occurred but cannot be quantified due to the lack of site-specific information.

Current exposures to on-site soils are of no apparent public health hazard to children because of limited on-site soil contamination and on-site soil containment through vegetative cover and fencing. Current exposure to potential waste materials on the property east of the site are considered indeterminate public health hazards since potential contamination on this site and land use have not been characterised.

CONCLUSIONS

From 1963-1989, Zonolite Co./W.R. Grace Corporation exfoliated vermiculite in Brutus, New York. The plant received and processed approximately 148,485 tons of vermiculite concentrate

from the W.R. Grace mine in Libby, Montana. The vermiculite contained Libby amphibole asbestos.

Evidence suggests that former Zonolite Co./ W.R. Grace employees at the Weedsport exfoliating plant were exposed to Libby amphibole asbestos. There are public accounts of stoner rock and vermiculite use on private properties for various applications. There is evidence that during operation the facility emitted considerable quantities of dust. This dust likely contained Libby amphibole asbestos when the plant was processing vermiculite concentrate originating from the W.R. Grace mine in Libby. The completed and potential exposure pathways to Libby amphibole asbestos and the associated public health hazards are summarized below:

Occupational

1. Former workers employed at the Weedsport facility were likely exposed to hazardous levels of Libby amphibole asbestos as a result of working in and around the facility during active exfoliation of Libby vermiculite. Several people who had a history of working with vermiculite were evaluated by their physician and/or in an occupational health clinic and were diagnosed with asbestos related disease (Personal Communication with Central New York Occupational Health Clinic, 2004). Occupational exposure was a *public health hazard* in the past.

2. Employees at the landfills that worked directly with stoner rock and other waste material were likely exposed to Libby amphibole asbestos. However, the frequency and duration of waste handling and disposal operations are unknown. Past exposure to Libby amphibole asbestos for landfill workers was an *indeterminate public health hazard*.

3. Employees of the former mulch company may have been exposed to low levels of Libby amphibole asbestos. Data from indoor air samples collected after W.R. Grace terminated operations did not detect airborne asbestos. If residual levels of asbestos existed, they were likely low and posed *no apparent public health hazard*. If more information becomes available in the future regarding this pathway, the hazard may be reclassified.

Household Contacts

4. Household contacts of former Zonolite Co./ W.R. Grace workers were likely exposed to Libby amphibole asbestos from contamination brought home on the skin, clothing, and hair of workers. Past household contact exposure was likely a *public health hazard*. Data are insufficient to estimate exposure levels.

5. Landfill employee's household contacts may have been exposed to Libby amphibole asbestos. However, employees contact with the waste was likely infrequent and household contact exposure to asbestos was likely even less. Past household contact exposure likely posed *no apparent public health hazard*.

6. Household contacts of the employees of the former mulching company were not likely exposed to significant levels of Libby amphibole asbestos, thus posing *no apparent public health hazard.*

Residential

7. The community immediately surrounding the facility was likely exposed to Libby amphibole asbestos from dust emissions associated with the site. Past community exposure to asbestos emissions was an *indeterminate public health hazard* as there are insufficient data to assess exposure levels. Results from the health statistics review may provide data to further assess this indeterminate hazard. If more information becomes available in the future regarding this pathway, the hazard may be reclassified.

8. Occupants of the private properties that contain vermiculite waste may have been exposed to Libby amphibole asbestos in the past. The likelihood of exposures depended on the handling duration, leveling practices and the concentration of asbestos in the waste. Past exposures present an *indeterminate public health hazard*, as data are insufficient to assess exposure. Based on the results from the US EPA's soil investigation on two of the private properties that received waste, current exposure to Libby amphibole asbestos associated with this waste is unlikely and poses *no apparent public health hazard*. The undeveloped property to the east of the site where waste materials were reportedly disposed may present an *indeterminate public health hazard* to people using the site in the past and present. This exposure pathway will be re-evaluated as more data become available.

9. In the past, individuals from the community may have been exposed to Libby amphibole asbestos if they worked or played in waste piles of stoner material on-site. Contact with the material was likely infrequent. Past exposure to asbestos through this pathway likely posed an *indeterminate public health hazard*.

10. Individuals residing near the landfills that received waste from the Weedsport facility may have been exposed to Libby amphibole asbestos if contaminated dust migrated off-site during operations. While no data are available to assess this potential exposure pathway, significant exposures were not likely, posing *no apparent health hazard*.

11. Individuals residing near the site and occupants of the site including former employees and trespassers may have been exposed to Libby amphibole asbestos present in on-site soil. Based on the results from on-site soil sampling, this potential past and present pathway poses *no apparent public health hazard*. The site currently does not present health risks to the surrounding community.

12. Future exposures to Libby amphibole asbestos in on-site soil are unlikely unless land use changes on-site. If future land use changes disturb on-site soil, public exposure to Libby amphibole asbestos is possible. It is necessary to notify future developers or site occupants of asbestos contamination so appropriate engineering controls can be implemented to minimize exposure and protect public health.

13. Past incidental ingestion of Libby amphibole asbestos for residents in the area consuming homegrown vegetables or through other ingestion activities may have resulted in limited exposure. This past exposure pathway presented *no apparent public health hazard*.

Consumer Products

14. Consumer exposure to asbestos through the use of products that contain Libby amphibole asbestos is not evaluated within the scope of this project. Several people who were potentially exposed to vermiculite in a non-occupational setting, such as through contact with Zonolite insulation in their homes, were examined by their physician and/or in an occupational health clinic and did not show signs of asbestos-related disease (Personal Communication with Central New York Occupational Health Clinic, 2004). Additional information for consumers of vermiculite products has been developed by US EPA, ATSDR, and NIOSH and provided to the public (see www.epa.gov/asbestos/insulation.html).

RECOMMENDATIONS

1. NYS DOH should work with ATSDR to continue to try to identify any former employees of the Zonolite Co./W.R. Grace Weedsport facility and their household contacts that were not previously identified. If anyone is identified, staff should discuss with them the risks associated with Libby amphibole asbestos exposure and encourage them to consult an occupational physician for a health evaluation. Occupational physicians are doctors with experience in the diagnosis and treatment of work-related illnesses.

2. If land use changes near the three areas containing >1% asbestos, sufficient engineering controls should be provided to mitigate any possible exposure to workers and future occupants of the site.

3. NYS DOH should continue working with US EPA and NYS DEC to investigate any off-site areas that were identified as having received vermiculite waste materials. This includes the neighboring wooded property, currently owned by Weedsport Associates LLC, northeast of the site, to determine if vermiculite waste materials were disposed on this property. If it is determined that this site is contaminated, the site should be secured and handled appropriately.

4. NYS DOH should review new site-specific information as it becomes available to evaluate exposure pathways. Obtaining data for some indeterminate exposure pathways may not be possible.

5. NYS DOH should continue to provide educational materials and references upon request to community members concerned about products containing vermiculite.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan for the site contains a description of actions that have been or will be taken by ATSDR, NYS DOH and/or other government agencies at the site. The purpose of the Public Health Action Plan is to ensure that this health consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse

human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and NYS DOH to follow-up on this plan to ensure its implementation.

- Actions Ongoing
  - NYS DOH will conduct follow-up activities as outlined in the recommendations, including the completion of the health statistics review.
  - NYS DOH will continue working with the US EPA and NYS DEC to investigate various off-site areas. These may include the neighboring wooded property, northeast of the site, to determine if vermiculite waste materials were disposed on this property. If it is determined that this site is contaminated, this site will be secured and handled appropriately.
  - ATSDR will combine the findings from this health consultation with findings from other sites that received Libby vermiculite to create a comprehensive report outlining overall conclusions and strategies for addressing the public health implications.
  - ATSDR staff are researching unpublished information within the US EPA database of W.R. Grace documents (estimated 3 million pages of information relating to Libby, Montana, and other vermiculite processing sites nationwide) to learn more about the site and other relevant details.

- Actions Planned
  - NYS DOH will work with ATSDR to continue to try to identify any former employees of the Zonolite Co./W.R. Grace Weedsport facility and their household contacts that have not been previously identified. If anyone is identified, staff will discuss with them the risks associated with exposure to Libby amphibole asbestos and encourage them to consult an occupational medicine physician for a health evaluation. For more information or to find an occupational medicine clinic, the public can visit the Association of Occupational and Environmental Health Clinic (AOEC) website at http://www.aoec.org or call 1-888-347-AOEC (2632).
  - NYS DOH will continue to provide educational materials and references upon request to community members concerned with products containing vermiculite. Additional information for consumers of vermiculite products has been developed by the US EPA, ATSDR, and NIOSH and provided to the public (see www.epa.gov/asbestos/insulation.html).
  - NYS DOH and ATSDR will review new information as it becomes available to determine appropriate site-specific public health actions
  - ATSDR will release annual reports summarizing health statistics review findings for selected sites for which data have been received.
  - NYS DOH and ATSDR will work with US EPA and NYS DEC to ensure that, should on-site land use change, proper engineering controls are implemented to minimize exposure and protect public health.

CERTIFICATION

The Health Consultation for the Former Zonolite Company/W.R. Grace Exfoliating Plant site was prepared by the New York State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

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Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation, and concurs with its findings.

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Team Leader, CAT, SPAB, DHAC, ATSDR

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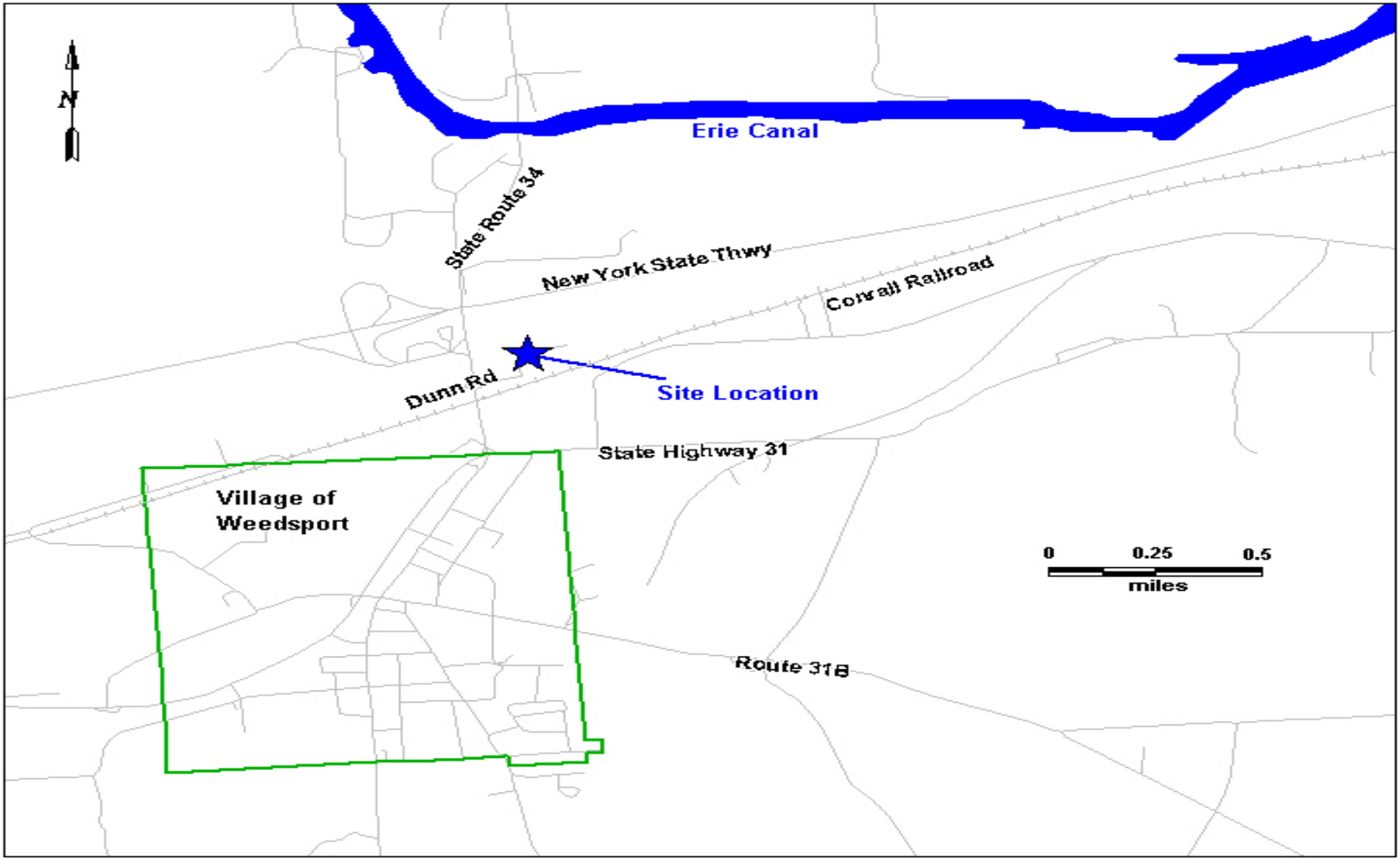
APPENDIX A

Site Location Maps

FIGURE 1: Former W.R. Grace Site Location
Dunn Road, Town of Brutus, Cayuga County



APPENDIX B

Vermiculite Import Table

TABLE 1:
Zonolite Co./W.R. Grace Shipments of Libby, Montana Vermiculite Ore Concentrate to the Former Exfoliating Plant in Brutus, New York

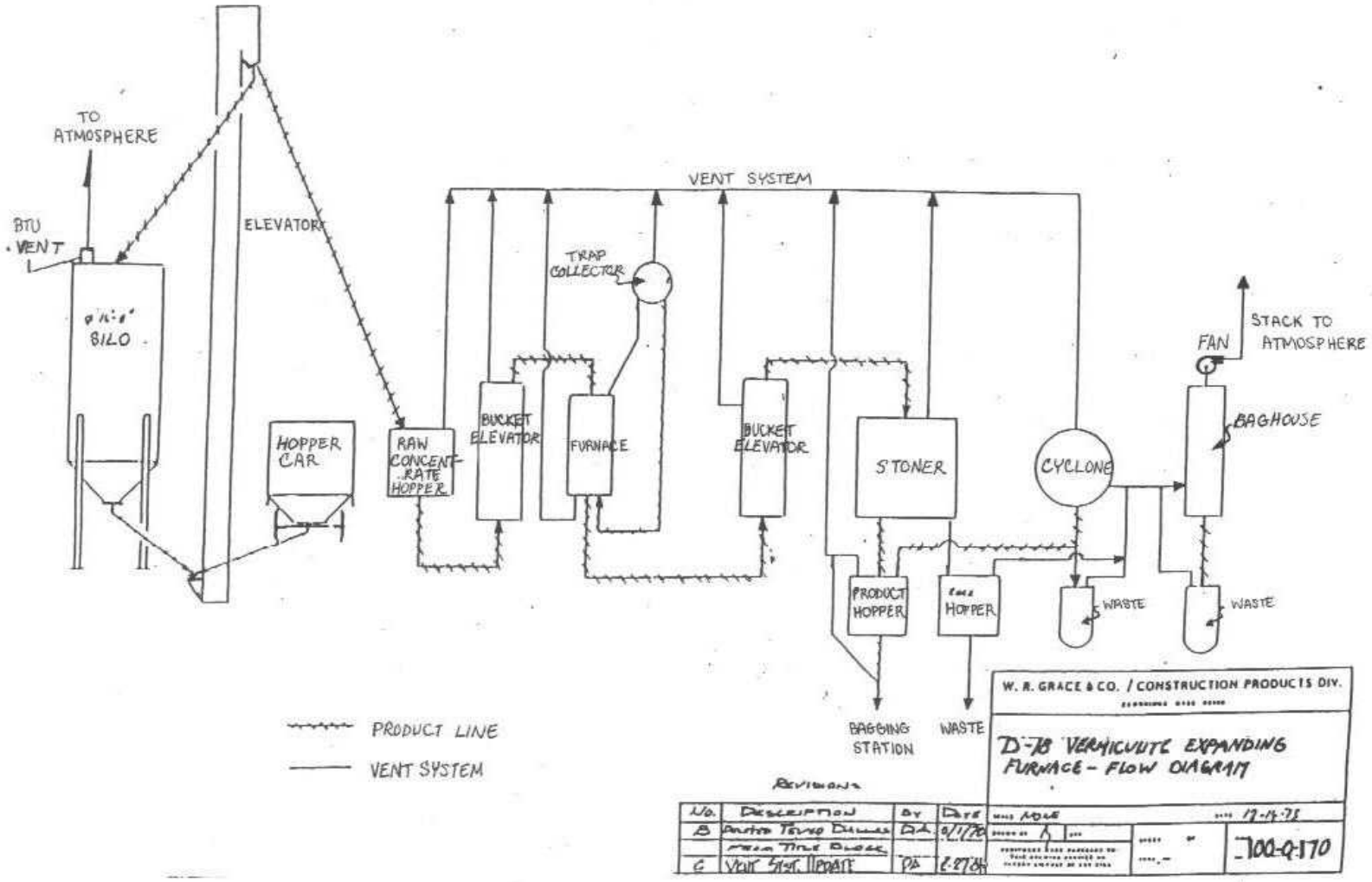
Year	Tons of Ore Received
1963	1397
1964	2053
1965	1586
1966	1507
1967	1329
1968	3066
1969	2728
1970	2865
1971	3217
1972	4929
1973	3243
1974	2907
1975	4256
1976	5693
1977	6095
1978	4863
1979	5119
1980	3505
1981	Not Available
1982	2853
1983	3106
1984	3137
1985	2504
1986	2718
1987	1739
1988	770
Total tons received	**77185**
Average tons/year	**3087**

Data Source: This table was replicated from the US EPA Region 2 Vermiculite Investigation OSC Soil Sampling Report, 2002 for the W.R. Grace Weedsport Facility. The table was prepared from documents included in the following transmittal: W.R. Grace & Co. response letter of August 28, 2000 from K.W. Lund., Esp. to US EPA Region 5 in response to 104(e) request.

APPENDIX C

Plant Processing Figure

Zonolite Co./W.R. Grace Exfoliating Plant Processing Figure



Source: Department of Environmental Conservation Region 7, Archived Documents: W.R. Grace Exfoliating Facility, Weedsport, NY File, 1963-1989.

APPENDIX D

Site Visit Photographs

Eastern end, north facing side of the former Zonolite Co./W.R. Grace vermiculite processing building.

Central section, north facing side of the former processing building.

West end, north facing side of former Zonolote Co./W.R. Grace vermiculite processing building.

North facing side of former processing building.

East end of former Zonolite Co./W.R. Grace vermiculite processing building. The storage silos were located immediately east of this building.

Eastern section of property – note the thick vegetative cover.

APPENDIX E

Asbestos Overview

Prepared by ATSDR 2003

Asbestos Overview

Asbestos is a general name applied to a group of silicate minerals consisting of thin, separable fibers in a parallel arrangement. Asbestos minerals fall into two classes, serpentine and amphibole. Serpentine asbestos has relatively long and flexible crystalline fibers; this class includes chrysotile, the predominant type of asbestos used commercially. Amphibole asbestos minerals are brittle and have a rod- or needle-like shape. Amphibole minerals regulated as asbestos by OSHA include five classes: fibrous tremolite, actinolite, anthophyllite, crocidolite, and amosite. However, other amphibole minerals, including winchite, richterite, and others, can exhibit fibrous asbestiform properties (ATSDR 2001).

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

The vermiculite mined at Libby contains amphibole asbestos, with a characteristic composition including tremolite, actinolite, richterite, and winchite; this material will be referred to as Libby amphibole asbestos. The raw vermiculite ore was estimated to contain up to 26% Libby amphibole asbestos as it was mined (MRI 1982). For most of the mine's operation, Libby amphibole asbestos was considered a byproduct 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) (MRI 1982).

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

Methods for Measuring Asbestos Content

There are a number of different analytical methods used to evaluate asbestos content in air, soil, and other bulk materials. Each method varies in its ability to measure fiber characteristics such as length, width, and mineral type. For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers longer than 5 μm and with an aspect ratio (length:width) greater than 3:1. This is the standard method by which regulatory limits were developed. Disadvantages of this method include the inability to detect fibers thinner than 0.25 μm in diameter and the inability to distinguish between asbestos and nonasbestos fibers (ATSDR 2001).

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 ~1 μm, widths

greater than ~0.25 μm, and aspect ratios (length to width ratios) of greater than 3. Detection limits for PLM methods are typically 0.25-1% asbestos.
Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods and can detect smaller fibers than light microscopic techniques. TEM allows the use of electron diffraction and energy-dispersive x-ray methods, which give information on crystal structure and elemental composition, respectively. This information can be used to determine the elemental composition of the visualized fibers. SEM does not allow measurement of electron diffraction patterns. One disadvantage of electron microscopic methods is that it is difficult to determine asbestos concentration in soils and other bulk materials (ATSDR 2001).

The PLM and TEM methods have 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 numbers of samples or for screening samples that contain relatively higher levels (0.1 to 1%) of Libby amphibole 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. When sample concentrations (of Libby amphibole asbestos) are low, the accuracy of the TEM method can be limited by the number of grids that are examined for a given sample. If the laboratory analyst does not count enough grids, the sample results will likely be inaccurate. In general the TEM approach is more tedious and time consuming – and therefore more costly – than PLM, but it provides the best approach for fiber identification and quantification at low sample concentrations.

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 (μg/m3)/(f/cc) was adopted as a conversion factor, but this value is highly uncertain since it represents an average of conversions ranging from 5 to 150 (μg/m3)/(f/cc) (EPA 2002c). 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 (EPA 2002c). Generally, a combination of PCM and TEM is used to describe the fiber population in a particular air sample.

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

Asbestos Health Effects and Toxicity

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

Malignant mesothelioma – Cancer of the lining of the chest (pleura) and other internal organs. This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure (ATSDR 2001).

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 (ATSDR 2001).

Noncancer effects – these include asbestosis, scarring and reduced lung function caused by asbestos fibers lodged in the lung; pleural plaques, localized or diffuse areas of thickening of the pleura (lining of the lung); pleural thickening, extensive thickening of the pleura which may restrict breathing; pleural calcification, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and pleural effusions, fluid buildup in the pleural space between the lungs and the chest cavity (ATSDR 2001).

There is not enough evidence to conclude whether inhalation of asbestos increases the risk of cancers at sites other than the lungs, pleura, and abdominal cavity (ATSDR 2001).

Ingestion of asbestos causes little or no risk of noncancer effects. However, there is some evidence that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors (ATSDR 2001).

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

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

ATSDR, responding to concerns about asbestos fiber toxicity from the World Trade Center Disaster, held an expert panel meeting to review fiber size and it's role in fiber toxicity in December, 2002 (ATSDR 2003). The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths less than 5 μm are essentially non-toxic when considering a role in mesothelioma or lung cancer promotion. However, fibers less than 5 μm in length may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to definitively make this conclusion.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly due to physical characteristics which allow chrysotile to be broken down and cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue (Churg 1993). 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 (Churg 1993). However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, as both types increase the risk of disease (OSHA 1994). EPA's Integrated Risk Information System (IRIS) assessment of asbestos also 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 to the observed variation in risk as does the fiber type itself (Berman and Crump 1999b).
Counting fibers using the regulatory definitions (see below) does not adequately describe risk of health effects, as fiber size, shape, and composition contribute collectively to risks in ways that are still being elucidated. For example, shorter fibers appear to preferentially deposit in the deep lung, but longer fibers might disproportionately increase the risk of mesothelioma (ATSDR 2001, Berman and Crump 1999b). Some of the unregulated amphibole minerals, such as the winchite present in Libby amphibole asbestos, can exhibit asbestiform characteristics and contribute to risk. Fiber diameters greater than 2-5 µm are considered above the upper limit of respirability (that is, too large to inhale) and do not contribute significantly to risk. Methods are being developed to assess the risks posed by varying types of asbestos and are currently awaiting peer review (Berman and Crump 1999b).

Current Standards, Regulations, and Recommendations for Asbestos

In industrial applications, asbestos-containing materials are defined as any material with greater than 1% bulk concentration of asbestos (EPA 1989). It is important to note that 1% is not a health-based level, but instead represents the practical detection limit in the 1970s when EPA regulations were created. Studies have shown that disturbing soils containing less than 1% amphibole asbestos can suspend fibers at levels of health concern (Weis 2001).

Friable asbestos (asbestos which is crumbly and can be broken down to suspendable fibers) is listed as a Hazardous Air Pollutant on EPA's Toxic Release Inventory (EPA 2002c). This requires companies that release friable asbestos at concentrations greater than 0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to Know Act.

OSHA has set a permissible exposure limit (PEL) of 0.1 f/cc for asbestos fibers longer than 5 µm and with an aspect ratio (length:width) greater than 3:1, as determined by PCM (OSHA 1994). This value represents a time-weighted average (TWA) exposure level based on 8 hours a day for a 40-hour work week. In addition, OSHA has defined an excursion limit in which no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes (OSHA 1994). 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 based upon empirical worker health observations, while the levels set from 1983 forward employed some form of quantitative risk assessment. ATSDR has used the current OSHA PEL of 0.1 f/cc as a reference point for evaluating asbestos inhalation exposure for past workers. ATSDR does not, however, support using the PEL for evaluating community member exposure, as the PEL is based on an unacceptable risk level.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in homes in the area, the Department of Health and Human Services, EPA and the Department of Labor formed the Environmental Assessment Working Group. This work group was made up of ATSDR, US Environmental Protection Agency, National Institute of

Occupational Safety and Health, CDC National Center for Environmental Health, Occupational Safety and Health Administration, New York City Department of Health and Mental Hygiene, the New York State Department of Health, and other state, local, and private entities. The work group set a re-occupation level of 0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure to this level (ATSDR 2003).

The National Institute of Occupational Safety and Health (NIOSH) set a recommended exposure limit of 0.1 f/cc for asbestos fibers longer than 5 μm. This limit is a TWA for up to a 10-hour workday in a 40-hour work week (NIOSH 2002). The American Conference of Government Industrial Hygienists (ACGIH) has also adopted a TWA of 0.1 f/cc as its threshold limit value (ACGIH 2000).

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7,000,000 fibers longer than 10 μm per liter, based on an increased risk of developing benign intestinal polyps (EPA 2002d). Many states use the same value as a human health water quality standard for surface water and groundwater.

Asbestos is a known human carcinogen. Historically, EPA has calculated an inhalation unit risk for cancer (cancer slope factor) of 0.23 per f/cc of asbestos (USEPA 2002c). 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, since above this concentration the slope factor might differ from that stated (EPA 2002c). 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 current assessment and the knowledge gained since it was implemented in 1986.

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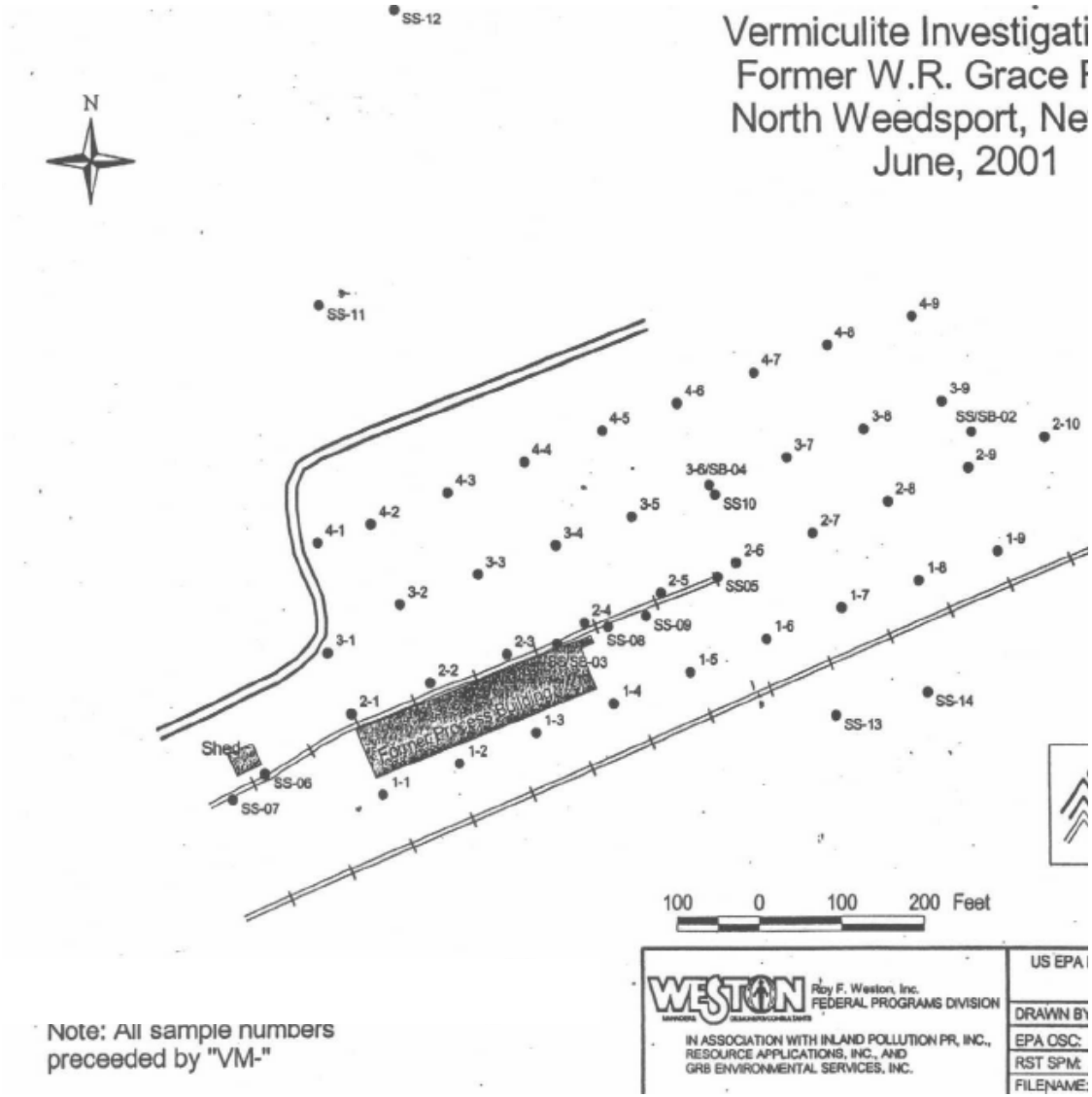
APPENDIX F

Soil Sample Locations Maps and Results



Note:
SS: Surface soil samples
SB: Subsurface samples collected 4-24 inches below the surface.
All of the sample identification numbers without a SS or SB prefix were surface soil samples.

Source: Environmental Protection Agency Region 2, Vermiculite Investigation OSC Soil Sampling Report W.R. Grace Weedsport, NY Site, 2002.

Source: Environmental Protection Agency Region 2, Vermiculite Investigation OSC Soil Sampling Report W.R. Grace Weedsport, NY Site, 2002.

Soil Sampling Analytical Results		
Sample Id	**Polarized Light Microscopy Results % Asbestos**	**Transmission Electron Microscopy Results % Asbestos**
1-1	< 0.25	NA
1-2	< 0.25	NA
1-3	< 0.25	NA
1-4	< 0.25	NA
1-5	< 0.25	ND
1-6	< 0.25	NA
1-7	< 0.25	NA
1-8	< 0.25	NA
1-9	< 0.25	NA
2-1	< 0.25	NA
2-2	< 0.25	NA
2-3	< 0.25	NA
2-4	< 0.25	NA
2-5	< 0.25	< 0.10
2-6	< 0.25	NA
2-7	ND	0.38
2-8	0.25	0.10
2-9	< 0.25	NA
2-10	ND	ND
3-1	< 0.25	NA
3-2	ND	< 0.10
3-3	0.25	0.16
3-4	< 0.25	NA
3-5	ND	0.28
3-6	< 0.25	NA
3-7	ND	NA
3-8	< 0.25	NA
3-9	< 0.25	NA
4-1	ND	ND
4-2	ND	ND
4-3	ND	ND
4-4	ND	ND
4-5	ND	ND
4-6	< 0.25	NA
4-7	ND	< 0.10
4-8	ND	ND
4-9	ND	< 0.10

Soil Sampling Analytical Results		
Sample Id	**Polarized Light Microscopy Results % Asbestos**	**Transmission Electron Microscopy Results % Asbestos**
SS-01	0.75	0.31
SB-01*	**1.50**	< 0.10
SS-02	< 0.25	< 0.10
SB-02*	0.50	0.48
SS-03	**2.25**	**3.35**
SB-03*	0.25	< 0.10
SB-04*	< 0.25	< 0.10
SS-05	**1.25**	< 0.10
SS-06	< 0.25	NA
SS-07	< 0.25	NA
SS-08	< 0.25	0.13
SS-09	< 0.25	NA
SS-10	< 0.25	NA
SS-11	ND	ND
SS-12	< 0.25	ND
SS-13	ND	ND
SS-14	ND	ND

Comments:
* Subsurface samples collected 4-24 inches below the ground surface
All other samples were surface soil (0-2 inches below ground surface)
ND: No Fibers Detected
NA: Not Analyzed
< 0.25 = % of asbestos observed was less than the PLM method detection limit of 0.25
< 0.10 = % of asbestos observed was less than the TEM method detection limit of 0.10

APPENDIX G

Potential Pathways of Exposure Table

POTENTIAL EXPOSURE PATHWAYS FOR SITES THAT RECEIVED LIBBY VERMICULITE					
SOURCE FOR ALL PATHWAYS: Libby asbestos (LA)-contaminated Vermiculite from Libby, Montana					
PATHWAY NAME	**ENVIRONMENTAL MEDIA & TRANSPORT MECHANISMS**	**POINT OF EXPOSURE**	**ROUTE OF EXPOSURE**	**EXPOSURE POPULATION**	**TIME**
Occupational	Suspension of LA fibers or contaminated dust into air during materials transport and handling operations or during processing operations	Onsite	Inhalation	Former and/or current workers	Past Present, Future
Household Contact	Suspension of LA 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 LA fibers into air by playing in or otherwise disturbing piles of vermiculite or waste rock	Onsite, at waste piles	Inhalation	Neighborhood children and adults, workers	Past Present, Future
Residential Outdoor	Suspension of LA fibers into air by disturbing contaminated vermiculite brought offsite for personal uses (gardening, traction, fill)	Residential yards or driveways	Inhalation	Neighborhood residents, workers' families or household contacts	Past Present, Future
Residential Indoor	Suspension of household dust containing LA fibers from plant emissions or worker clothing into air	Residences	Inhalation	Neighborhood residents, workers' families or household contacts	Past Present, Future
Ambient Air	Stack emissions and fugitive dust from plant operations into neighborhood air	Neighborhood around site	Inhalation	Neighborhood residents	Past
Onsite	Suspension of LA fibers into air from disturbing contaminated vermiculite, waste, or soil remaining on site	At areas of remaining contamination at or around the site	Inhalation	Cleanup workers, neighborhood residents, current workers, trespassers	Past Present, Future
Consumer Products	Suspension of LA fibers into air from using or disturbing insulation or other consumer products containing Libby vermiculite	At homes where LA-contaminated products were/are present	Inhalation	Household residents, contractors	Past Present, Future

APPENDIX H

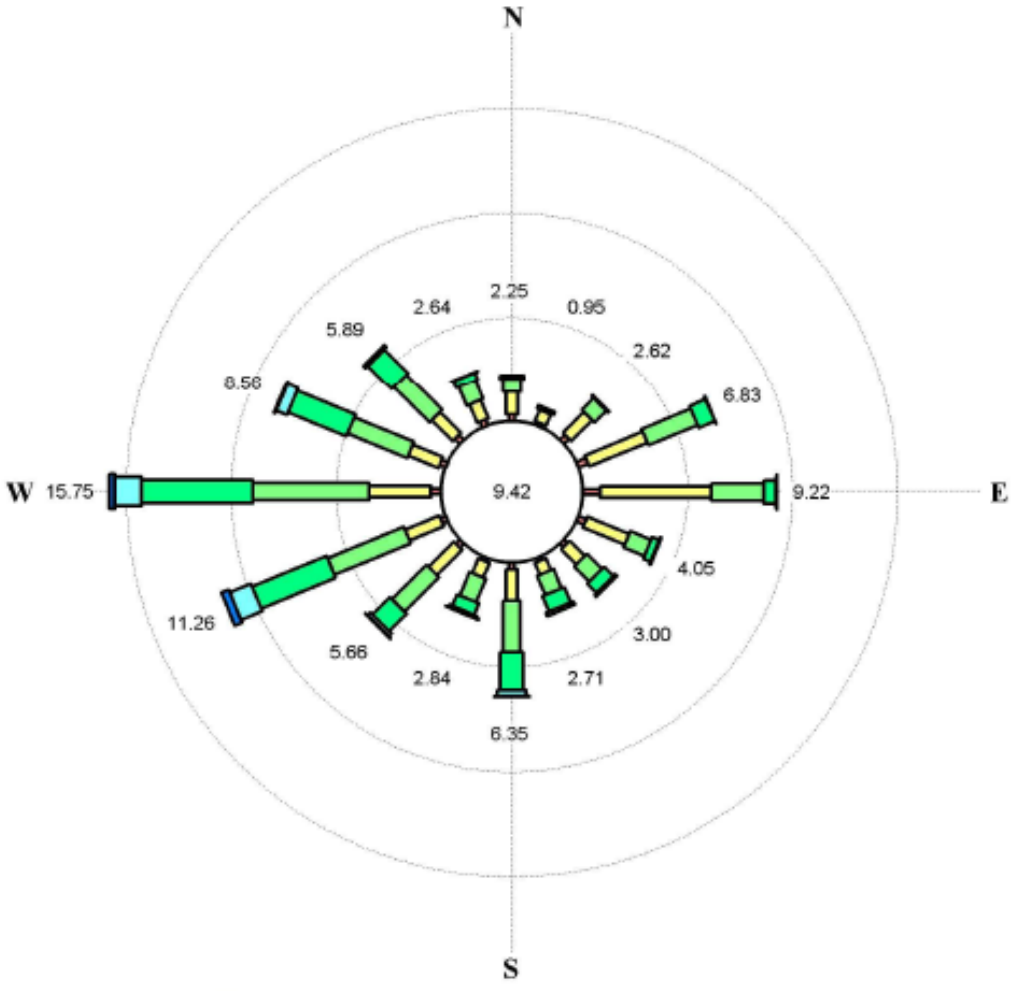
Wind Rose for Weedsport, Cayuga County, New York

1978 – 1982

Prepared by ATSDR and US EPA, Emergency Response Team in 2002.

Zonolite Co. / W. R. Grace
Weedsport, NY
1978 - 1982

Data from Syracuse Hancock International Airport
26 miles E of site



Calms included at center.
Rings drawn at 5% intervals.
Wind flow is FROM the directions shown.

APPENDIX I

Former Zonolite Company/W.R. Grace Exfoliating Plant
Health Consultation Response to Comments:

Appendix I
Former Zonolite Company/W.R. Grace Exfoliating Plant
Health Consultation Response to Comments:

This summary was prepared to address comments and questions on the public comment draft of the Former Zonolite Company/W.R. Grace Exfoliating Plant Health Consultation. The public was invited to review the draft during the public comment period, which ran from March 1, 2004 through April 1, 2004. NYS DOH received 9 written responses and approximately 40 phone calls related to the site. Some statements were reworded for clarity and several comments containing the same or similar concerns were combined to reduce repetition. If you have any questions about this summary, you can contact the NYS DOH project manager for the site at the toll-free number: 1-800-458-1158, extension 27870.

Comment #1: The dust was intense, it settled on trees, cars, the house, and in the pool. In this regard, predicted routes of exposure should include inhalation of dust and ingestion of pool water.

Response #1: We recognize that there were emissions, including dust and odors, in the past. We also recognize that there are other potential routes of exposure to Libby amphibole asbestos in addition to the inhalation route. Although ingestion is recognized as a potential route of exposure associated with this site, the health risks associated with oral exposures to asbestos are much less significant compared to inhalation exposures.

Comment #2: What were the air emission regulations for the years 1963-1989? Why didn't the plant have to comply with the air emission regulations even when the neighbors complained?

Response #2: We have limited information about air emission regulations and the compliance history of the exfoliation plant during this time period. The various dust emission controls used at the facility were not designed specifically to eliminate asbestos emissions. The facility was not considered an asbestos processor and did not have to comply with air emission regulations for the asbestos industry. For more information, you may wish to contact the New York State Department of Environmental Conservation, Region 7 Division of Air Resources at (315) 426-7552.

Comment #3: In 1964, the air pollution control board had taken temporary measures to have the plant cease operations when the wind blew towards nearby residents. However, are there wind directions that would not affect the residents nearby?

Response #3: There are private properties with residences and businesses in all directions of the site at varying distances. However, the closest residents live to the east of the plant, on Tow Path Road and Dunn Road. Residents closest to the site and in the direction of the prevailing winds, which blow easterly, were considered to have been at greatest risk of exposure to Libby amphibole asbestos in dust. When the wind was blowing in a northeasterly or southwesterly direction, emissions were not traveling directly toward the homes on Towpath or Dunn Road.

Comment #4: Children play in the dirt more than adults and are more likely to put things in their mouths. I grew up near the former Zonolite Co./W.R. Grace site, what are my chances of getting an asbestos related disease? How much time do I have before I start showing signs of asbestos disease?

Response #4: Several environmental, chemical, and biological factors influence whether someone will develop a disease as a result of asbestos exposure. The factors include duration and frequency of exposure, how the asbestos entered the body (i.e. inhalation, ingestion, etc.), and how a body reacts to the exposure. The health risks associated with oral exposures to asbestos (such as children putting things in their mouth) are much less significant compared to inhalation exposures. Ingestion of asbestos causes little or no risk of noncancer effects. There is some limited evidence which suggest that ingestion of asbestos may slightly increase the risk for certain cancers (primarily gastrointestinal), but it is unclear whether the increased risk is due to asbestos or some other factor. In addition, lifestyle factors (i.e.: smoking) can play a significant role in whether or not an asbestos related disease develops. An asbestos-related disease may take several years (up to 30 years) to develop after exposure. We do not have sufficient information on past asbestos exposures near the W.R. Grace facility to make estimates about the likelihood of an individual person getting an asbestos-related disease.

If you are concerned about the possibility of asbestos exposure when you were a child, you can consult your physician or contact one of the clinics in the New York State Occupational Health Clinic Network. If you still live in the Weedsport area, you may contact the Central New York Occupational Health Clinical Center of SUNY Upstate Medical University which is part of the NYS Network and can be reached at 1-315-432-8899 or toll free at 1-800-458-1158. The clinic directors of the NYS Network of Occupational Health Clinics are board-certified in occupational medicine, which means that they have special training in diagnosing asbestos-related disease. If you do not live in New York State, you can contact the Association of Occupational and Environmental Clinics (AOEC) at 1-888-347-2635. The AOEC is a network of clinics available in many other states. The AOEC clinic physicians also have special training in diagnosing asbestos-related disease.

Comment #5: Vermiculite was observed in the mud and water of a nearby creek, where neighborhood children would play. Is the creek contaminated?

Response #5: Vermiculite was apparently observed in a nearby waterway, likely Putnam Brook. There are no reports that indicate that this brook or any other waterway was used for disposal. Wind may have transported vermiculite off-site, which may have collected in the creek. Water generally reduces the potential for asbestos fibers to become suspended into the air and inhalation. In addition, the creek was not likely used as a drinking water source for local residents in the past. If vermiculite was present in the water and shorelines of the brook in the past, vermiculite and asbestos fibers may be present today. This waterway will be examined during the future investigations.

Comment #6: Is there anytime between 1963-1973 that my family could have been exposed to poisonous elements?

Response #6: Asbestos may have been present in the dust that was emitted from the facility and its processes. We do not have data to quantify potential exposures associated with this pathway for residents in the immediate area of the site, specifically for residents on Dunn Road and Towpath Road. If a resident is concerned that he/she may have been exposed to asbestos, they are encouraged to consult their physician or call the NYS Occupation Health Clinic. For more information on the NYS Occupational Health Clinic, including contact information, refer to response #4.

Comment #7: Where was the stoner rock processed at the Weedsport plant disposed of between 1963-1970?

Response #7: Records indicate that materials went to the Seneca Falls landfill and a Port Byron landfill. Vermiculite waste was also used on three local private properties. Two of the properties that received the waste were farm properties and the waste was used as a soil additive. On the third property the waste was used to fill a gully. In addition, the public has indicated that vermiculite waste was spread on the former Zonolite Co./W.R. Grace site and on a property east of the site.

Comment #8: Off-site soil samples from properties on Dunn Road and Towpath Road were collected from a horseshoe pit and in the area where a pool once stood. These locations were not appropriate and the properties should be re-sampled with direction from the property owners.

Response #8: The majority (86%) of the results from soil samples collected on-site were below the detection limit of <0.25% or not detected (ND). Off-site soil samples would likely have lower levels of asbestos than those detected on-site. If any residents believe that they have specific areas on their properties that may contain asbestos from the site, please contact the NYS DOH project manager at toll-free number: 1-800-458-1158, extension 27870.

Comment #9: Please help the people who lived around the site in the past and present. Advise them on what to do, what to expect, and come out to talk to the ones who lived there at that time.

Response #9: NYS DOH spoke with many concerned residents in the immediate area of the site and residents in other more distance areas. We will continue to be available to answer questions and provide information about the site, asbestos, and general information about asbestos related diseases. Members of the community can call to speak with NYS DOH staff at 1-800-458-1158, Extension 27870. If the citizens or community representatives would like to meet with the NYS DOH and other involved agencies in person, the NYS DOH can arrange such a meeting.

Comment #10: I grew up on Dunn Road and played on the property, as did my siblings. Should we be tested?

Response #10: NYS DOH encourages any person(s) that spent a considerable amount of time on the site or in the immediate vicinity to seek evaluation at the Occupational Health Clinic or to discuss their concerns with their primary care physician. We especially encourage those who may have had repeated contact with the vermiculite (ore or finished product) and/or the waste materials to seek medical evaluation.

Comment #11: Those of us who were at higher risk want testing and medical evaluation. Some of us cannot afford to pay out of pocket medical expenses.

Response #11: We have recommended that people who may have been exposed to asbestos associated with this site seek evaluation at a NYS Occupation Health Clinic. The clinics accept all forms of medical insurance and will pro-rate expenses based on the financial situation of the patient. The facility may also assist former employees to file for compensation to cover medical expenses if the exposure can be tracked to former work activities.

Comment #12: If we were exposed to dust contaminated with Libby amphibole asbestos years ago, shouldn't there be medical coverage today? If Superfund offers us medical coverage today, will it still cover years to come?

Response #12: Federal Superfund does not cover medical costs associated with any Superfund site. Superfund, a common name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), is the law that authorizes the US EPA to conduct environmental investigation, cleanup projects, and environmental monitoring. State Superfund (New York State's Inactive Hazardous Waste Disposal Site Remedial Program) also does not cover medical expenses for those adversely affected by a site.

Comment #13: Can exposure to asbestos cause fertility problems or breast cancer?

Response #13: We know of no studies that indicate an association between exposure to asbestos via inhalation, ingestion, or dermal contact and the development of breast cancer or adverse reproductive effects.

Comment #14: Can exposure to asbestos cause asthma, sinus problems, or allergies?

Response #14: We know of no studies that suggest that exposure to asbestos causes allergies or allergic responses in humans. Nor do we know of studies that specifically relate asbestos exposure to sinus problems. However, asbestos is known to produce irritation of the lungs and upper airways, and exposure to irritants can result in exacerbation of existing asthma. We therefore cannot rule out the possibility that exposure to asbestos could increase the risk for asthma exacerbations. The respiratory diseases associated with asbestos include lung cancer, asbestosis, and pulmonary fibrosis.

Comment #15: Is the 1.6 acres fenced and secured?

Response #15: The site is enclosed with a fence to limit entry. The fence varies in height and structure and in some locations may not be a significant deterrent to trespassers.

Comment #16: The site is larger than 1.6 acres; there is a landfill several acres in size located east of the site. There are still mounds of vermiculite found on that land today. Kids ride four wheelers and bikes in this area and may be exposed. There should be grid type soil sampling conducted on this property and the area should be secured to deter trespassers.

Response #16: The site, defined as the portion of the property that was leased by Zonolite Co./ W.R. Grace, is currently fenced and vegetation covers most of the on-site soil. Little asbestos was found in soil samples collected from on-site. Several reports assert that large amounts of stoner rock were disposed on the property east of the site. NYS DOH is working with NYS DEC and US EPA to investigate this site further and will assess the potential for any on-going exposures not previously investigated. This investigation will consider all reports of other areas that may contain asbestos.

Comment #17: On the property east of the site, there was a ten-foot deep pit where barrels of liquid waste were dumped. The barrels contained asphalt emulsion, water sprayed on vermiculite, gypsum, and dupinol. Could this impact our private drinking water wells?

Response #17: The barrels described in the comment may have contained wastes associated with the wet scrubber or the asphalt emulsion, Monokote, and silicone application process. The Cayuga County Department of Health in collaboration with NYS DOH collected water samples from several private drinking water wells in the area immediately surrounding the site. The water samples were analyzed by the NYS DOH Wadsworth Center laboratories for volatile organic compounds and inorganic compounds (metals). Some naturally occurring inorganic compounds were detected in the water samples at concentrations below the NYS DOH drinking water standards established for public water supplies. No volatile organic compounds were detected in the water samples. The sampling data found no impacts on private drinking water associated with the site.

Comment #18: When soil was contaminated years ago, could this present a danger of airborne asbestos today if the soil was disturbed?

Response #18: Asbestos, specifically amphibole asbestos is not generally broken down and can remain in the environment for long periods of time (ATSDR 2001a.). Consequently, if vermiculite waste contaminated with asbestos fibers is present in surface soils, the asbestos fibers could become suspended in the air if the soil in the area is disturbed. Various areas on-site and the apparent landfill east of the site will be investigated.

Comment #19: The US EPA samples and reported levels of asbestos were below detected levels (ND). Does this present danger to my family or me? If even the slightest trace of asbestos is detected, why isn't this site being cleaned up?

Response #19: ND represents "non-detect," which means that asbestos fibers were not detected in the sample. The Asbestos Hazard Emergency Response Act (AHERA) classifies any material containing >1% asbestos, by weight, as an Asbestos Containing Material (ACM) (Addison, 1994). This is the value we typically use to determine if a material should be handled as hazardous waste. If a soil contains less than 1% asbestos, the potential for exposure to asbestos would depend on soil characteristics (i.e., vegetated or exposed, dry or moist, etc.) and the type and duration of handling the soil. Since the asbestos detected on-site is mixed with the soil and covered with vegetation, the potential for exposures to asbestos are considered low. In addition,

entrance restrictions further reduce the potential for exposures. Currently, the site poses no apparent public health hazard for individuals residing near the site or trespassers on the site.

Comment #20: How can this site be for sale or lease if it is a public health hazard? What will be done to remove contaminated soil from the site today?

Response #20: The low levels of asbestos detected in surface soil in limited areas on-site do not present a hazard to the community under current conditions. With proper handling and use of engineering controls the site could be redeveloped or used without posing a risk for exposure to future occupants or the surrounding community.

Comment #21: What is "implementation of engineering controls during site development"?

Response #21: Engineering controls can be employed when work is conducted on a site to contain contamination and to protect the environment and community surrounding a site. For this site, engineering controls should be employed to contain dust or particulate migration off-site. An example of an engineering control includes wetting the soil where work is being done to control dust. In addition, air monitoring for dust and/or asbestos is often conducted to verify that the engineering control is effective.

Comment #22: If we are not sure if recent workers were contaminated in 2001, aren't exposures still possible?

Response #22: Employees of the former mulch company may have been exposed to low-levels of Libby amphibole asbestos. However, data from indoor air samples collected after Zonolite Co./W.R. Grace ended operations did not contain airborne asbestos. If residual levels of asbestos existed when the mulching company operated in the on-site building, they were likely low and posed no apparent public health hazard.

Comment #23: How come there were only 60 reports sent out? The entire town should be notified of the dangers of the Weedsport facility site.

Response #23: Our public outreach plan focused on those people most likely to have been exposed to Libby amphibole asbestos. This included former employees of the facility, their household contacts, and residents in the immediate vicinity of the site. In addition, the health consultation was placed in the local library for any interested person to review.

Former employees were considered at the greatest risk, as they worked directly with the vermiculite and stoner rock. A limited list of former employees was generated from site-specific documents that included employee information. Several additional names were gathered during phone conversations between NYS DOH staff and former employees. State and national directories were then used to gather the current addresses of former employees. Site-specific information was sent to the former employees. Household contacts were mainly identified through phone conversations with former employees. Additional site-specific information was sent to the household contacts that were identified.

If any residents were exposed to air emissions from the site, it was most likely the residents residing closest to the exfoliation plant when it was in operation. People in the Village of Weedsport were less likely to have been significantly exposed to asbestos from the site.

Several copies of the health consultation and related materials were sent to members of the public upon request. The NYS DOH staff continue to be available to answer inquiries related to the site, vermiculite attic insulation, and the hazards associated with asbestos.

Comment #24: Why did no one reply to any communications from the community in the past?

Response #24: In the past, several letters and a petition signed by local residents were provided to W.R. Grace and State/local agencies. The letters contained concerns from the community and, in response, the State conducted several follow-up activities including air sampling and requiring the company to make modifications to the processing plant. If you have any questions about specific communications, please contact the NYS DOH project manager for the site at the toll-free number: 1-800-458-1158, extension 27870

APPENDIX J

ATSDR Glossary of Terms

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-8737.

General Terms

Absorption - The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute - Occurring over a short time [compare with chronic].

Acute exposure - Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect - A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect - A change in body function or cell structure that might lead to disease or health problems

Aerobic - Requiring oxygen [compare with anaerobic].

Ambient - Surrounding (for example, *ambient* air).

Anaerobic - Requiring the absence of oxygen [compare with aerobic].

Analyte - A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study - A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect - A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level - An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation - Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study - A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in

human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring - Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake - The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing - Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota - Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden - The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

Cancer - Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk - A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen - A substance that causes cancer.

Case study - A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study - A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number - A unique number assigned to a substance by the American Chemical Society Abstracts Service.

Central nervous system - The part of the nervous system that consists of the brain and the spinal cord.

CERCLA - [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic - Occurring over a long time [compare with acute].

Chronic exposure - Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation - A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP) - A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and

review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV) - Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway - [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) - CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration - The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant - A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect - A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal - Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact - Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology - The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit - The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention - Measures used to prevent a disease or reduce its severity.

Disease registry - A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD - United States Department of Defense.

DOE - United States Department of Energy.

Dose (for chemicals that are not radioactive) - The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals) - The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship - The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media - Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism - Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA - United States Environmental Protection Agency.

Epidemiologic surveillance - [see Public health surveillance].

Epidemiology - The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure - Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment - The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction - A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation - The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway - The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry - A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study - A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS) - A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds - Training sessions for physicians and other health care providers about health topics.

Groundwater - Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{½}$) - The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard - A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat) - The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste - Potentially harmful substances that have been released or discarded into the environment.

Health consultation - A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education - Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation - The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion - The process of enabling people to increase control over, and to improve, their health.

Health statistics review - The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

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

Incidence - The number of new cases of disease in a defined population over a specific time period.

Ingestion - The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation - The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure - Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro - In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo - Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL) - The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring - A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism - The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite - Any product of metabolism.

mg/kg - Milligram per kilogram.

mg/cm^2 - Milligram per square centimeter (of a surface).

mg/m^3 - Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration - Moving from one location to another.

Minimal risk level (MRL) - An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity - State of being ill or diseased, the occurrence of a disease or condition that alters health and quality of life.

Mortality - Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen - A substance that causes mutations (genetic damage).

Mutation - A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or **NPL)** - EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP) - Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard - A category used in ATSDR's public health 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.

No-observed-adverse-effect level (NOAEL) - The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard - A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL - [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model) - A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica - A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume - A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure - The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population - A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP) - A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb - Parts per billion.

ppm - Parts per million.

Prevalence - The number of existing disease cases in a defined population during a specific time period.

Prevalence survey - The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention - Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session - An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period - An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action - A list of steps to protect public health.

Public health advisory - A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA) - An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard - A category used in ATSDR's public health 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 or radionuclides that could result in harmful health effects.

Public health hazard categories - Public health hazard categories are statements about 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 no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement - The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance - The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting - A public forum with community members for communication about a site.

Radioisotope - An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide - Any radioactive isotope (form) of any element.

RCRA - [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population - People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD) - An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry - A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation - The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA) - This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA - RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD - [see reference dose]

Risk - The probability that something will cause injury or harm.

Risk reduction - Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication - The exchange of information to increase understanding of health risks.

Route of exposure - The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor - [see uncertainty factor]

SARA - [see Superfund Amendments and Reauthorization Act]

Sample - A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size - The number of units chosen from a population or an environment.

Solvent - A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination - The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations - People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder - A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics - A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance - A chemical.

Substance-specific applied research - A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund - [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

Superfund Amendments and Reauthorization Act (SARA) - In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water - Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance - [see public health surveillance]

Survey - A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect - A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen - A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent - Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile - An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

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

Tumor - An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor - Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL).

Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

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

Volatile organic compounds (VOCs) - Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency
http://www.epa.gov/OCEPAterms/
National Library of Medicine (NIH)
http://www.nlm.nih.gov/medlineplus/mplusdictionary.html

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