Health Consultation

FORMER O.M. SCOTT AND SONS COMPANY

14111 SCOTTSLAWN ROAD

MARYSVILLE, UNION COUNTY, OHIO

EPA FACILITY ID: OHD990834483

SEPTEMBER 22, 2005

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

Health Consultation: A Note of Explanation

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

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

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

HEALTH CONSULTATION

FORMER O.M. SCOTT AND SONS COMPANY

14111 SCOTTSLAWN ROAD

MARYSVILLE, UNION COUNTY, OHIO

EPA FACILITY ID: OHD990834483

Prepared by:

U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

Foreword: ATSDR's National Asbestos Exposure Review

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

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

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

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

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

- The U.S. Environmental Protection Agency (EPA) mandated further action at the site because of contamination already present there.

- or -

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

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

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

Background

Site Information

The Scotts Miracle-Gro Company (formerly O.M Scott and Sons Company, and herein referred to as “Scotts”) is located at 14111 Scottslawn Road, Marysville, Union County, Ohio, approximately 30 miles northwest of Columbus, Ohio. It includes corporate offices, warehouses, and an operating facility that manufactures fertilizers and pesticides. The facility no longer exfoliates or uses vermiculite, which was used in consumer products as a carrier and filler. This facility was listed as an EPA further action site and it exfoliated approximately 430,000 tons of vermiculite during the years 1967–1980. Therefore, this site was included in the ATSDR Phase 1 evaluations.

The Scotts facility began operations in 1957. The plant operates 24 hours per day, 7 days per week. With a workforce of approximately 1,000 employees, it is a major employer in the area. The facility is in a sparsely populated, rural area that encompasses approximately 830 acres. The site is bordered to the north and south by open fields and wooded areas; on the east by a railroad and highway; and on the west by a residential area (a mobile home park about 1/2 mile from the site) (see Map 1) [1]. Because retail distribution is a large part of the Scott’s business, shipping operations fill many of the buildings on site.

Exfoliation operations at this facility occurred from 1967 until the spring of 2001, when the company phased-out vermiculite from its products. The exfoliation equipment was located at the corner of the plant near the railroad tracks, in the vermiculite expansion plant or the “east” plant, which was demolished after the phase-out of vermiculite. Before 1967, the Scotts Company received vermiculite that was not from Libby (The Scotts Company, personal communication, September 2002). From 1967 to 1980, the facility used vermiculite from the Libby, Montana, mine. In 1980, the facility switched from using Libby ore to using ore from Africa, South Carolina, and Virginia (The Scotts Company, personal communication, September 2002; unpublished information from EPA database of W.R. Grace documents). Scotts swept and vacuumed dust from the facility as part of a cleanup in 1980 (The Scotts Company, personal communication, September 2002), but no documents of the cleaning event could be located.

Approximately 430,000 total tons of Libby, Montana, vermiculite were received at this facility in about 4,521 shipments during the years 1967–1980 (unpublished information from EPA invoice database). This facility was the single largest consumer of vermiculite ore from the Libby mines in the United States, according to EPA records. Vermiculite from Libby was found to contain several types of asbestos fibers, including the amphibole asbestos varieties tremolite and actinolite. It also contained the related fibrous asbestiform minerals winchite, richterite, and ferro-edenite [2]. This report uses the term *Libby asbestos* to refer to the characteristic composition of asbestos contaminating the Libby vermiculite. It is difficult to measure all the different mineral fibers in Libby asbestos specifically. In this document, sample results are reported as “tremolite,” “tremolite asbestos,” or “actinolite/tremolite” to indicate the presence of Libby asbestos.

Exfoliation Process

EPA staff toured the Scotts facility and viewed the vermiculite exfoliation process in 2000 [3]. The following description summarizes the process observed during that visit; it may not represent processes used before 2000. The exfoliation process is no longer used at the facility; vermiculite was phased-out from the products in 2001.

Vermiculite was transported to the exfoliation plant by rail cars, dump trucks, or hopper bottom vehicles. The deliveries were unloaded on the west side of the plant near the railroad tracks and dumped into hoppers. Material-handling equipment transported vermiculite in the hoppers via horizontal screw conveyers and vertical elevators to storage silos. The vermiculite was transferred to furnaces, exfoliated, and sized through shakers and a series of screens. Dust and fines generated from this process were collected through hydrofiltration, which knocks down the released particulates with water. The collected wash-down material flows by gravity to a settling pond (Pond #3), where fines and solids settle out of suspension. Clarified water is pumped back into the hydrofiltration system. The facility states that the pond was monitored for contaminants and water level. Sand is also generated from the screening procedure and is either used as a material filler in the product or is disposed of at one of two local landfills off-site [3].

The facility had eight furnaces to exfoliate the vermiculite. The number of units operating at one time depended on the demand for the material in the finished product. The exfoliation furnaces were vertical units that require the feed stock to be fed from the top and processed materials passed out of the bottom. The exfoliation process used heat to 1000° F to drive off moisture and expand the vermiculite particles. At the time of EPA's inspection, three of the eight furnaces were operating. Final processed vermiculite was transported to storage silos to be blended with finished pesticide and fertilizer products. The facility used vermiculite in six of its products. The environmental manager estimated that vermiculite made up 10%–15% of the product contents, before vermiculite was phased out of the products in 2001. The facility produces all products on site and does not sell its products to secondary vendors [3].

Waste Material and Emissions Controls

Waste rock from the exfoliation process was either buried in an on-site landfill or sent to an off-site landfill (The Scotts Company, personal communication, September 2002). The stoner rock or waste rock that was buried in the landfill did not require any special handling at the time—it was considered nonhazardous by EPA (The Scotts Company, personal communication, September 2002). Scotts and EPA sampled the landfills and found no asbestos [4, 5].

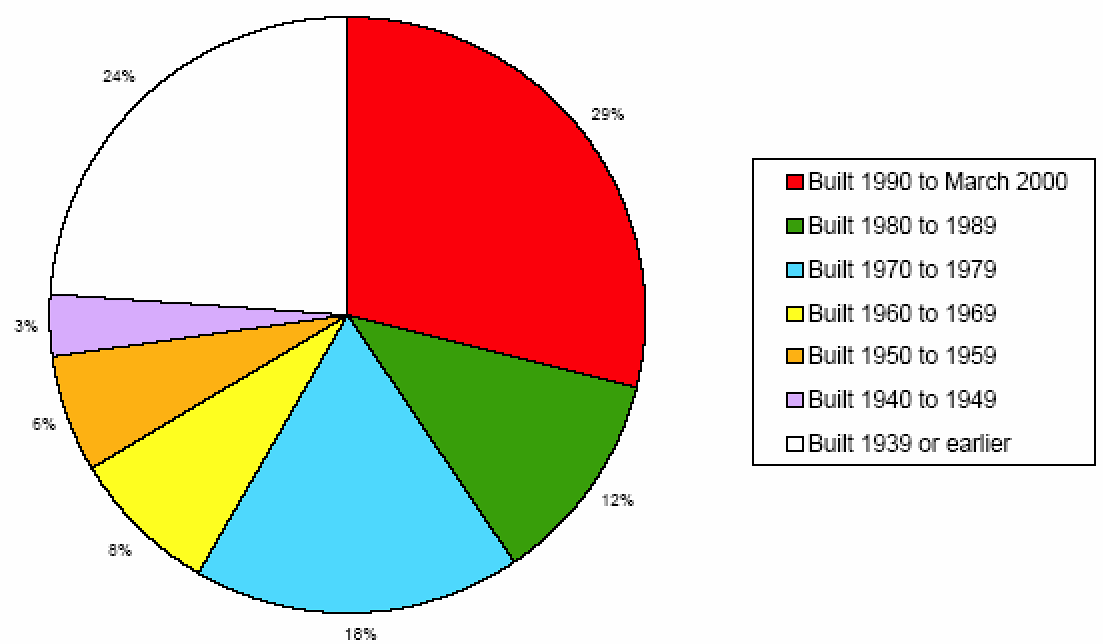
Stack emissions testing reportedly always found that total particulates and emissions were very low (Scotts Company, personal communication, September 2002); however, ATSDR does not have documentation of particulate sampling results. Cyclones, or high efficiency scrubbers, were reportedly part of the original exfoliation furnace design at the facility (Scotts Company, personal communication, September 2002). ATSDR has some documentation that cyclones were in place since 1971, and were reported to reduce 95% of emissions in the waste stream [6]. Particulate control technologies were typically installed in the 1970s in response to stricter air emission regulations included in the Clean Air Act. The old expansion building had hydrofilters that were about 15 feet higher than the top of the building. Storage bins were kept inside of the building, so fugitive emissions are expected to have been low.

After the solids settled out from the hydrofiltration process in settling pond #3, the company sometimes used the waste water, after testing, to irrigate fields it owned by the facility (The Scotts Company, personal communication, September 2002). This settling pond was closed in 2001, after the phase-out of vermiculite from products (The Scotts Company, personal communication, September 2002).

Demographics

The Scotts facility is located in a rural, sparsely populated area. According to 1990 census data, 58 housing units, populated by 185 people, are within 1 mile of the facility (See Map 1 and 2, Appendix A) [7]. The nearest residential area is a mobile home park about ½ mile from the facility. About 60% of the houses within 1 mile of the site were built before 1980, when processing of Libby vermiculite stopped (see Figure 1) [8].

Figure 1: Year of Construction for Homes within 1 Mile
Census 2000



Site Environmental Data

EPA and Scotts both conducted soil sampling at the Marysville facility in 2000. EPA's Superfund Technical Assessment and Response Team (START) collected four grab soil samples on November 29, 2000: at the on-site landfill, on the bank of the settling pond, and at an on-site dust pile. Each sample measured approximately 3 cubic inches. EPA analyzed those by polarized light microscopy (PLM) for percent and type of asbestos. All samples were nondetect for asbestos [4].

Scotts collected six grab soil samples on May 25, 2000, at five former on-site landfills and the field broadcast area. The samples were collected at a depth corresponding to the known vermiculite waste depth. This was accomplished by digging into the soil until vermiculite was observed. Soil samples were collected at various depths (see Table 1), composited, and sent to Severn Trent Laboratories for asbestos analysis by PLM. All samples were nondetect for asbestos [5].

Table 1. Summary of Soil Sampling Results

Sample Location	Date	PLM (percent asbestos by volume) *	Sampling Entity	Depth of Sample
West bank of settling pond #3	November 2000	Nondetect	EPA START	3 in.
South side of settling pond #3	November 2000	Nondetect	EPA START	3 in.
Landfill #4	November 2000	Nondetect	EPA START	3 in.
Sand/vermiculite/ore dust pile from north side of West Plant under the " sand system collector"	November 2000	Nondetect	EPA START	3 in.
Landfill #1	May 2000	Nondetect	Scotts	5–6 ft. bls**
Landfill #2	May 2000	Nondetect	Scotts	2–12 in. bls
Landfill #3	May 2000	Nondetect	Scotts	3–3.5 ft. bls
Landfill #4	May 2000	Nondetect	Scotts	1–2 ft. bls
Landfill #5	May 2000	Nondetect	Scotts	6–12 in. bls
Field Broadcast Area #2	May 2000	Nondetect	Scotts	1–3 ft. bls

* detection limit typically 0.25%–1.0% for polarized light microscopy (PLM)
** bls = below surface

In December 2000, the National Institute for Occupational Safety and Health (NIOSH) collected air samples as part of a request from the Occupational Safety and Health Administration (OSHA) to assess potential worker exposures to asbestos associated with current vermiculite use [9]. The air samples were split and independently analyzed by NIOSH, OSHA, and EPA. All of the time-weighted averages (TWAs) were less than the current OSHA permissible exposure limit (PEL) of 0.1 fibers/cm^3. Two samples were between 0.1 fibers/cm^3 and 0.01 fibers/cm^3 (0.02 fibers/cm^3 as measured by NIOSH for an expander operator, and 0.05 fibers/cm^3 as measured by EPA for a track operator) [9]. This NIOSH sampling took place in 2000, approximately 20 years after the facility stopped using Libby asbestos vermiculite ore in its processes. These air samples were intended to characterize exposure to current (non-Libby asbestos) vermiculite. The results also suggest, however, that no significant contamination resulted from residual Libby asbestos in the year 2000. Scotts company has discontinued its use of vermiculite altogether as of 2001, which included dismantling and removing all vermiculite expanding equipment.

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. Fibrous amphibole minerals are brittle and have a rod- or needle-like shape. Amphibole minerals regulated as asbestos by OSHA include five classes: crocidolite, amosite, and the fibrous forms of tremolite, actinolite, and anthophyllite. Other unregulated amphibole minerals, including winchite, richterite, and others, can also exhibit fibrous asbestiform properties [10].

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

Vermiculite that was mined in Libby, Montana, contains amphibole asbestos, with a characteristic composition including tremolite, actinolite, richterite, and winchite; this material will be referred to as Libby asbestos. The raw vermiculite ore was estimated to contain up to 26% Libby asbestos as it was mined [11]. For most of the mine's operation, Libby asbestos was considered a by-product of little value and was not used commercially. The mined vermiculite ore was processed to remove unwanted materials and then sorted into various grades or sizes of vermiculite that were then shipped to sites across the nation for expansion (exfoliation) or use as a raw material in manufactured products. Samples of the various grades of unexpanded vermiculite shipped from the Libby mine contained 0.3%–7% fibrous tremolite-actinolite (by mass) [11].

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

Methods for Measuring Asbestos Content

A number of different analytical methods are used to evaluate asbestos content in air, soil, and other bulk materials. Each method varies in its ability to measure fiber characteristics such as length, width, and mineral type. For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers with lengths greater than 5 micrometers (>5 µm) and with an aspect ratio (length to width) greater than 3:1. This is the standard method by which regulatory limits were developed. Disadvantages of this method include the inability to detect fibers less than 0.25 (<0.25) µm in diameter and the inability to distinguish between asbestos and nonasbestos fibers [10].

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

Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods that can detect smaller fibers than light microscopic techniques. TEM allows the use of electron diffraction and energy-dispersive x-ray methods, which give information on crystal structure and elemental composition, respectively. This information can be used to determine the elemental composition of the visualized fibers. SEM does not allow measurement of electron diffraction patterns. One disadvantage of electron microscopic methods is that determining asbestos concentration in soil and other bulk material is difficult [10].

For risk assessment purposes, TEM measurements are sometimes multiplied by conversion factors to give PCM equivalent fiber concentrations. The correlation between PCM fiber counts and TEM mass measurements is very poor. A conversion between TEM mass and PCM fiber count of 30 micrograms per cubic meter per fiber per cubic centimeter ($\mu g/m^3$)/(f/cc) was adopted as a conversion factor, but this value is highly uncertain because it represents an average of conversions ranging from 5 to 150 ($\mu g/m^{3)}$/(f/cc) [12]. 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 [12]. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular air sample.

Asbestos Health Effects and Toxicity

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

> *Malignant mesothelioma*—cancer of the membrane (pleura) that encases the lungs and lines the chest cavity. This cancer can spread to tissues surrounding the lungs or other organs. The great majority of mesothelioma cases are attributable to asbestos exposure [10].
>
> *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 [10].
>
> *Noncancer health effects*—these include asbestosis, scarring, and reduced lung function caused by asbestos fibers lodged in the lung; pleural plaques, localized or diffuse areas of thickening of the pleura; pleural thickening, extensive thickening of the pleura which may restrict breathing; pleural calcification, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and pleural effusions, fluid buildup in the pleural space between the lungs and the chest cavity [10].

Not enough evidence is available to determine whether inhalation of asbestos increases the risk of cancer at sites other than the lungs, pleura, and abdominal cavity [10].

Ingestion of asbestos causes little or no risk of noncancer effects. However, some evidence indicates that acute oral exposure might induce precursor lesions of colon cancer and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors [10].

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

The scientific community generally accepts the correlations of asbestos toxicity with fiber length as well as fiber mineralogy. Fiber length may play an important role in clearing the materials from the body, and mineralogy may affect both biopersistence and surface chemistry.

ATSDR, responding to concerns about asbestos fiber toxicity from the World Trade Center disaster, held an expert panel meeting to review fiber size and its role in fiber toxicity in December 2002 [13]. The panel concluded that fiber length plays an important role in toxicity. Fibers with lengths <5 µm are essentially nontoxic in terms of association with mesothelioma or lung cancer promotion. However, fibers with lengths <5 µm may play a role in asbestosis when exposure duration is long and fiber concentrations are high. More information is needed to definitively reach this conclusion.

In accordance with these concepts, it has been suggested that amphibole asbestos is more toxic than chrysotile asbestos, mainly because physical differences allow chrysotile to break down and to be cleared from the lung, whereas amphibole is not removed and builds up to high levels in lung tissue [14]. 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 [14]. However, OSHA continues to regulate chrysotile and amphibole asbestos as one substance, as both types increase the risk of disease [15]. EPA's Integrated Risk Information System (IRIS) assessment of asbestos also currently treats mineralogy (and fiber length) as equipotent.

Evidence suggesting that the different types of asbestos fibers vary in carcinogenic potency and site specificity is limited by the lack of information on fiber exposure by mineral type. Other data indicate that differences in fiber size distribution and other process differences can contribute at least as much as fiber type to the observed variation in risk [16].

Counting fibers using the regulatory definitions (see below) does not adequately describe risk of health effects. Fiber size, shape, and composition contribute collectively to risk in ways that are still being elucidated. For example, shorter fibers appear to deposit preferentially in the deep lung, but longer fibers may disproportionately increase the risk of mesothelioma [10, 16]. Some of the unregulated amphibole minerals, such as the winchite present in Libby asbestos, can exhibit asbestiform characteristics and contribute to risk. Fiber diameters greater than 2 µm–5 µm are considered above the upper limit of respirability (that is, too large to inhale), and thus do not contribute significantly to risk. Methods to assess the risk posed by varying types of asbestos are being developed and are currently awaiting peer review [16].

Current Standards, Regulations, and Recommendations for Asbestos

In industrial applications, asbestos-containing materials are defined as any material with >1% bulk concentration of asbestos [17]. It is important to note that 1% is not a health-based level, but instead represents the practical detection limit in the 1970s when OSHA regulations were created. Studies have shown that disturbing soil containing <1% amphibole asbestos, however, can suspend fibers at levels of health concern [18].

Friable asbestos (asbestos which is crumbly and can be broken down to suspendible fibers) is listed as a hazardous air pollutant on EPA's Toxic Release Inventory [19]. This classification requires companies that release friable asbestos at concentrations >0.1% to report the release under Section 313 of the Emergency Planning and Community Right-to-Know Act.

OSHA's permissible exposure limit (PEL) is 0.1 f/cc for asbestos fibers with lengths >5 µm and with an aspect ratio (length:width) >3:1, as determined by PCM [15]. This value represents a time-weighted average (TWA) exposure level based on 8 hours per day for a 40-hour work week. In addition, OSHA has defined an "excursion limit," which stipulates that no worker should be exposed in excess of 1 f/cc as averaged over a sampling period of 30 minutes [15]. Historically, the OSHA PEL has steadily decreased from an initial standard of 12 f/cc established in 1971. The PEL levels prior to 1983 were determined on the basis of empirical worker health observations, while the levels set from 1983 forward employed some form of quantitative risk assessment. ATSDR has used the current OSHA PEL of 0.1 f/cc as a reference point for evaluating asbestos inhalation exposure for past workers. ATSDR does not, however, support using the PEL for evaluating exposure for community members, because the PEL was developed as an occupational exposure for adult workers.

In response to the World Trade Center disaster in 2001 and an immediate concern about asbestos levels in buildings in the area, the Department of Health and Human Services, EPA, and the Department of Labor formed the Environmental Assessment Working Group. This work group was made up of ATSDR, EPA, CDC's National Center for Environmental Health, the National Institute for Occupational Safety and Health (NIOSH), the New York City Department of Health and Mental Hygiene, the New York State Department of Health, OSHA, and other state, local, and private entities. The work group set a re-occupation level of 0.01 f/cc after cleanup. Continued monitoring was also recommended to limit long-term exposure at this level [20]. In 2002, a multiagency task force headed by EPA was formed specifically to evaluate indoor environments for the presence of contaminants that might pose long-term health risks to residents in Lower Manhattan. The task force, which included staff from ATSDR, developed a health-based benchmark of 0.0009 f/cc for indoor air. This benchmark was developed to be protective under long-term exposure scenarios, and it is based on risk-based criteria that include conservative exposure assumptions and the current EPA cancer slope factor. The 0.0009 f/cc benchmark for indoor air was formulated on the basis of chrysotile fibers and is therefore most appropriately applied to airborne chrysotile fibers [21].

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 [22]. The American Conference of Government Industrial Hygienists has also adopted a TWA of 0.1 f/cc as its threshold limit value [23].

EPA has set a maximum contaminant level (MCL) for asbestos fibers in water of 7,000,000 fibers longer than 10 µm per liter, on the basis of an increased risk of developing benign intestinal polyps [24]. Many states use the same value as a human health water quality standard for surface water and groundwater.

Asbestos is a known human carcinogen. Historically, EPA's IRIS model calculated an inhalation unit risk for cancer (cancer slope factor) of 0.23 per f/cc of asbestos [12]. This value estimates additive risk of lung cancer and mesothelioma using a relative risk model for lung cancer and an absolute risk model for mesothelioma.

This quantitative risk model has significant limitations. First, the unit risks were based on measurements with phase contrast microscopy and therefore cannot be applied directly to measurements made with other analytical techniques. Second, the unit risk should not be used if the air concentration exceeds 0.04 f/cc because the slope factor above this concentration might differ from that stated [12]. Perhaps the most significant limitation is that the model does not consider mineralogy, fiber-size distribution, or other physical aspects of asbestos toxicity. EPA is in the process of updating their asbestos quantitative risk methodology given the limitations of the IRIS model currently used and the knowledge gained since this model was implemented in 1986.

Discussion

The vermiculite processed at this site during the years 1967–1980 originated from the mine in Libby, Montana, and is known to be contaminated with asbestos. Studies conducted in the Libby community indicate health impacts that are associated with asbestos exposure [25, 26]. The findings at Libby provided the impetus for investigating this site, as well as other sites across the nation that received asbestos-contaminated vermiculite from the Libby mine. It is important to recognize, however, that the asbestos exposures documented in the Libby community are in many ways unique and will not collectively be present at other sites that processed or handled Libby vermiculite. This site investigation of the Scotts Company in Marysville, Ohio, is part of a national effort to identify and evaluate potential asbestos exposures that may be expected at other sites that processed Libby ore.

Exposure Assessment and Toxicological Evaluation

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

- Information on past concentrations of Libby asbestos in air in and around the plant is limited. Also, as described in the preceding section, significant uncertainties and conflicts in the methods used to analyze asbestos exist. This makes it hard to estimate the levels of Libby asbestos people may have been exposed to.

- Information about how and how often people came in contact with the Libby asbestos from the plant is insufficient, because most exposures happened so long ago. This information is necessary to estimate quantitative exposure doses.
- Information about how some vermiculite materials, such as waste rock, were handled or disposed is incomplete. This makes it difficult to identify and assess both past and present potential exposures.

Given these difficulties, the public health implications of past operations at this site are evaluated qualitatively. Current health implications are likewise evaluated qualitatively. The following sections describe the various types of evidence we used to evaluate exposure pathways and reach conclusions about the site. Definitions for the hazard category terminology used to characterize the pathways are presented in Appendix B.

Exposure Pathway Analysis

An exposure pathway is how a person comes in contact with chemicals originating from a source of contamination. Every exposure pathway consists of the following five elements: 1) a *source* of contamination; 2) a *media* such as air or soil through which the contaminant is transported; 3) a *point of exposure* where people can contact the contaminant; 4) a *route of exposure* by which the contaminant enters or contacts the body; and 5) a *receptor population*. On the basis of these conditions, ATSDR places pathways in one of four categories:

Completed: A pathway is considered complete if all five elements are present and connected.
Potential: A potential exposure pathways indicate that exposure to a contaminant *could* have occurred in the past, *could* be occurring currently, or *could* occur in the future. A potential exposure exists when information about one or more of the five elements of an exposure pathway is missing or uncertain.
Eliminated: An eliminated pathway was a potential or completed pathway in the past, but has had one or more of the pathway elements permanently removed to prevent present and future exposures.
Incomplete: An incomplete pathway is missing one or more of the pathway elements and it is likely that the elements were never present and not likely to be present at a later point in time.

After reviewing information from Libby, Montana, and from facilities that processed vermiculite ore from Libby, a list of possible exposure pathways for vermiculite processing facilities was developed (Appendix C). All pathways have a common source—vermiculite from Libby contaminated with Libby asbestos—and a common route of exposure—inhalation. Although asbestos ingestion and dermal exposure pathways could exist, health risks from these pathways are minor in comparison to those resulting from inhalation exposure to asbestos and will not be evaluated.

The status of the exposure pathways considered for this site is listed in Table 2. Not every pathway identified will be a significant source of exposure for a particular site. A description and evaluation of the pathways for this site are presented in the following paragraphs.

Table 2. Summary of Inhalation Pathways Considered for Former O.M. Scott and Sons Company

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

Occupational

Former Workers. The occupational exposure pathway for people who worked at the Scotts facility during the time the facility exfoliated vermiculite from Libby (1967–1980) is considered complete. Former workers were exposed to airborne levels of asbestos that posed a public health hazard.

The Scotts Company processed approximately 430,000 tons of vermiculite from the Libby mine. Scotts began sampling indoor air for worker exposure to asbestos in 1972, and began performing chest x-rays of workers in 1976 (unpublished information from EPA database of W.R. Grace documents). OSHA conducted an industrial hygiene survey at Scotts in 1978 because of reports of asbestos-related diseases in the company's workers [27]. In addition, unpublished information from W.R. Grace records indicate that former workers were exposed to significant levels of Libby asbestos in air at the Scotts facility.

During May 1973, Scotts conducted personal monitoring for the expander operator on 4 separate days. Time-weighted averages were determined from seven or eight 15-minute samples, so they may not represent an 8-hour workday average. The time-weighted averages of asbestos of these personal monitoring results are significantly higher than current and previous OSHA PELs. Results of this personal monitoring are summarized in Table 3 (unpublished information from EPA database of W.R. Grace documents).

Table 3. Personal Monitoring Results for Asbestos for an Expander Operator at Scotts During May 1973 (in f/cc) in 15-Minute Samples

Date	Minimum	Average	Ceiling (maximum)
5/8/1973	0.6	3.57	10
5/9/1973	0.3	8.17	35
5/30/1973	1.2	4.12	8.2
5/31/1973	1.2	16.85	59.3

Source: unpublished information from EPA database of WR Grace documents.

In addition to the limited personal monitoring, several sets of historical engineering samples were available for the years 1972 through 1976. According to internal memos, these samples were primarily taken to determine what controls were needed to meet the decreasing OSHA PEL in 1976. The sampling data have been categorized by ATSDR as four different types: area, semipersonal, personal, and ore-unloading. *Area* refers to a sample taken in a general process area; *semipersonal* refers to an area air sampler that was used to follow the expander operator through his workday; *personal* refers to a sampler physically located in the employee's breathing zone; and *ore-unloading* refers to an area sampler that was hung on the side of the ore car while unloading. The personal sampling included here was not included in the discussion of TWA employee monitoring because of the short duration of personal sampling (i.e., not enough time to determine TWA). Most samples were recorded in 15-minute periods. Some semipersonal and personal samples were in 60-minute periods. Ore-unloading samples occurred in 2- or 3-minute periods. Most of the samples were significantly higher than current and previous OSHA PELs. The highest levels of asbestos found were during ore unloading with levels up to 245 f/cc for 2 or 3 minutes. A summary of these samples are in Table 4.

Table 4. Historical Air Sampling for O.M. Scott and Sons Company, 1972–1976, in 2-Minute to 60-Minute Sampling Periods

Date	Type of samples	# of samples	Range (f/cc)	Average (f/cc)
6/1972	Area	8	0 – 8.3	2.1
4/1973	Area	8	0 – 8.8	3.0
11/1975	Area	13	0 – 4.5	0.9
12/1975	Area	3	0.6 – 5.2	2.2
	Semipersonal	4	1.2 – 7.6	4.7
1/1976	Area	3	1.5 – 3.1	2.4
	Semipersonal	7	0.08 – 2.6	1.0
3/1976	Area	16	0.2 – 8.5	2.7
	Semipersonal	8	0.3 – 10.5	2.4
	Ore-unloading	1	245.0	245.0
4/1976	Area	16	0.3 – 31.3	5.2
	Semi-personal	7	1.2 – 4.3	2.3
4/1976	Area	1	0.4	0.4
	Semipersonal	7	0.2 – 0.8	0.4
	Ore-unloading	3	12.3 – 110.4	46.0
5/1976	Area	11	1.8 – 50.2	13.4
	Ore-unloading	2	53.0 – 207.7	130.4
5/1976	Semipersonal	2	0.1 – 1.5	0.8
	Personal	2	0.4 – 2.0	1.2
	Area	1	0.4	0.4
10/1976	Area	18	0.5 – 10.0	2.3
	Personal	3	0.3 – 1.6	0.8

Source: unpublished information from EPA database of W.R. Grace documents.

This historical sampling provides some limited information on what former Scotts employees working in the expander areas of the plant may have been exposed to, at least for the years 1972–1976. Levels before 1972 were probably at least as high as those from 1972–1976, if not higher. Air pollution controls were generally installed at all expanding facilities in the mid-1970s in anticipation of the decreasing OSHA PEL. The levels of asbestos after 1976 are unknown, but they may have decreased from additional engineering controls. However, an OSHA industrial hygiene survey conducted in late 1978 to early 1979 documents that dusty conditions were still a problem, especially during cleaning operations:

> The cleanup operations generated the highest employee exposure levels. An employee monitored for total dust while cleaning out the baghouse was exposed to an 8-hour time weighted average of approximately 160 mg/m^3. Respiratory protection was inadequate. Maintenance employees cleaning out exhaust fans were also overexposed. The operators assigned to screens and mills were observed looking up inside hoppers and banging caked product off the sides. When the screens and mills operator was not checking screens and mills he was usually busy sweeping up spills and leaking product…the operators assigned to clean out the dryers when they are down for routine maintenance are exposed to fairly high dust concentrations when they enter the dryer to shovel out product or knock off caked deposits… Employees working in the track area were exposed to fairly heavy concentrations of dust while railcars were dumped and while expanded vermiculite or other product

> was shoveled into the floor grate leading to a conveyor that led to the storage hoppers. The track area was not separated from the rest of the trionize area by a wall prior to 1976 so most of the trionize department was exposed to dust generated during unloading of vermiculite prior to that time. [27]

Scotts discontinued use of Libby ore in 1980, so exposure to Libby asbestos after 1980 is expected to have dropped significantly. However, because exfoliation continued with vermiculite ore from other mines, conditions may have remained dusty.

Although asbestos was detected at high levels, respirator use was limited at the facility, similar to practices at other facilities at that time. Employees were using dust masks at the facility at the time of OSHA's survey in 1978. However, the way they were used was probably not effective for reducing asbestos exposure, as staff from OSHA observed employees removing respirator straps to chew and spit tobacco [27].

Available information suggests former workers used to leave their clothes at the facility to be laundered every day. However, documentation could not be located to determine compliance with this practice. If clothes or coveralls were left at the facility, the workers who laundered these clothes may have been exposed to Libby asbestos. It is unknown if these persons would have been on-site workers or off-site.

In addition to air sampling data, health outcome data are available that strengthen ATSDR's conclusion that occupational exposure at Scotts in the past was a public health hazard. Scotts began offering x-ray examinations to workers in 1976. That year, x-rays of two employees indicated signs of asbestosis. In 1978, Scotts reported four cases of bloody pleural effusion in the lungs of Scotts workers. That led to an investigation by the company and federal agencies to examine occupational exposure to asbestos in more detail. A preliminary review of worker x-rays in 1979 observed that:

- 32 of 125 worker x-rays showed pleural and/or interstitial abnormalities;
- the prevalence of pleural and/or interstitial abnormalities were approximately twice as high for workers in the exfoliating department compared to the maintenance and packaging departments;
- the proportion of pleural and/or interstitial abnormalities increased with length of employment in all departments; and
- the proportion of abnormalities increased with worker age (unpublished information from EPA database of W.R. Grace documents).

By around 1983, 12 cases of pleural effusions of unknown origin were found among Scotts employees over a 12-year work period [28]. A study of a cohort of Scotts workers was conducted by Lockey et al in 1983. This study demonstrated that cumulative tremolite-actinolite fiber exposure was correlated with dyspnea (difficulty in breathing) and pleuritic chest pain, and pleural changes (thickening and/or plaques) on chest x-rays [28].

Workers employed at Scotts after about 1980 would not have directly handled Libby asbestos; however, it is unknown if any residual Libby asbestos was present in the exfoliation facility. This would be dependent on how well the facility was cleaned after Libby asbestos use ceased. ATSDR is not aware of any documentation of how the facility was cleaned, or any post-cleaning sampling. In 2000, air sampling was completed by NIOSH to characterize potential exposure to asbestos from use of current vermiculite sources. The results did not indicate the presence of any significant residual Libby asbestos contamination; all TWAs were below the current OSHA PEL of 0.1 f/cc.

Current and Future Workers. Current workers at the Scotts Company are not exposed to Libby asbestos contamination. Libby asbestos has not been used at the facility since 1980, and the entire vermiculite process was shut down in 2001. At that time, all equipment was dismantled and removed, and the area was cleaned. No chest x-rays since 1980 have shown abnormalities related to the plant (The Scotts Company, personal communication, September 2002).

ATSDR has eliminated this exposure pathway because Libby asbestos is no longer used, the facility no longer exfoliates vermiculite from any source, and all exfoliation equipment has been dismantled and removed.

Household Contact

Household contacts of former workers may have been exposed to Libby asbestos. Former workers may have transported Libby asbestos home from work on their clothing or hair and thus exposed household members. However, the facility states that it has always been a policy for workers to leave coveralls at the plant for laundering and shower before leaving (The Scotts Company, personal communication, September 2002). The OSHA industrial hygiene survey refers to a policy that clean clothes (that were laundered daily by the facility), boots, and gloves were specified by the company for pesticide operations. The survey also states “employees are provided with a clean uniform every day and they are given the opportunity to shower before going home” [27]. Documentation could not be located to verify if this policy was also required for workers in the vermiculite expansion area. If workers did leave their clothes and shower before going home, this would have significantly reduced, if not eliminated, the asbestos exposure to family members. Although it can not be stated definitively that these practices took place, ATSDR believes the potential for exposure to household contacts would be less for this facility compared to other facilities where laundering and showering services were not available. However, it is unknown when this policy or service went into effect. Asbestos carried home on the clothes and bodies of workers may have been a significant pathway in the early years of operation at the facility.

Current workers are not being exposed to Libby asbestos; therefore, present and future worker take-home of asbestos is an eliminated exposure pathway.

Waste piles

Past exposure of community members to waste piles at the former site are possible, but unlikely. Records indicate that wastes from the facility were disposed in on-site and off-site landfills (unpublished information from EPA database of W.R. Grace documents). It is possible that waste rock from the facility was temporarily stockpiled on-site. However, personal communication with Scotts personnel (September 2002) stated that storage bins were kept inside the plants. The area is quite rural and it is unlikely that community members, including children, would have accessed the site. Additional information is needed to confirm past waste handling practices and potential community exposure to on-site waste piles.

No evidence of waste piles or waste material was observed at the site during visits by EPA and ATSDR. No historical information was found to suggest that waste piles existed, or if they did exist, were accessible to community members or children. This is an eliminated pathway for present and future exposures since no waste piles have been identified. Although exposure was unlikely, the pathway is potential for past exposures due to insufficient information.

On-Site

The sampling results for on-site soil and landfills do not indicate that there is any Libby asbestos contamination on-site. However, it is assumed that the landfills do contain asbestos, but it is buried deeper than the depth at which sampling occurred. A large of amount of waste was generated at this site, much of which was contained in on-site landfills. Disturbance to these landfills creates a potential for exposure to workers and trespassers that would come into contact with the landfill. This potential exposure is very limited and is only for workers that may be disturbing on-site landfills at deep levels. Although highly unlikely that this sequence of events would occur, exposure to onsite soils is a potential future pathway.

Ambient Air

The Scotts facility may have released Libby asbestos fibers into the air via stack emissions and/or fugitive dusts. However, specific information concerning plant emissions was not available, so risk estimates from this exposure cannot be made. Even with emissions data, it would be difficult to construct past exposures, given limited information on population in the area. The Minnesota Department of Health developed an air dispersion model for an expansion plant in Minneapolis, Minnesota, which suggested that areas very close (within one block) to an expansion plant could have had elevated fiber levels, but the levels were predicted to drop off rapidly as distance increased [29]. Site-specific emissions characteristics and meteorological conditions could affect results greatly. However, if a similar pattern existed at the Scotts facility, it is unlikely that significant exposure occurred because the rural area is sparsely populated. The 1990 census data lists only five housing units in a ¼-mile radius from the site, and 18 housing units in a ½-miles radius from the site. The residential area is to the west of the site. Wind rose data from Port Columbus International Airport indicates that wind direction is primarily towards the north and east (see Map 3, Appendix A). The majority of the time, ambient air emissions of asbestos would have blown away from the residential area; therefore, the community was most likely not exposed to asbestos in the air on a regular basis.

However, certain instances and information indicate that community members may have been exposed. Scotts owns 830 acres of mainly unrestricted property. Trespassers may have had easy access to the property and may have been exposed at times when Libby ore was being exfoliated. Employees and their families also could use a park and swimming pool on Scotts' property. Exposure could have occurred, to some extent, if people were using those facilities during a time when Libby ore was being exfoliated and the wind was blowing in that direction. These exposures would have been intermittent and infrequent. Anecdotal information about complaints of dust on cars at the mobile home park near the facility (Union County health officials, personal communication, September 2002) leads to an assumption that asbestos emissions could have reached some residents. It is unclear how long the mobile home park has been there; one Scotts representative believes it has been there since the early 1970s. However, without ambient air data, the available information is insufficient to evaluate the significance of this exposure pathway. ATSDR has classified this pathway as potential for past exposures and eliminated for current and future exposures because Libby asbestos is no longer used.

Residential Outdoor

Some vermiculite processing facilities in the United States allowed or encouraged workers and nearby community members to take stoner rock, vermiculite, or other process materials for personal use [30]. At Scotts, according to available information, people living in the community near the plant face minimal risk of asbestos exposure from soils in their yards, either in the past or currently. The area immediately around the plant is rural and sparsely populated. Personal communication with Scotts indicates that wastes from the facility were disposed of at on-site and off-site landfills (The Scotts Company, personal communication, September 2002). There is no indication that people ever hauled Libby asbestos-contaminated materials away for personal use, so it is doubtful that people could be currently exposed to vermiculite in the soil of their yards. However, because the facility processed a high tonnage of Libby vermiculite in the past and insufficient information is available to verify the actual disposal of waste, the past, present and future community exposure to waste rock brought home for personal use is a potential exposure pathway (indeterminate public health hazard). Information indicates that allowing community members to take home waste rock was not a common practice; therefore, any exposure would have been limited and not community-wide.

Residential Indoor

Residents could have inhaled Libby asbestos fibers from household dust, either from plant emissions that infiltrated into homes or from dust brought inside from waste products brought home for personal use. We found no information on past levels of contamination in ambient air, but it is unlikely that past ambient air emissions would have been high enough to infiltrate houses significantly in this sparsely populated area. No information has been gathered about community members using waste materials in their yards. It is unlikely that this was a common practice at this facility because wastes were disposed of in on-site off-site landfills. However, the facility processed a high tonnage of Libby vermiculite in the past and insufficient information is available concerning historical waste disposal and ambient air levels. Therefore, the past community exposure to waste rock brought home for personal use is a potential exposure pathway (indeterminate public health hazard). The current and future exposure to residential indoor asbestos is extremely unlikely because Libby asbestos has not been used at the facility since 1980. In addition, routine housekeeping (particularly wet cleaning methods) over the past 20 years would probably have removed any residual Libby asbestos in area homes. The current and future exposure pathway has been eliminated.

Consumer Products

People who purchased and used vermiculite products may be exposed to asbestos fibers from using those products in and around their homes. At this time, determining the public health implication of commercial or consumer use of vermiculite products (such as home insulation or gardening products) is beyond the scope of this evaluation. However, studies have shown that disturbing or using these products can result in airborne asbestos fiber levels higher than occupational safety limits [18, 31]. Additional information for consumers of vermiculite products has been developed by EPA, ATSDR, and NIOSH and provided to the public (see URL: www.epa.gov/asbestos/insulation.html).

Health Outcome Data

Health outcome data can be used to give a more thorough evaluation of the public health implications of a given exposure. Health outcome data can include mortality information (e.g., the number of people who have died from a certain disease) or morbidity information (e.g., the number of people in an area who have a certain disease or illness). In Libby, Montana, the number of recorded deaths associated with asbestos-related diseases was significantly elevated (as compared with the state or the nation as a whole), especially among former workers of the vermiculite mine and their household contacts [25]. Former workers and their household contacts also showed higher rates than expected of pleural (lung lining) abnormalities, indicating higher exposure and a higher risk for developing asbestos-related disease [32].

A study conducted in 1984 on a cohort of Scotts workers demonstrated that cumulative tremolite-actinolite fiber exposure was correlated with dyspnea (difficulty in breathing) and pleuritic chest pain, and pleural changes such as thickening and/or plaques on chest x-rays [28]. A follow-up study of the 1984 study is currently being conducted to evaluate disease progression of the original group of workers.

The ATSDR Division of Health Studies, in cooperation with state partners, is conducting an ongoing effort to gather health outcome data for communities near selected former vermiculite facilities. A review of the available health statistics data for the community near this site has been completed and a copy is in Appendix D. The review was completed by examining death certificates for primary reason for death, for the years 1979–1998, for all people living within the city of Marysville. The review did not find a higher than expected number of asbestos-related diseases. However, the small number of potentially affected people around the site could make it difficult to detect any community-level health effects. In addition, it is possible that even though an individual had an asbestos-related disease (e.g., asbestosis), the primary cause of death could have been different (e.g., heart attack). This review was limited to examining death certificates and did not review incidence of cases of asbestos-related diseases or cancers because this information was not available.

Child Health Considerations

ATSDR recognizes 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 is committed to evaluating their special interests at the site.

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

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

Because of the limited amount of information regarding the exposure pathways at this site, the health implications to children are difficult to determine. From information reviewed by ATSDR to date, the most at-risk children are those who were household members of former workers while the plant was expanding Libby vermiculite, especially in the early years of operation. Other exposure pathways (ambient air, residential outdoor, waste piles) may also have affected children, but ATSDR does not have information at this time to determine if these pathways were complete or not.

Conclusions

- Workers at The Scotts Company (formerly O.M. Scott and Sons Company) in Marysville, Ohio were exposed to airborne levels of Libby asbestos above the current occupational standard (OSHA PEL) in the past; past occupational exposures were a public health hazard.
- Current workers at the site are not being exposed to Libby asbestos; therefore, it poses no public health hazard. Future disturbances of on-site landfills that may contain asbestos could result in exposure to workers.
- Household members of former workers may have been exposed to elevated levels through Libby asbestos carried home on workers' hair and clothing. That may have occurred if workers did not use Scotts' laundering service and/or follow the policy of leaving dusty clothes on-site and showering before they went home. It could also have occurred during the period before this policy was developed. Past exposure under this scenario is a public health hazard. However, if workers did follow this policy, then household members of former workers were unlikely to have been exposed to hazardous levels of asbestos carried home on workers' hair and clothing. In that scenario, household contact exposure is not a public health hazard.
- Household contacts of current workers are not being exposed to Libby asbestos; current exposures to people living with current workers pose no public health hazard.
- No available evidence suggests that waste piles were kept onsite or that community members accessed the site and were exposed to them in the past; however, additional information is necessary to confirm these data. In the past, waste piles at the site posed an indeterminate public health hazard.
- No available evidence indicates any waste piles or materials currently onsite, so waste piles do not currently pose a public health hazard.
- The only asbestos that might still remain on the site would be buried in on-site landfills. Future construction or excavation activities at the site may disturb these soils containing Libby asbestos. However, site conditions currently pose no public health hazard.
- Insufficient data are available to determine whether ambient or fugitive dust emissions from the plant were significant enough to expose neighboring homes to Libby asbestos; past ambient air exposures and residential indoor exposures pose an indeterminate public health hazard. Current ambient air exposures and residential indoor exposures are not a public health hazard.

- No evidence indicates that community members ever used vermiculite or waste materials in their yards or driveways; however, additional information is necessary to confirm this. We found no information that suggests it was a common practice to use waste rock from the facility. Residential outdoor exposures pose an indeterminate public health hazard, but exposure to waste rock at residences is unlikely.
- Health outcome data for the community around the site did not identify asbestos-related diseases at a higher rate than expected.

Recommendations

- Develop plans to ensure that adequate controls are in place to protect workers from asbestos exposure during excavation or disturbance of onsite soils.
- Promote awareness of past asbestos exposures among former workers and members of their households.
- Provide reliable, easily accessible, and understandable information concerning asbestos-related health issues to exposed individuals and concerned community members.
- Identify and contact residents who lived in the area during the period when the plant was exfoliating Libby vermiculite to confirm that waste material was not given to the community.

Public Health Action Plan

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

Actions Completed

- EPA completed a preliminary inspection report in March 2000.
- ATSDR completed a site visit in September 2002.
- The ATSDR Division of Health Studies, in cooperation with Ohio as a state partner, conducted a health statistics review for the Marysville area in April 2004.

Actions Ongoing

- ATSDR staff is researching unpublished information within the EPA database of W.R. Grace documents (estimated 3 million pages of information relating to Libby, Montana, and other nationwide vermiculite processing sites).

Actions Planned

- ATSDR will notify the current site owner and local permitting authorities that management plans should be developed to protect workers from asbestos exposure during excavation or disturbance of onsite soils.
- ATSDR will combine the findings from this health consultation with findings from

other sites nationwide that received Libby vermiculite to create a comprehensive report outlining overall conclusions and strategies for addressing public health implications.
- ATSDR, in cooperation with additional agencies, is researching and determining the feasibility of conducting worker and household contact follow-up activities.

Site Team

Author
Jennifer Freed, MPH
Environmental Health Scientist
Division of Health Assessment and Consultation

Author – Appendix D Health Statistics Review
Kevin Horton, MSPH
Epidemiologist
Division of Health Studies

Regional Representatives
Mark Johnson, PhD
Senior Regional Representative/Senior Toxicologist
Division of Regional Operations, Region 5

Michelle Colledge, MPH
Regional Representative/Environmental Health Specialist
Division of Regional Operations, Region 5

EPA Representative
Jim Augustyn
On-Scene Coordinator
U.S. Environmental Protection Agency, Region 5

Reviewers

Barbara Anderson, M.S., P.E.
Environmental Health Scientist
Exposure Investigations and Consultation Branch (EICB), DHAC, ATSDR

John Wheeler, Ph.D., DABT
Senior Toxicologist
Exposure Investigations and Consultation Branch (EICB), DHAC, ATSDR

Susan Moore, M.S.
Branch Chief
Exposure Investigations and Consultation Branch (EICB), DHAC, ATSDR

References

1. Agency for Toxic Substances and Disease Registry. Trip report for Marysville, Ohio. Atlanta, Georgia. September 25, 2002.
2. US Geological Survey. Bulletin 2192. Reconnaissance study of the geology of US vermiculite deposits—Are asbestos minerals common constituents? Denver: US Department of the Interior; 2002 May 7. Accessed on July 31, 2002 at URL: http://geology.cr.usgs.gov/pub/bulletins/b2192/ .
3. US Environmental Protection Agency. Region 5. Preliminary inspection report, The Scotts Company, Marysville, Ohio. Chicago, Illinois. March 7, 2000.
4. Ecology and Environment, Inc. Memo to Gail Nabasny, US EPA Region 5, concerning Ohio vermiculite sampling. December 13, 2000.
5. Science Applications International Corporation. Memo to Gary Daugherty, Scotts Company, regarding results of vermiculite sampling for asbestos at the Scotts Company, Marysville, Ohio, facility. June 29, 2000.
6. Ohio Environmental Protection Agency. Appendix A, of Application for a permit to operate an air contaminant source. Columbus, Ohio. August 22, 1983.
7. Bureau of the Census. 1990 census population. Washington, DC: US Department of Commerce, 1990.
8. Bureau of the Census. 2000 census population. Washington, DC: US Department of Commerce, 2000.
9. National Institute for Occupational Safety and Health. Site visit report 2002-0437. The Scotts Company, Marysville, Ohio. Washington, DC: US Department of Health and Human Services; 2003 Jul 25.
10. Agency for Toxic Substances and Disease Registry. Toxicological profile for asbestos (update). Atlanta: US Department of Health and Human Services; September 2001.
11. Midwest Research Institute. Collection, analysis, and characterization of vermiculite samples for fiber content and asbestos contamination: report prepared for the US Environmental Protection Agency Office of Pesticides and Toxic Substances. Kansas City, Missouri. September 1982.
12. US Environmental Protection Agency. Integrated risk information system (for asbestos). Accessed on July 31, 2002 at URL: http://www.epa.gov/iris/subst/0371.htm
13. Agency for Toxic Substances and Disease Registry. Report on the expert panel on health effects of asbestos and synthetic vitreous fibers: the influence of fiber length. Atlanta: US Department of Health and Human Services; 2003. Available at URL: http://www.atsdr/cdc.gov/HAC/asbestospanel/index.html.
14. Churg A. Asbestos-related disease in the workplace and the environment: controversial issues. In: Churg A, Katzenstein AA. The lung: current concepts (monographs in pathology, no. 36). Philadelphia: Lippincott, Williams, and Wilkins; 1993. p. 54–77.
15. Occupational Safety and Health Administration. Occupational exposure to asbestos. Federal Register 59:40964-41162, Aug 10, 1994; Federal Register 60:33973-34002, June 29, 1995.
16. Berman DW, Crump K. Methodology for conducting risk assessments at asbestos superfund sites. Part 2: Technical background document (interim version). Prepared for the US Environmental Protection Agency Region 9. San Francisco: February 15, 1999.

17. US Environmental Protection Agency. Guidelines for conducting the AHERA TEM clearance test to determine completion of an asbestos abatement project. Washington: Environmental Protection Agency, Office of Toxic Substances. EPA 560/5-89-001. NTIS No. PB90-171778.
18. US Environmental Protection Agency. Memorandum to Paul Peronard from Christopher Weis regarding amphibole mineral fibers in source materials in residential and commercial areas of Libby pose an imminent and substantial endangerment to public health. Denver, Colorado. December 20, 2001.
19. Environmental Protection Agency. Toxic air pollutants Web site. Accessed on October 29, 2002, at URL: http://www.epa.gov/air/toxicair/newtoxics.html
20. Agency for Toxic Substances and Disease Registry. World Trade Center response activities. Close-out report. September 11, 2001–April 30, 2003. May 16, 2003. Atlanta: US Department of Health and Human Services; 2003.
21. US Environmental Protection Agency. World Trade Center indoor environment assessment: selecting contaminants of potential concern and setting health-based benchmarks. New York: US Environmental Protection Agency, Region 2. May 2003.
22. National Institute of Occupational Safety and Health. Online pocket guide to chemical hazards. Accessed on July 16, 2002, at URL: http://www.cdc.gov/niosh/npg/npgd0000.html
23. American Conference of Government Industrial Hygienists. 2000 threshold limit values for chemical substances and physical agents and biological exposure indices. Cincinnati: American Conference of Government Industrial Hygienists; 2000.
24. US Environmental Protection Agency. National primary drinking water regulations. Accessed on July 16, 2002, at URL: http://www.epa.gov/safewater/mcl.html
25. Agency for Toxic Substances and Disease Registry. Health consultation on mortality in Libby, Montana. Atlanta: US Department of Health and Human Services. August, 2002.
26. Peipins LA, Lewin M, Campolucci S, Lybarger JA, Miller A, Middleton D, et al. Radiographic abnormalities and exposure to asbestos-contaminated vermiculite in the community of Libby, Montana, USA. Environ Health Perspect 2003;111(14)1753–9. doi:10.1289/ehp.6346. Available through URL: http://dx.doi.org/ or at URL: http://ehp.niehs.nih.gov/docs/2003/6346/abstract.html.
27. Occupational Safety and Health Administration. Industrial hygiene survey for OM Scott and Sons, Scottslawn Rd, Marysville, Ohio. Report number 06635-180. November 29, 1978 to January 19, 1979.
28. Lockey JE, Brooks SM, Jarabek AM, Khoury PR, McKay RT, Carson A, et al. Pulmonary changes after exposure to vermiculite contaminated with fibrous tremolite. Am Rev Respir Dis 1984;129(6):952–8.
29. Minnesota Pollution Control Agency. Memorandum to James Kelly, Minnesota Department of Health, from Gregory Pratt regarding modeled concentrations and deposition of tremolite near the Western Mineral Products/WR Grace facility. Minneapolis, Minnesota. June 12, 2001.
30. Minnesota Department of Health/Agency for Toxic Substances and Disease Registry. Health consultation for Western Mineral Products site (a/k/a Western Mineral Products), City of Minneapolis, Hennepin County, Minnesota. Atlanta: US Department of Health and Human Services; May 2001.

31. US Environmental Protection Agency. Sampling and analysis of consumer garden products that contain vermiculite. Seattle: US Environmental Protection Agency, Region 10. August 2000.
32. Agency for Toxic Substances and Disease Registry. Preliminary findings of Libby, Montana, asbestos medical testing. Accessed on October 29, 2002, at URL: http://www.atsdr.cdc.gov/asbestos/combined_testing.html

Appendix A
Maps

Figure 1: Site Location and 1990 Demographics

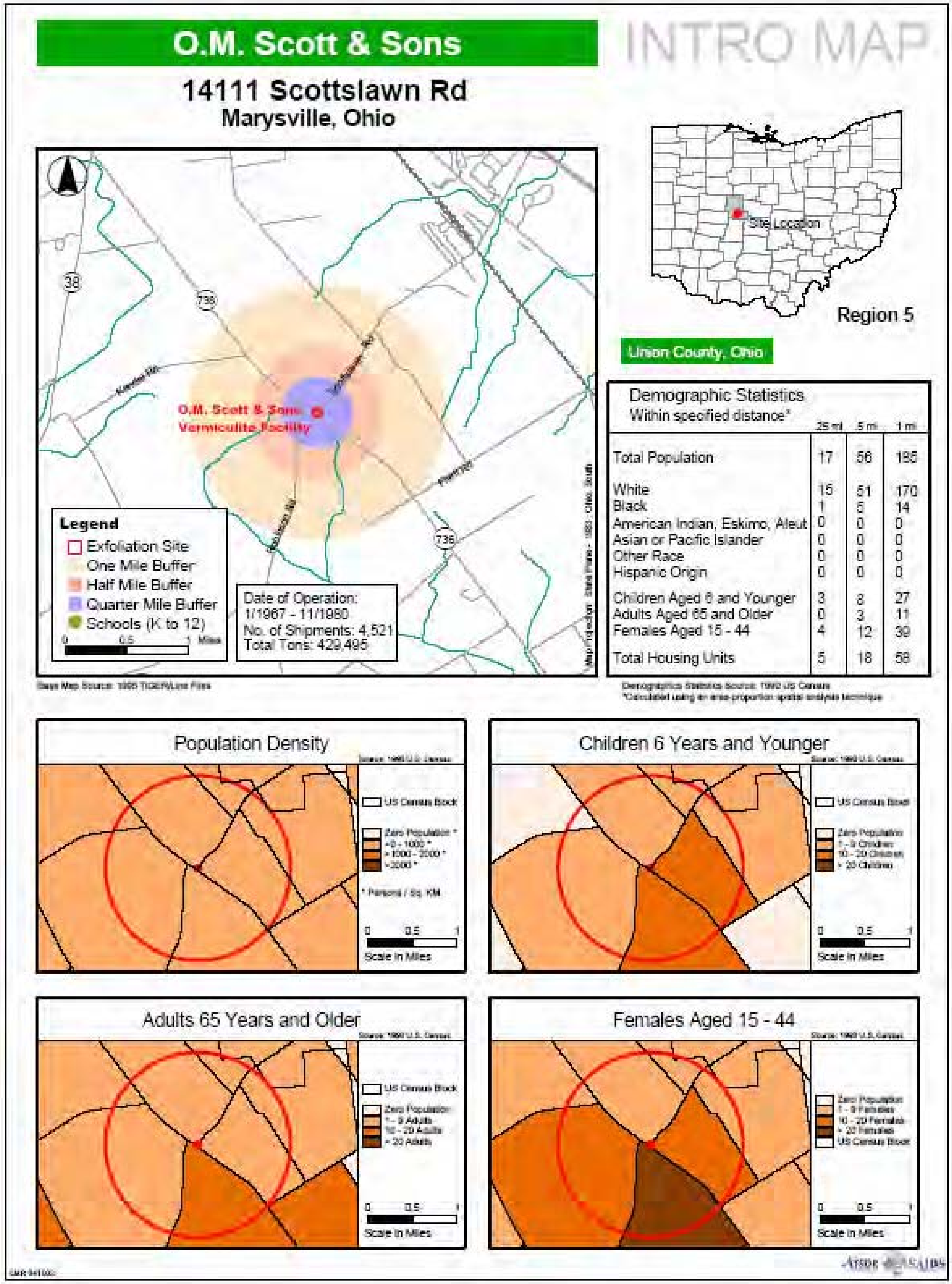


Figure 2: Area map showing property boundaries

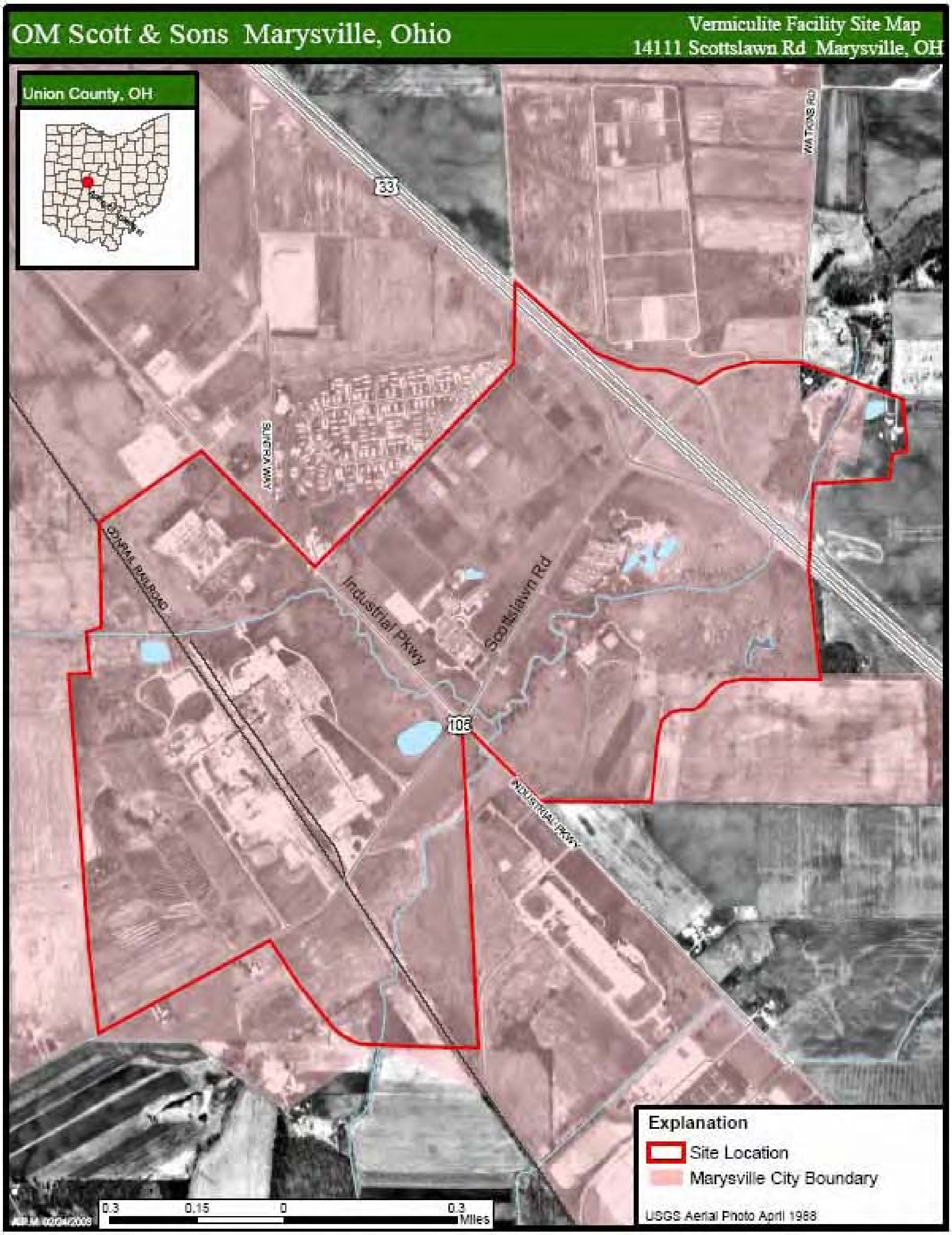
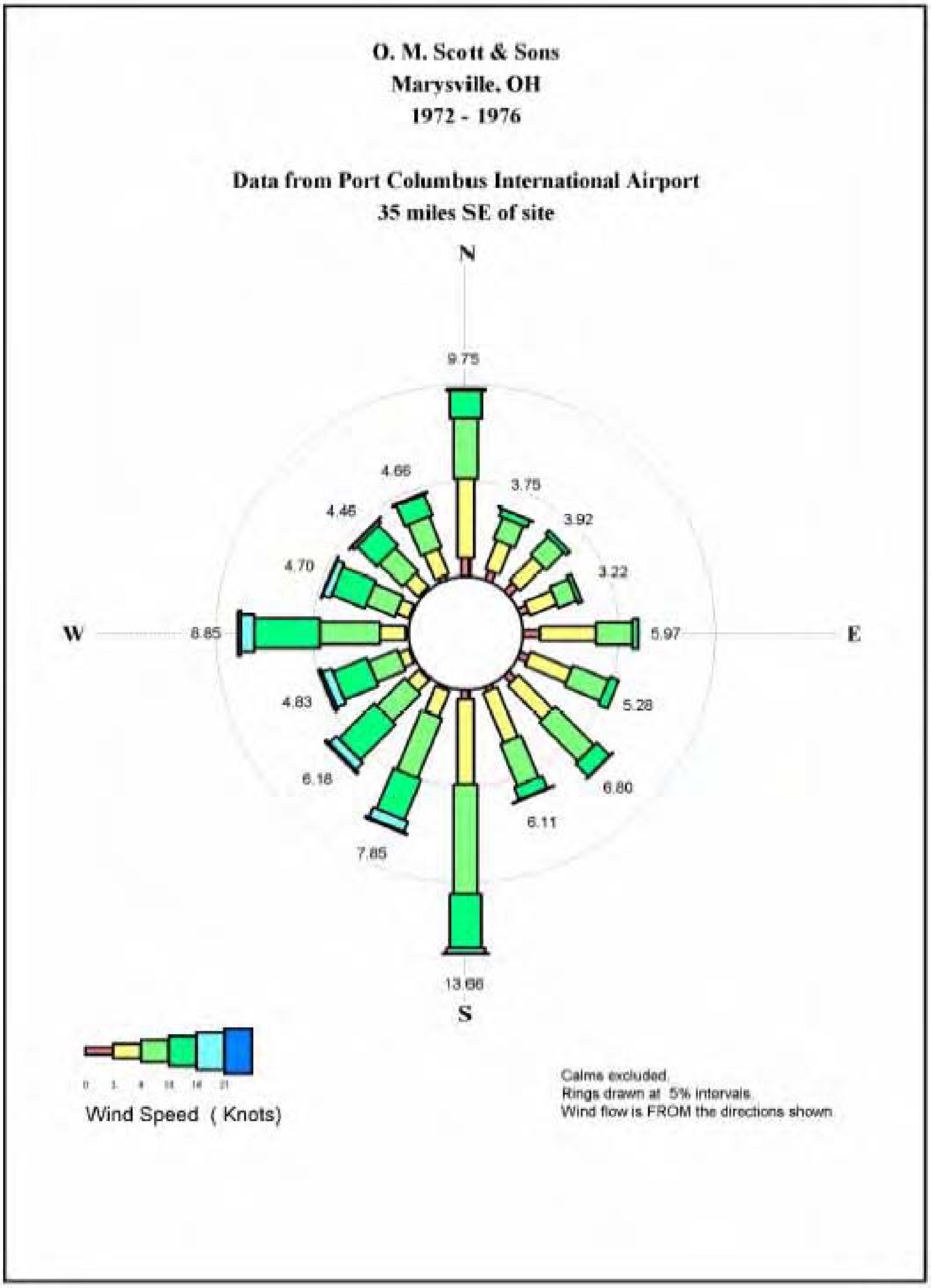


Figure 3: Wind Rose



Appendix B
Public Health Hazard Category Definitions

Hazard Category Definitions

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.

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.

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.

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.

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.

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.

Appendix C
Exposure Pathways

APPENDIX C. Exposure Pathways—Vermiculite Processing Facilities[1]

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

Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Time
Occupational	Suspension of Libby asbestos fibers or contaminated dust into air during materials transport and handling operations or during processing operations	On-site	Inhalation	Former and/or current workers	Past, present, future
Household Contact	Suspension of Libby asbestos fibers into air from dirty clothing of workers after work	Workers' homes	Inhalation	Former and/or current workers' families and other household contacts	Past, present, future
Waste Piles	Suspension of Libby asbestos fibers into air by playing in or otherwise disturbing piles of vermiculite or waste rock	On-site, at waste piles	Inhalation	Community members, particularly children	Past, present, future
Onsite Soils	Suspension of Libby asbestos fibers into air from disturbing contaminated material remaining in onsite soils (residual soil contamination, buried waste)	At areas of remaining contamination at or around the site	Inhalation	Current on-site workers, contractors, community members	Present, future
Ambient Air	Stack emissions and fugitive dust from plant operations into neighborhood air	Neighborhood around site	Inhalation	Community members, nearby workers	Past
Residential Outdoor	Suspension of Libby asbestos fibers into air by disturbing contaminated vermiculite brought offsite for personal uses (gardening, paving driveways, traction, fill)	Residential yards or driveways	Inhalation	Community members	Past, present, future
Residential Indoor	Suspension of household dust containing Libby asbestos fibers from plant emissions or residential outdoor waste	Residences	Inhalation	Community members	Past, present, future
Consumer Products	Suspension of Libby asbestos fibers into air from using or disturbing insulation or other consumer products containing Libby vermiculite.	At homes where Libby asbestos-contaminated products were/are present	Inhalation	Community members, contractors, and repairmen	Past, present, future

1 This table is a general review of exposure pathways at all vermiculite processing sites, not just for the former O.M. Scotts and Sons Company.

Appendix D
Health Statistics Review

Health Statistics Review for Populations Near the O.M. Scott and Sons Site in Marysville, Ohio*

Background

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

Methods

Only mortality data from death certificates were used for this analysis. Cancer registry data was not used in this analysis because the years of data requested by ATSDR (1986–1995) are not available from ODH (ODH has complete cancer registry data for the years 1992, 1996, 1997, 1998, 1999 and 2000). The target population/area for the mortality analysis consisted of people who died of potential asbestos-related diseases while residing within the city limits of Marysville (population 9,656 according to 1990 Census data). The city limits of Marysville were chosen because that area contains the O.M. Scott and Sons site located at 14111 Scottslawn Road, Marysville, OH 43040. Additionally, the city limits of Marysville were chosen because they represent the smallest geographic area surrounding the site that is electronically coded on Ohio death certificates.

∗ Provided to ATSDR Division of Health Assessment and Consultation by Kevin Horton, MSPH, ATSDR Division of Health Studies, April 2004.

The mortality analysis period of 1979–1998 was chosen because

1) it covered the most recent 20 years of mortality data available at the time the analysis began,
2) it corresponded to an approximate latency period in which initial exposure occurred and death would be expected, and
3) only one ICD revision is used.

This mortality analysis used 12 disease groupings (see Table). Of the 12 groupings, the three of greatest interest to ATSDR were the ones that have a known association with asbestos exposure. These three include asbestosis [ICD-9 501]; malignant neoplasm of peritoneum, retroperitoneum, and pleura [ICD-9 158, 163, which includes mesothelioma]; and malignant neoplasm of lung and bronchus [ICD-9 162.2–162.9]. The other nine disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the analysis areas.

Sex-specific, age-standardized mortality ratios (SMRs) were calculated for asbestos-related deaths. An SMR is a measure of whether the number of people who died from selected diseases in the Marysville target area is the same as, lower, or higher than the number of people we would expect to find if the occurrence of selected diseases in the Marysville target area was the same as the occurrence of selected diseases in a comparison population. The comparison population used in this analysis was for the rest of the country. This comparison population was national death certificate data received from the National Center for Health Statistics (5). If the number of people who died from selected diseases in this Marysville target area is the same as the number we would expect to find, the SMR will equal 1. If the number of citizens in this Marysville target area who died from selected diseases is less than one would expect, the SMR will be between 0 and 1. If the number of citizens in this Marysville target area who died from selected diseases is more than one would expect, the SMR will be greater than 1.

Ninety-five percent confidence intervals (95% CIs) were calculated to assess statistical significance (6). A confidence interval is a range of possible values for the SMR that are considered consistent with the normal variation in disease over time in a geographic area. The confidence interval consists of two numbers—the lower bound and the upper bound of the range of normal SMR values. If both the lower and upper bound numbers of the confidence interval are less than 1, then the conclusion of the statistical test is that a disease is occurring less frequently in the Marysville community than it is in the U.S. population. This is called a "statistically significant decrease" or a "statistically significant deficit." If the lower bound number is less than 1 and the upper bound number is greater than 1, then the conclusion of the statistical test is that a disease is occurring in the Marysville community at the same frequency as in the U.S. population (or cannot be distinguished from normal fluctuations using this statistical technique). This is called "not statistically significantly different"). Lastly, if both of the numbers in the confidence interval are higher than 1, then the conclusion of the statistical test is that a disease is occurring more frequently in the Marysville community than it is in the rest of the country. This is called a "statistically significant increase" or a "statistically significant excess."

Results

The Table below shows, for each disease group analyzed:

1) whether past studies have shown a link between asbestos exposure and that type of disease;
2) the number of people in the Marysville target area who developed the specified disease;
3) the number of people we would expect to develop the specified disease if the community had the same occurrence of disease as the rest of the country;
4) the SMR; and
5) the 95% confidence interval for the SMR.

For the period 1979–1998, seven of the 12 disease groupings in the Marysville target area had SMRs greater than 1; however, none of the SMRs were statistically significant and were within the normal range of what would be expected (Table). In the remaining five disease groupings, the SMRs were less than or equal to 1.

Discussion and Limitations

The main goal of conducting these HSRs is to help determine if communities near facilities that received Libby vermiculite have higher than expected occurrences of asbestos-related diseases. The SMR analysis suggests that the occurrence of known asbestos-related diseases (i.e., mesothelioma, asbestosis, lung cancer) in the Marysville target area do not appear to be significantly higher than expected compared with the rest of the country.

There are many limitations to using existing data sources to examine the relationship between environmental exposures and chronic diseases (a chronic disease is one that develops over a long period of time). Some of the major limitations in this analysis include, but are not limited to: exposure misclassification, population migration, lack of control for confounding factors (i.e., smoking status data), overstated numerators/under-estimated denominators, large study areas, and small numbers of deaths. Most of these limitations would make it less likely that this type of analysis would identify a higher than expected occurrence of asbestos-related deaths among people who lived near the O.M. Scott and Sons site in Marysville during its years of operation.

References

1. Dearwent S. Mortality in Libby, Montana, 1979–1998. Atlanta: Agency for Toxic Substances and Disease Registry, December 2000.
2. Lybarger J, Lewin M, Miller A, Kess S. Preliminary findings of medical testing of individuals potentially exposed to asbestoform minerals associated with vermiculite in Libby, Montana: an interim report for community health planning. Atlanta: Agency for Toxic Substances and Disease Registry, February 2001.
3. Lybarger J, Lewin M, Miller A, Kess S. Report to the community: medical testing of individuals potentially exposed to asbestoform minerals associated with vermiculite in Libby, Montana, from July through November, 2000. Atlanta: Agency for Toxic Substances and Disease Registry; August 2001.

4. Horton DK, Kaye WE. Health statistics review protocol for US communities that received asbestos-contaminated vermiculite from Libby, Montana. Atlanta: Agency for Toxic Substances and Disease Registry, April 2001.
5. Centers for Disease Control and Prevention. National Center for Health Statistics (unpublished data). Atlanta: Centers for Disease Control and Prevention; 2000.
6. Breslow NE, Day NE. Statistical methods in cancer research, Vol. II—The design and analysis of cohort studies. Oxford University Press, NY: International Agency for Research on Cancer, 1989.

Selected Disease	Past studies show a link to asbestos exposure?	Number of people who died	Expected number of deaths*	SMR†	95% Confidence Interval‡	
					Lower	Upper
Malignant neoplasm of selective digestive organs (ICD-9 150-154, 159)	Weak link	67	66.8	1.0	0.8	1.3
Malignant neoplasm of respiratory system and intrathoracic organs (ICD-9 161-165)	Yes	107	101.6	1.0	0.9	1.3
Malignant neoplasm of lung and bronchus§ (ICD-9 162.2-162.9)	Yes	106	98.1	1.1	0.9	1.3
Malignant neoplasm of peritoneum, retroperitoneum, and pleura (includes mesothelioma)§ (ICD-9 158, 163)	Yes	0	0.8	0.0	0.0	0.0
Malignant neoplasm without specification of site (ICD-9 199)	No	30	25.0	1.2	0.8	1.7
Diseases of pulmonary circulation (ICD-9 415-417)	No	15	10.1	1.5	0.8	2.5
Chronic obstructive pulmonary disease (ICD-9 490-496)	No	68	69.6	1.0	0.8	1.2
Asbestosis§ (ICD-9 501)	Yes	0	0.2	0.0	0.0	0.0
Other diseases of respiratory system (ICD-9 510-519)	No	17	13.3	1.3	0.7	2.0
All malignant neoplasms (ICD-9 140-208)	No	424	383.7	1.1	1.0	1.2
Malignant neoplasm of female breast (ICD-9 174)	No	39	34.6	1.1	0.8	1.5
Malignant neoplasm of prostate (ICD-9 185)	No	28	24.1	1.2	0.8	1.7

Table: Mortality Data Findings for Residents of Marysville, Ohio, Who Died From Selected Diseases and Lived Near the O.M. Scott and Sons Site, 1979–1998

* Calculated using mortality data received from the National Center for Health Statistics (unpublished data) (5).
† The *standardized mortality ratio* (SMR) equals the number of people who died divided by the expected number of deaths.
‡ The 95% CIs were calculated to assess statistical significance using Byar's approximation (6).
§ Have known associations with asbestos exposure. The other disease groupings analyzed were reported in the literature as having weaker associations with asbestos exposure or were ones that were included to evaluate reporting/coding anomalies in the target area.