Health Consultation

ADROW CHEMICAL COMPANY SITE

WANAQUE, PASSAIC COUNTY, NEW JERSEY

EPA FACILITY ID: NJD982717092

SEPTEMBER 30, 2006

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.

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HEALTH CONSULTATION

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EPA FACILITY ID: NJD982717092

Prepared by:

New Jersey Department of Health and Senior Services
Public Health Services Branch
Consumer and Environmental Health Services
Hazardous Site Health Evaluation Program

Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary

At the request of the New Jersey Department of Environmental Protection (NJDEP), the New Jersey Department of Health and Senior Services (NJDHSS), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared a health consultation for the former Adrow Chemical Company, Wanaque Borough, Passaic County, New Jersey. This health consultation was performed to evaluate whether concentrations of mercury in indoor air within the former Adrow Chemical Company building would pose a public health threat to future building occupants.

The Adrow Chemical Company operated at the site from 1963 to 2000. Subsequent to plant closure, on-site areas of concern were identified and were remediated with oversight by the NJDEP. However, elevated concentrations of mercury were detected in indoor air due to the residual contamination present in building interior. Since remediation of non-environmental media (i.e., building interior surfaces) does not fall under the jurisdiction of NJDEP regulations, the contamination remaining within the building interior was referred to the NJDHSS.

Following an initial request by NJDEP in July 2004, NJDHSS evaluated the building interior contamination and sent a letter dated February 2, 2005 to the property owner citing concerns over measures previously conducted in an attempt to reduce mercury concentrations in indoor air within the building. Further attempts to address the mercury contamination within the building were conducted by the property owner in September and November 2005 as cited in a letter report forwarded to the NJDHSS dated February 9, 2006.

Remedial actions conducted for the building interior through November 2005 have not been adequate to demonstrate successful remediation of mercury vapor concentrations to levels fully protective of public health. Although concentrations of mercury in indoor air were significantly lower for the December 2005 sample data following the application of a sealant (AFM Safecoat Hardseal®) to the building interior, they remained above the chronic ATSDR Minimal Risk Level (MRL). In addition, this sealant is not approved for use as an emission control barrier for concrete surfaces or mercury contaminated surfaces as per the sealant manufacturer (see Appendix A). Therefore, the application of the sealant to control mercury emissions from contaminated concrete surfaces and other building interior components is not considered an appropriate control nor is it considered a permanent remedy.

Indoor air concentrations ranging from 0.7 to 41 micrograms per cubic meter ($\mu g/m^3$) have been demonstrated to significantly exceed the ATSDR MRL of 0.2 $\mu g/m^3$ for chronic exposures to mercury. In a specific situation, the ATSDR Division of Toxicology has developed a residential re-occupancy level of $\leq$1.0 $\mu g/m^3$ and a commercial re-occupancy level of 3.0 $\mu g/m^3$, provided no metallic mercury is present. The ATSDR considers these levels to be safe and acceptable exposure levels. However, remedial actions conducted at the site are not considered a proven technology or a

remedy to permanently reduce mercury concentrations in indoor air to levels $\leq$1.0 µg/m^3 or $\leq$3.0 µg/m^3. Additionally, a portion of the basement crawl space area has not been investigated during any phase of remedial activities conducted at the site; therefore, there is a potential for metallic mercury contamination to be present in this area. As such, there is a potential inhalation exposure pathway for future occupants at the site due to 1) mercury levels exceeding both the chronic MRL and the ATSDR recommended re-occupancy levels; 2) the failure to use proven technology as a permanent remedial measure; and 3) the lack of continued air monitoring at the site. Therefore, the ATSDR and NJDHSS categorize the building interior for the Adrow Chemical Company site as a ***Public Health Hazard*** to future building occupants.

There is a potential for exposure to mercury through ambient air in the vicinity of the building, since monitoring to date has not been sufficient to show that levels are below the ATSDR chronic MRL, the inhalation exposure limit as recommended by the NJDHSS. Since there are residential properties in close proximity to the building and there is unrestricted access to the property area, the potential exists for adults and children to inhale ambient air with mercury concentrations exceeding the NJDHSS recommended chronic inhalation exposure limit. The extent of this exposure would be dependent on the duration and frequency spent within proximity to the site where the concentration of mercury may exceed the chronic MRL. Since there is an insufficient amount of data to characterize ambient air mercury concentrations, the extent of exposure for individuals at adjacent properties and in the vicinity of the site perimeter cannot be fully determined. As such, the ATSDR and NJDHSS categorize inhalation exposure at adjacent residential properties and in ambient air in immediate proximity to the former Adrow Chemical Company site as an ***Indeterminate Public Health Hazard***.

NJDHSS and ATSDR recommend restricting access to the building interior and the site perimeter until there is a permanent reduction of mercury in indoor air to be protective of public health. The agencies further recommend restricting access to the site perimeter.

NJDHSS and ATSDR also recommend additional investigation of the basement area to verify there is no remaining contamination present and acting as a contributing source of mercury concentrations in indoor and ambient air, investigation of a potential venting system in the basement crawl space, and the preparation of a Health and Safety Plan including utilization of personal protective measures for individuals accessing the building interior.

The NJDHSS is available to review and evaluate future data in order that the ***Indeterminate Public Health Hazard*** category can be reevaluated and to evaluate remedial actions performed by the property owner regarding remediation of the mercury contamination remaining within the building interior.

Statement of Issues

The New Jersey Department of Environmental Protection (NJDEP) requested assistance from the New Jersey Department of Health and Senior Services (NJDHSS) to determine whether mercury concentrations detected in indoor air of a building formerly used to conduct mercury refining operations by the former Adrow Chemical Company, located in Wanaque Borough, Passaic County, New Jersey, would be a public health concern to future building occupants. Past operations conducted by Adrow Chemical Company had contaminated the building interior with mercury, causing elevated concentrations of mercury in indoor air.

Since remediation of non-environmental media (i.e., building interior surfaces) does not fall under the jurisdiction of NJDEP regulations, the contamination remaining within the building interior was referred to the NJDHSS by NJDEP. Following an initial request by NJDEP in July 2004, NJDHSS evaluated the building interior contamination and sent a letter dated February 2, 2005 to the property owner citing concerns over measures previously conducted in an attempt to reduce mercury concentrations in indoor air within the building. Further attempts to address the mercury contamination within the building were conducted by the property owner in September and November 2005 which have been evaluated by the NJDHSS in this report.

Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the NJDHSS reviewed environmental data available for the site and prepared the following health consultation to determine if there are public health implications associated with indoor air exposures to mercury to potential future building occupants. An additional component addressing exposure to mercury in ambient air by residents in close proximity to the site has also been completed and is presented in this report.

Figure 1: Location of Adrow Chemical Company

Background

Adrow Chemical Company is located at 2 Lines Avenue, Wanaque Borough, Passaic County, New Jersey. The site is situated on a 0.5-acre lot with industrial, commercial and residential structures in the immediate vicinity.

Refining and purifying mercury operations at Adrow Chemical Company began in 1963. The company was also listed as a mercury recycling center by the Ohio Environmental Protection Agency (OSPPERA 2002). Chemicals used in the mercury refining process included nitric acid, ammonia and alcohols. Hazardous waste generated from the mercury refining process included nitric acid and mercurous nitrate. Adrow Chemical Company operations ceased in

June 2000. No other commercial operations have been conducted and the building remains vacant at the time of the preparation of this report (NJDEP 2005).

Remedial Activities

In 2001, due to cessation of operations of Adrow Chemical Company, a Preliminary Assessment/Site Investigation was conducted by the property owner as required under the Industrial Site Recovery Act (ISRA) regulations (N.J.A.C. 7:26B) (NJDEP 2003). This investigation revealed several areas of concern at the site including soil and groundwater contamination. Concerning the building interior, mercury contamination was confirmed in indoor air, building surfaces and in soils below the building.

Remedial investigation to identify the source of mercury contamination in the building interior was conducted. The building is comprised of the main floor (small office and three facility operation rooms), a bathroom, and a basement/crawl space (see Figure 2). The facility operation rooms are noted as: Rooms 1 (distillation room); 2 (finished product room); and 3 (main production room/laboratory). Mercury beads and puddles were observed within and below the floorboards in Rooms 1 and 2. Based on this discovery, the wood floors for Rooms 1 and 2 were removed. Samples collected from underlying soils indicated the presence of mercury contamination. Mercury impacted soils located beneath Rooms 1 and 2 were removed to levels below the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC). The wood floors were also disposed off-site. This area of concern was reviewed and approved by NJDEP for no further remedial action.

Soils below Room 3 could not to be evaluated due to the thick concrete floor (estimated to be approximately four feet); however, surface wipe sample results revealed the concrete floor of Room 3 was contaminated with mercury.

Additionally, indoor air samples collected from the building during investigation activities indicated mercury contamination. In the fall of 2002, building components (sheetrock walls, ceiling, and insulation) were removed and disposed off-site in an unsuccessful effort to remediate mercury concentrations in indoor air.

On July 27, 2005, the NJDEP issued a No Further Action (NFA) and Covenant Not to Sue letter to the property owner for the entire property (NJDEP 2005). This NFA has been issued indicating the soil and ground water contamination has been sufficiently addressed in accordance with NJDEP regulations. However, the contamination of the building interior and indoor air with respect to the protectiveness of future occupants has been referred to the NJDHSS for further evaluation.

At the time this health consultation was prepared, at the recommendation of the NJDHSS, the Wanaque Health Department has not issued a certificate of occupancy for the building (NJDEP 2005).

Site Visit

On April 26, 2006, a site visit was conducted at the former Adrow Chemical Company site. NJDHSS representatives were Glenn Pulliam, Tariq Ahmed and Gary Centifonti. Also present were representatives of the Wanaque Health Department, Viron Consulting Group, LLC (Viron) and the property owner.

The property consists of a wood framed structure on top of a concrete slab (partial) and block foundation. Site access is unrestricted to the building exterior as there is no perimeter fence. The building is approximately 60 feet by 25 feet. The interior plan for the main floor has changed; the three former facility operation rooms have been combined into one large room. Representatives from Viron indicated that in mid-2005 new sheetrock was installed on the walls and ceiling in the main floor area. In addition, vent ducts above the ceiling were replaced. After the installation of the new building materials, the interior walls, ceiling and floors were coated with a sealant (AFM Safecoat Hardseal®) and the floor joint spaces were caulked in attempt to control indoor mercury emissions from known (concrete floor area) and potential unknown sources of contamination. Following the application of the sealant, vinyl floor tiles and carpeting were installed. The building interior and exterior areas noted the areas to be visibly clean. The area above the ceiling was not inspected.

The basement/crawl space area was inspected and was found to interconnect to the basement area below the adjoining commercial building to the east. The crawl space portion of the basement lies below the former Rooms 1 and 2, the office area and the bathroom (See Figure 2). According to follow-up conversations with Viron and NJDEP, soil in the crawl space below the office area and the bathroom were not evaluated during past remedial investigations. Additionally, there is a PVC pipe in the crawl space area extending into the former soil excavation area below former Rooms 1 and 2. This pipe was observed to vent to the roof. The function of this vent pipe is uncertain.

The immediate surrounding area consists of commercial and residential mixed use. The nearest residential property boundaries are within 15 feet to the north and south and approximately 50 feet to the west of the building. There was visible evidence that children are present and play in the backyard at the adjacent property to the south.

Demographics

Using the 2000 United States Census data, the ATSDR estimates that approximately 3,950 people live within a one-mile radius of the site (see Figure 3).

Environmental Contamination

An evaluation of site-related environmental contamination consists of a two tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures. First, maximum concentrations of detected

substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COC), are selected for further evaluation. Contaminant levels above environmental guideline CVs do not mean that adverse health effects are likely, but that a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for the screening environmental contaminants to identify COCs. These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media.

Substances exceeding applicable environmental guideline CVs were identified as COCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations.

Building Interior Contamination

In early 2003, floor wipe sample results conducted in Room 3 confirmed the presence of mercury contamination. To address the mercury contamination of the concrete floor, the top ¼ inch of floor surface was removed (scarification). Scarification is a process in which the top layer of a surface is removed by a scraping or abrasion process. Post-scarification floor wipe samples showed mercury at concentrations of 49 to 5,400 µg/wipe indicating the concrete floor remained contaminated.

Following scarification, an epoxy coating was applied on the concrete floor surface as a barrier in an attempt to prevent the volatilization of mercury remaining within the floor. However, indoor air sampling conducted in September 2004 and June 2005 indicated elevated concentrations of mercury. Post-coating sample results indicated that remedial measures implemented were unsuccessful in abating mercury contamination within the building. Results of the indoor air sampling events are provided in the following section.

As detailed in the site visit description, following the June 2005 indoor air sampling event, a second attempt to abate indoor air mercury concentrations was

performed with the application of AFM Safecoat Hardseal® to the floors, walls and ceiling of the building interior during September and November 2005. Analytical results of follow-up indoor air sampling conducted in December 2005 indicate that mercury concentrations in indoor air were less than 1 µg/m^3. NJDHSS contacted the manufacturer of AFM Safecoat Hardseal® and was informed that the application of this sealant is not recommended for concrete and makes no claim to the ability of the product to seal and prevent mercury emissions from contaminated surfaces (see Appendix A).

Indoor Air Sampling

In April 2004, indoor air sampling was conducted following the application of the epoxy coating on the concrete floor in Room 3. The concentrations ranged from 3.11 to 3.56 micrograms per cubic meter (µg/m^3); however, the sample collection methodology and analytical method for this sampling event could not be confirmed. Therefore, results for this sampling event were excluded from this evaluation. Subsequently in May 2004, indoor air concentrations of mercury were measured using a Jerome 431-X mercury vapor analyzer; the concentration ranged from 11 to 22 µg/m^3. The Jerome 431-X analyzer is used as a screening instrument for detecting the presence of mercury vapors and does not meet quality assurance/quality control requirements of approved laboratory methods (i.e. NIOSH 6009 laboratory analytical method for mercury air sample analysis); therefore, this data is presented for reference only and was not used in this evaluation (NJDEP 1994).

Concentrations of mercury in indoor air were measured again in September 2004 and June 2005 using NIOSH Method 6009 at various locations within the building. Concentrations ranged from 13.4 to 41 µg/m^3 which also exceeded the ATSDR Environmental Media Evaluation Guide of 0.2 µg/m^3 (see Table 1). In addition, concentrations of mercury in indoor air were measured in December 2005 following the application of the AFM Safecoat Hardseal®.

Table 1
Summary of Indoor Air Mercury Concentrations
September 2004 through December 2005

Contaminant	Sample Date	Number of Samples	Concentration Detected - (µg/m^3)			EMEG (µg/m^3)
			Minimum	Maximum	Average	
Mercury	September 2004	4	**13**	**22**	**19**	0.2
	June 2005	4	**22**	**41**	**30**	
	December 2005	3	**0.7**	**0.8**	**0.73**	

EMEG – Environmental Media Evaluation Guide (ATSDR 2005)
Bold values indicate exceedence of EMEG value

Ambient Air Sampling

Two ambient air samples were collected in June 2005 and December 2005 using NIOSH Method 6009 at a location near the south wall of the building (estimated to be about 20 feet from the building). Concentrations ranged from less than 0.4 to less than 0.7 µg/m^3. However, detection limits for these samples exceeded the ATSDR EMEG of 0.2 µg/m^3 (see Table 2). There are no data on indoor air in adjacent buildings.

Table 2
Summary of Ambient Air Mercury Concentrations
Sample Data: June 2005 & December 2005

Contaminant	Sample Date	Number of Samples	Concentration Detected (µg/m^3)	EMEG (µg/m^3)
Mercury	June 2005	1	**<0.4**	0.2
	September 2005	1	**<0.7**	

EMEG – Environmental Media Evaluation Guide (ATSDR 2005)
"<" indicates the sample results is less than the laboratory practical quantitation limit; the laboratory detection limit was not reported.
Bold values indicate exceedence of EMEG value

Contaminant of Concern

The contaminant of concern for the Adrow Chemical Company site is mercury. A toxicological summary for mercury is provided in Appendix B.

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern. Site-specific exposure doses can be calculated and compared with health guideline CVs.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;

4. route of exposure; and
5. receptor population.

Generally, the ATSDR considers three exposure pathway categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

The evaluated exposure pathways for site-related contaminants are presented in Table 3.

Potential Exposure Pathways

There is a potential future exposure pathway for inhalation of mercury to adults and children (depending on potential future use of the building as residential or non-residential) occupying the Adrow Chemical Company site. The pathway involves release of mercury from source(s) into the indoor air where people will inhale mercury and become exposed.

There is also a potential exposure pathway for inhalation of mercury vapor to adults and children who either live at the adjacent residential properties or are within close proximity to the site. To date, test results for ambient air have not been sufficiently sensitive to demonstrate whether mercury levels are below the ATSDR MRL. This pathway may involve the release of mercury from the building interior to ambient air through passive ventilation, where people may inhale mercury and become exposed.

Public Health Implications

Once it has been determined that individuals could come in contact with site-related contaminants (i.e., a completed or potential exposure pathway), the next step in the public health assessment process is the calculation of site-specific exposure doses. This is called a health guideline comparison which involves looking more closely at site-specific exposure conditions, the estimation of exposure doses, and the evaluation with health guideline CVs. Health guideline CVs are based on data drawn from the epidemiologic and toxicologic literature and typically include uncertainty or safety factors to ensure that they are amply protective of human health.

Non-Cancer Health Effects

To assess non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects.

MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15-364 days); and chronic (365 days or more). MRLs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies, and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, observed effect levels include:

- no-observed-adverse-effect level (NOAEL); and
- lowest-observed-adverse-effect level (LOAEL).

A NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or in experimental animals. A LOAEL is the lowest dose of a substance that has been reported to cause harmful (adverse) health effects in people or in experimental animals. In order to provide additional perspective on the potential for adverse health effects, calculated exposure doses may also be compared to the NOAEL or LOAEL. As the exposure dose increases beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

The MRL for mercury for chronic inhalation exposure is 0.2 $\mu g/m^3$ which is equal to the EMEG provided in the preceding section.

Inhalation - Indoor Air

All post-remedial indoor air sample results exceeded the MRL (see Table 1). The maximum concentration of mercury detected in the indoor air was 41 $\mu g/m^3$ which is approximately 200 times higher than the chronic inhalation MRL of 0.2 $\mu g/m^3$.

This MRL was derived from a LOAEL reported in a 1983 study that confirmed a neurological effect (increased frequency of tremors) based on the findings of 26 male workers exposed to mercury vapor during the work-day at a concentration of 26 ± 4 $\mu g/m^3$ for an average duration of approximately 15 years (Fawer et al. 1983). Since this LOAEL is based on a worker exposure of 40 hours per week, it was adjusted to represent a continuous exposure of 6 $\mu g/m^3$ then divided by an uncertainty factor of 30 for sensitive populations to establish the chronic inhalation MRL. The uncertainty factor is used to account for human variability including sensitive subgroups. Although this MRL was derived based on an adult working population, it is considered sufficiently protective of the most sensitive subgroups for this health endpoint, specifically neurodevelopmental effects in developing embryos/fetuses and children.

An additional study conducted in 1991 established a LOAEL based on occupational exposure to an average mercury concentration in air of 76 $\mu g/m^3$ (Ehrenberg et al. 1991). The LOAEL for this study was identified as difficulty with heel-to-toe gait in exposed individuals. This LOAEL is assumed for an average exposure of 40 hours per week; therefore, when adjusted for a continuous exposure, the LOAEL is approximately 18 $\mu g/m^3$.

The average concentration of mercury in indoor air at the site based on September 2004 and June 2005 concentrations was approximately 24 µg/m^3; future building occupants chronically exposed at this concentration could experience neurological adverse health effects. Concentrations of mercury in indoor air measured in December 2005 following the application of the AFM Safecoat Hardseal® were lower; however, they remained above the chronic MRL. Since this sealant is not approved for use as an emission control barrier for concrete surfaces or for mercury contamination, as per the sealant manufacturer (see Appendix A), there is no assurance that there will not be future emissions of mercury into the indoor air of the building, at concentrations creating a risk for neurological adverse health effects to develop under chronic exposure conditions. Additionally, a portion of the basement crawl space has not been investigated; therefore, there is a potential for metallic mercury to be present in this area, creating a source for mercury vapors in the building interior.

The NJDHSS recommends that the ATSDR MRL of 0.2 µg/m^3 should be used as re-occupancy level for unrestricted building use, particularly if children may be present. In a specific situation, the ATSDR Division of Toxicology has developed a residential re-occupancy level of $\leq$1.0 µg/m^3 and a commercial re-occupancy level of 3.0 µg/m^3, provided no metallic mercury is present. The ATSDR consider these levels to be safe and acceptable exposure levels. The residential re-occupancy level was established in considering remedial actions which would create a disruptive environment to occupants and family quality of life.

Inhalation – Ambient Air

The post-remedial maximum concentration of mercury detected in ambient air within the property boundary was estimated to be less than 0.7 µg/m^3, but the method was not sufficiently sensitive to show that the concentration did not exceed the chronic inhalation MRL of 0.2 µg/m^3 which is the exposure inhalation limit recommended by NJDHSS. It is possible that mercury may be emitted from the building interior to the ambient air. Since residential properties are in close proximity to the building and there is unrestricted access to the property area, the potential exists for adults and children to inhale ambient air with mercury concentrations exceeding the chronic MRL. The extent of potential exposure to an individual through the ambient air pathway cannot be determined at this time, since ambient air levels have not been adequately characterized and the frequency and duration of time spent by nearby residents in the vicinity of the building is not known. However, exposure through this pathway would likely be low, if existing data are representative of site conditions. In addition, since there is no data from indoor air of adjacent buildings, the potential for exposure to mercury in these locations cannot be evaluated.

Children's Health Considerations

ATSDR's recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they eat and breathe more than adults. They also play outdoors and often bring food into contaminated areas. They are shorter than adults, which means they breathe dust, soil, and heavy vapors closer to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most important, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. Additionally, since inhalation exposure to mercury is known to readily enter the bloodstream, there are valid concerns regarding fetal development in pregnant women.

Children do not have access to the building interior as the building is secured by locked doors and windows. However, there is unrestricted access to the property by children; should mercury vapors be present, exposure to children could occur if they are in the vicinity of the site perimeter. It is also evident that children frequent the backyard area of the adjacent property to the south which is in close proximity of the site perimeter. The extent of exposure to children would likely be low, and would vary based on frequency and duration of time spent in close proximity to the site perimeter.

Conclusions

The Adrow Chemical Company operated at the site from 1963 to 2000. Subsequent to plant closure, on-site areas of concern were identified and were remediated with oversight by the NJDEP. However, elevated concentrations of mercury were detected in indoor air due to the residual contamination present in the building interior. Since remediation of non-environmental media (i.e. building interior surfaces) does not fall under the jurisdiction of NJDEP regulations, the contamination remaining within the building interior was referred by NJDEP to the NJDHSS.

Remedial actions conducted for the building interior through November 2005 have not been adequate to demonstrate successful remediation of mercury vapor concentrations to levels fully protective of public health. Although concentrations of mercury in indoor air were significantly lower for the December 2005 sample data following the application of the AFM Safecoat Hardseal®, they remained above the chronic inhalation MRL of 0.2 $\mu g/m^3$ which is the exposure inhalation limit recommended by NJDHSS. In addition, this sealant is not approved for use as an emission control barrier for concrete surfaces or mercury contaminated surfaces as per the sealant manufacturer (see Appendix A). Therefore, the application of the sealant to control mercury emissions from contaminated concrete surfaces and other building interior components is not considered an appropriate control nor is it considered a permanent remedy.

Indoor air concentrations have been demonstrated to significantly exceed the ATSDR MRL of 0.2 $\mu g/m^3$ for chronic exposures to mercury. In a specific situation, the ATSDR Division of Toxicology has developed a residential re-occupancy level of $\leq$1.0 $\mu g/m^3$ and a commercial re-occupancy level of 3.0 $\mu g/m^3$, provided no metallic mercury is present. The ATSDR consider these levels to be safe and acceptable exposure levels. However, remedial actions conducted at the site are not considered a proven technology or a remedy to permanently reduce mercury concentrations in indoor air to levels $\leq$1.0 $\mu g/m^3$ or $\leq$3.0 $\mu g/m^3$. Additionally, since a portion of the basement crawl space area has not been investigated, there is a potential for metallic mercury to be present and acting as a source to indoor and ambient air. As such, there is a potential inhalation exposure pathway for future occupants at the site due to 1) mercury levels exceeding both the chronic MRL and the ATSDR recommended re-occupancy levels; 2) the failure to use proven technology as a permanent remedial measure; and 3) the lack of continued air monitoring at the site. Therefore, the ATSDR and NJDHSS categorize the building interior for the Adrow Chemical Company site as a ***Public Health Hazard*** to future building occupants.

There is a potential for exposure to mercury through ambient air in the vicinity of the building since monitoring to date has not been sufficient to show that levels are below the ATSDR chronic MRL, the inhalation exposure limit as recommended by the NJDHSS. Since there are residential properties in close proximity to the building and there is unrestricted access to the property area, the potential exists for adults and children to inhale ambient air with mercury concentrations exceeding the chronic MRL. The extent of this exposure is expected to be low, and would be dependent on the duration and frequency spent within proximity to the site. Since there is an insufficient amount of data to characterize ambient air mercury concentrations, the extent of exposure for individuals at adjacent properties and in the vicinity of the site perimeter cannot be fully determined. As such, the ATSDR and NJDHSS categorize inhalation exposure at adjacent residential properties and in ambient air in immediate proximity to the former Adrow Chemical Company site as an ***Indeterminate Public Health Hazard***.

Recommendations

1. Since the building interior remains contaminated, the owner should restrict access to the building until an effective permanent remedy is implemented. Additionally, since ambient air concentrations have not been shown to be below the NJDHSS recommended level of ≤ 0.2 µg/m^3 in close proximity to the building, measures should be taken by the owner to restrict access to all individuals at the property boundary.

2. A Health and Safety Plan should be prepared by the owner identifying the contamination remaining in the building and the appropriate personal protective measures to be utilized by individuals authorized to access the building, including appropriate respiratory protection. All authorized individuals should be trained and deemed medically fit to wear a respirator.

3. Remedial investigations should continue at the site until all sources contributing to the indoor air mercury contamination are identified so that a long-term permanent remedy may be implemented. This remedy would also address the issue of reducing mercury concentrations in ambient air to below the NJDHSS recommended level of ≤ 0.2 µg/m^3 on a permanent basis to prevent the potential for exposure to mercury vapors to nearby residents.

4. The basement area below the building should be evaluated to verify there is no remaining contamination present and acting as a contributing source of mercury concentrations in indoor and ambient air.

5. The purpose of the PVC piping in the crawl space should be investigated. If its purpose is determined to be for control of residual mercury vapors, written documentation should be provided to NJDEP and NJDHSS.

6. The remedial objectives outlined below should be the minimal remedial objectives required to be met regarding future re-occupancy of this building.

   Minimum Mercury Remediation Objectives

   The NJDHSS recommends against re-occupancy of this building until further remedial measures are implemented to abate the vapor concentrations as follows:

   1) The NJDHSS recommends reducing mercury vapors to ≤ 0.2 µg/m^3 within the building as the minimum remediation achievement goal if the property will be converted for residential use or as a child-occupied facility. The ATSDR has developed a residential re-occupancy level for mercury vapor of ≤ 1.0 ug/m^3, provided no metallic mercury is present, based on site-specific criteria. This re-occupancy level was established in considering remedial actions which would create a disruptive environment to occupants and family quality of life.

The ATSDR considers this residential re-occupancy level to be a safe and acceptable exposure level.

2) The ATSDR suggested occupancy level for commercial settings of $\leq$ 3.0 $\mu g/m^3$ for all building interiors should be the minimum remediation achievement goal for any non-residential (commercial or industrial) use. If the remediation goal is set for commercial settings, the NJDHSS recommends that institutional controls by the local municipality be put in place to prevent residential use of the building unless future remedial actions are performed to meet the NJDHSS recommended remediation goal of $\leq$ 0.2 $\mu g/m^3$.

3) The remedial measure or control implemented should be a permanent remedy to assure that mercury concentrations in indoor air will remain below the applicable residential or commercial occupancy level. Additionally, this remedy should require concentrations of mercury in ambient air to remain at the NJDHSS recommended level of $\leq$ 0.2 $\mu g/m^3$ on a permanent basis to prevent the potential for exposure to the chronic MRL to nearby residents.

4) Clearance monitoring should be performed monthly for one year following successful completion of remediation to ensure mercury vapor concentrations remain below the applicable residential or commercial occupancy level listed above prior to re-occupancy. Building interior and ambient air should be monitored for mercury at an appropriate frequency and length of time following re-occupancy of the building to ensure that mercury vapors remain below the applicable residential or commercial occupancy level (USEPA 1997).

Public Health Action Plan (PHAP)

The purpose of a PHAP 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 the NJDHSS and ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and NJDHSS are as follows:

Public Health Actions Taken

1. Available indoor air data and other relevant information pertaining to the Adrow Chemical Company site have been reviewed and evaluated to determine human exposure pathways and public health issues.

2. The NJDHSS has contacted American Formulating and Manufacturing, the manufacturer of AFM Safecoat Hardseal®, and obtained correspondence and

product information on the appropriate uses of this sealant. This information is provided in Appendix A.

3. The NJDHSS had responded to the property owner, via Viron Consulting Group, LLC (Viron), in a letter dated June 28, 2006 regarding remedial actions conducted at the property as per a Viron letter dated February 9, 2006. This response letter is provided as Appendix C.

4. The NJDHSS had responded to the property owner, via Viron, in a letter dated February 2, 2005 regarding remedial actions conducted at the property as per a Viron letter dated December 8, 2004. This response letter is provided as Appendix D.

Public Health Actions Planned

1. Copies of the health consultation will be provided to the property owners and the Wanaque Health Department.

2. The NJDHSS and the ATSDR will review and evaluate future air sample data when made available by the property owner and/or Wanaque Health Department. This information will be used for 1) the reevaluation of the ***Indeterminate Public Health Hazard*** category for present and future inhalation mercury exposures; and 2) offering guidance to the Wanaque Health Department of future air sampling results and/or remedial actions performed by the property owner regarding remediation of the mercury contamination remaining within the building interior.

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999. Toxicological profile for mercury, update. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry, "Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators," 2000.

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Ehrenberg RL, Vogt RL, Smith AB, et al. Effects of elemental mercury exposure at a thermometer plant. American Journal of Industrial Medicine, 1991; 19(4):495-507.

Letter prepared by American Formulating and Manufacturing to Gary Centifonti of New Jersey Department of Health and Senior Services regarding use of AFM Safecoat Hardseal®. April 19, 2006.

Letter report prepared by Viron Consulting Group, LLC. to Wanaque Board of Health regarding April 2004 air sampling results for mercury. June 4, 2004.

Letter prepared Christopher J. Chapman of Wanaque Board of Health to Thomas Voss of Viron Consulting Group, LLC. July 1, 2004.

Letter report prepared by Thomas Voss of Viron Consulting Group, LLC. to Gary Centifonti of New Jersey Department of Health and Senior Services regarding September 2004 air sampling results for mercury. December 8, 2004.

Letter report prepared by Viron Consulting Group, LLC. to New Jersey Department of Senior Services regarding June 2005/December 2005 air sampling results for mercury. February 9, 2006.

Memo from Pat Mastrincola, property owner of Adrow Chemical Company site, to Gary Centifonti, New Jersey Department of Health & Senior Services via facsimile, not dated.

Ngim, C.H.; Boey, B. W.; Jeyaratnam, J; Chronic Neurobehavioural Effects of Elemental Mercury in Dentists, British Journal of Industrial Medicine, 1992; 49:782-790.

[NJDEP] New Jersey Department of Environmental Protection. Field Analysis Manual. July 1994.

[NJDEP] New Jersey Department of Environmental Protection. Industrial Site Recovery Act (ISRA) regulations (N.J.A.C. 7:26B). February 24, 2003.

[NJDEP] New Jersey Department of Environmental Protection. Letter to Thomas Voss from Karen Lesto concerning comments on a July 2003 Remedial Investigation Report written by Viron Consulting Group, LLC regarding the Adrow Chemical Company site. Trenton, New Jersey. November 19, 2003.

[NJDEP] New Jersey Department of Environmental Protection. Letter to Thomas Voss from Stephen E. Maybury regarding No Further Action Approval for the Adrow Chemical Company site. Trenton, New Jersey. July 27, 2005.

[NJDHSS] New Jersey Department of Health and Senior Services. Letter to Thomas Voss of Viron Consulting Group, LLC from James A. Brownlee concerning re-occupancy issues for the Adrow Chemical Company site. Trenton, New Jersey. February 2, 2005.

[NJDHSS] New Jersey Department of Health and Senior Services. Letter to Thomas Voss of Viron Consulting Group, LLC from James A. Brownlee concerning remedial actions conducted at the Adrow Chemical Company site. Trenton, New Jersey. June 28, 2006.

[OSPPERA] Ohio Spill Prevention, Planning and Emergency Response Association. "Mercury Spill Response & Cleanup Document," 2002.

[USEPA] United States Environmental Protection Agency. Integrated Risk Information System, Mercury, elemental 1995. *http://www.epa.gov/IRIS/subst/0370.htm*

[USEPA] United States Environmental Protection Agency. Superfund Record of Decision: Grand Street Mercury. EPA ID: NJ0001327733. Hoboken, New Jersey. September 30, 1997.

[USEPA] United States Environmental Protection Agency – Region 5. "Mercury Response Guidebook," March 2001.

Preparers of Report:

Glenn Pulliam
Occupational Health Consultant II
New Jersey Department of Health and Senior Services
Hazardous Site Health Evaluation Program

Tariq Ahmed, P.E., Ph. D.
Research Scientist I
New Jersey Department of Health and Senior Services
Hazardous Site Health Evaluation Program

Steven M. Miller, M.S., Ph. D.
Environmental Scientist
New Jersey Department of Health and Senior Services
Hazardous Site Health Evaluation Program

ATSDR Regional Representatives:

Arthur Block
Senior Regional Representative
Office of Regional Operations, Region II

Leah T. Escobar, R.S.
Associate Regional Representative
Office of Regional Operations, Region II

ATSDR Technical Project Officer:

Gregory V. Ulirsch, M.S., Ph. D.
Technical Project Officer
Superfund Site Health Assessment Branch
Division of Health Assessment and Consultation

Any questions concerning this document should be directed to:

New Jersey Department of Health and Senior Services
Consumer and Environmental Health Services
Hazardous Site Health Evaluation Program
P.O. Box 369
Trenton, New Jersey 08625-0369

CERTIFICATION

The health consultation for the Adrow Chemical Company site, Wanaque, Passaic County, New Jersey was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was conducted by the cooperative agreement partner.

Gregory V. Ulirsch, M.S., Ph. D.
Technical Project Officer, CAT, CAPEB, DHAC
Agency for Toxic Substances and Disease Registry

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

Alan Yarbrough
Team Leader, CAT, CAPEB, DHAC
Agency for Toxic Substances and Disease Registry

Table 3

Adrow Chemical Company, Wanaque Borough, Passaic County, New Jersey

Evaluated Exposure Pathways

Medium	Exposure Pathway Elements			Pathway Classification
	Point of Exposure	Route of Exposure	Receptor Population	
Indoor Air	Building Interior	Inhalation	Adults	Present - Eliminated (1)
	Residences (Adjoining Properties)		Adults and Children	Present & Future - Potential
Ambient Air	Building Exterior	Inhalation	Adults and Children	Present & Future - Potential

(1) Pathway eliminated as building is unoccupied.

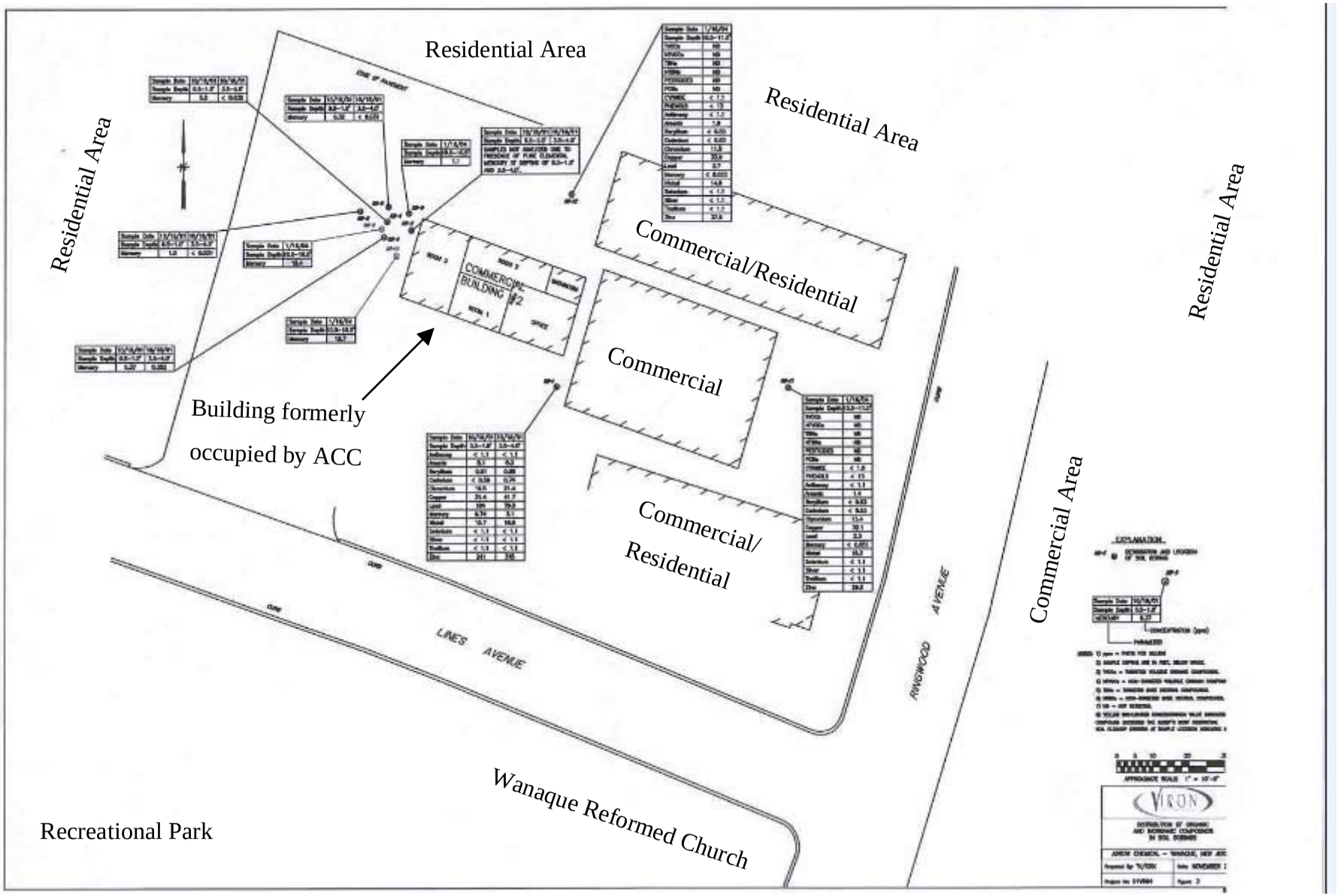


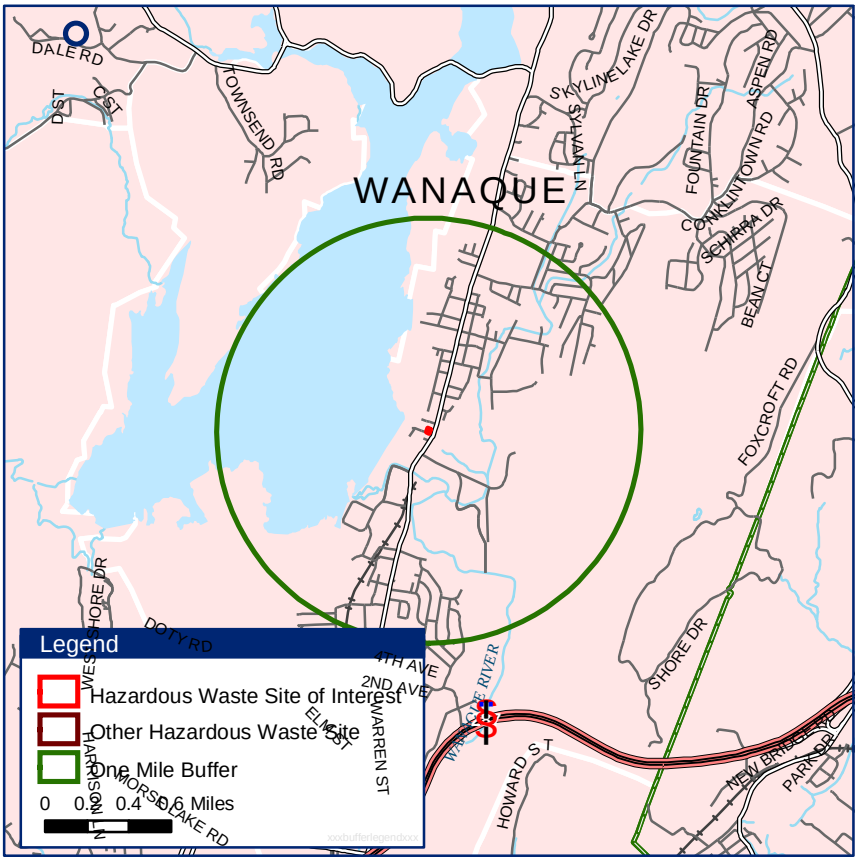
Figure 2: Location of building formerly occupied by Adrow Chemical Company (ACC).

Adrow Chemical Company, Inc.

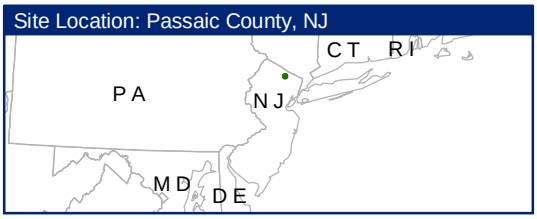
Wanaque, NJ

EPA Facility ID: NJD982717092

ATSDR CDC
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY



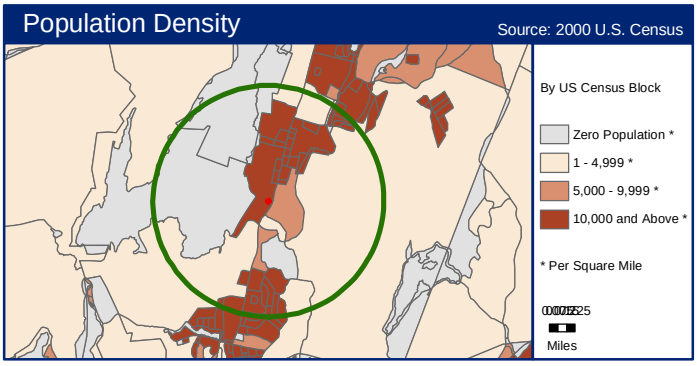
Base Map Source: Geographic Data Technology (DYNAMAP 2000), August 2002
Site Boundary Data Source: ATSDR Public Health GIS Program, August 2002
Coordinate System (All Panels): NAD 1983 StatePlane New Jersey FIPS 2900 Feet

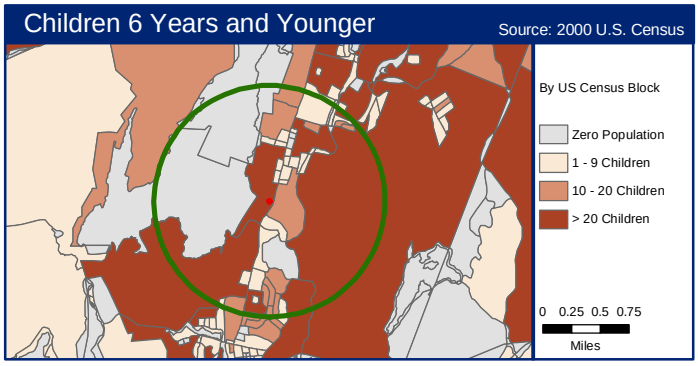


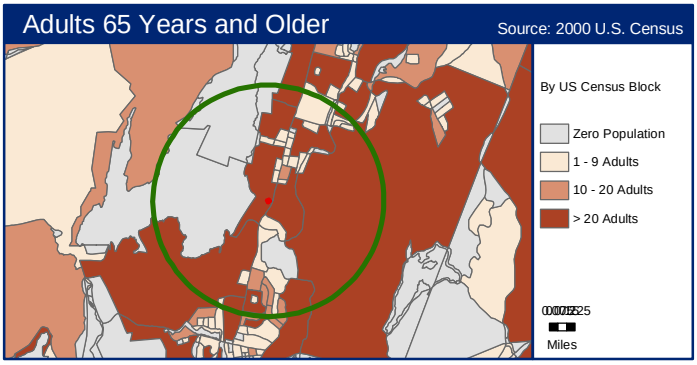
Demographic Statistics

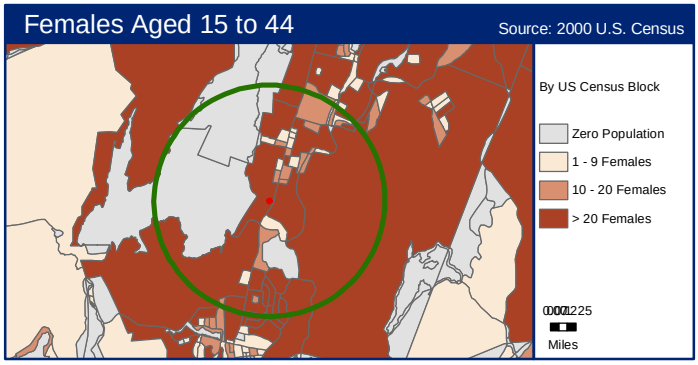
Within Specified Distance of Site*	0.5 mi	1 mi
Total Population	1,086	3,959
White Alone	1,004	3,684
Black Alone	16	38
Am. Indian & Ak Native Alone	1	3
Asian Alone	30	103
Native Hawaiian & Other Pacific Islander Alone	0	0
Some Other Race Alone	16	65
Two or More Races	19	66
Hispanic or Latino**	39	164
Children Aged 6 and Younger	84	370
Adults Aged 65 and Older	105	388
Females Aged 15 to 44	263	886
Total Housing Units	435	1,425

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.









GENERATED: 03-24-2005

Figure 3: Demographic Information for the former Adrow Chemical Company site based on 2000 U.S. Census.

Building formerly occupied by Adrow Chemical Company.

Former front office area within building interior.

Building interior of former Rooms 2 & 3 where Adrow Chemical Company conducted mercury refining operations.

Basement crawl space area below former Rooms 2 & 3,
former front office area and bathroom.

Adjacent commercial property to the east of the site along Ringwood Avenue.

Appendix A

American Formulating and Manufacturing
Letter Dated April 19, 2006

Safecoat AFM SafeChoice

American Formulating AND Manufacturing
3251 Third Avenue, San Diego, CA 92103 Phone: 619.239.0321 Fax 619.239.0565 www.afmsafecoat.com

April 19, 2006

Gary Centifonti
c/o NJ Dept of Health & Senior Services
Consumer/E-Health Services
3635 Quaker Bridge Rd. - Box 369
Trenton, NJ 08625

Dear Mr Centifonti:

Referencing a telephone conversation I had with Don Gerber in your office, AFM does not recommend using AFM Safecoat Hard Seal on concrete. I have included the technical data sheet for Hard Seal for your reference. We do make safer alternative sealers for concrete but make no claim to their ability to mitigate concrete emissions.

Please review the information and call me with any questions, 619-239-0321.

Sincerely,

Jay Watts
VP - AFM

Safecoat®

Hard Seal *Interior*

DESCRIPTION: Safecoat Hard Seal is a multi-use, clear gloss sealer especially formulated to provide mar resistance to both low and high porosity surfaces. Because it forms a continuous membrane when applied properly it is particularly effective at sealing in any pollution or toxic chemical compounds outgassing from the surface to which it is applied.

USE ON: Typically used on previously uncoated and unsealed woodwork, cabinetry and vinyl tile. To prevent outgassing of previously coated surfaces, can also be applied over existing paints, stain and colorfast wallpaper. When applying to a previously coated surface test in inconspicuous places for satisfactory appearance. Correct application will slightly deepen color of existing surface. Not for use on particle board or chipboard.

PRODUCT NUMBER AND CONTAINER SIZE:
31201 (quart), 31101 (gallon) and 31301 (five gallon).

ADVANTAGES / SIGNIFICANT BENEFITS:
- Hard, durable clear gloss appearance.
- Powerful sealer to prevent outgassing of pollution and toxicity from underlying substrate.
- Low odor, non-offensive to installer and occupant.
- Safely used by and for the chemically sensitive.
- Fights indoor air pollution, seals in the outgassing from the substrate.
- Very low VOC content, meets or exceeds all federal and state air quality regulations, including California.
- Contains no formaldehyde.

SURFACE PREPARATION: Surfaces to be coated with Safecoat Hard Seal should be sound and cleaned of grease and oil. Cleaning with a odorless, dye-free, all-purpose cleaner like ***SafecChoice Super Clean*** is recommended. Surface and underlying substrate should be completely dry before application.

APPLICATION: Always have adequate ventilation. Before using, stir Safecoat Hard Seal by gently rolling container. Do not shake; shaking causes bubbles. Then apply as is using a sponge, squeegee or appropriate spray equipment. Use a painter's mask when spraying. It is important to apply in very thin coats. Thick coats will overly darken the color of underlying surfaces. For best results, this product should not be reduced.

COVERAGE: One gallon of Safecoat Hard Seal covers approximately 350 square feet in one coat depending on surface porosity.

CLEAN-UP: Clean tools and equipment with warm, soapy water (***SafeChoice Super Clean*** would be excellent) while they are still wet.

DRYING/CURING TIME: Under normal conditions, Safecoat Hard Seal dries to touch in one hour and is re-coatable after 2 hours. Normal conditions include a dry surface, access to fresh air flow, moderate humidity, and temperatures above 55°F. Thick application, high humidity or conditions other than normal will cause Safecoat Hard Seal to dry and cure more slowly.

LIMITATIONS: Unlike conventional sealers, Safecoat is made without formaldehyde preservatives. Do not contaminate. Store in airtight containers. Do not use when indoor or surface temperature is below 55°F. Not for use on particle board or chipboard.

HEALTH PRECAUTIONS: As with all coatings and sealers, keep container tightly closed and out of the reach of children. Do not take internally. Keep from freezing. Always use adequate ventilation. If you are chemically sensitive, always test for personal tolerance.

LIMITED LIABILITY: The great variation between environmental factors, possible surfaces and application techniques, and the lack of control we have over such matters, must affect our policies. Safecoat products are guaranteed not to be defective when applied and used in accordance with instructions. However, liability, whether express or implied, is limited to replacement of product or refund of purchase price and cannot include liability for labor costs or consequential damages. Because of the variety of circumstances affecting each job, it is the user's responsibility to determine the suitability and safety of the product for any particular application. This limited warranty may not be modified or extended by manufacturer's representatives, distributors, or dealers of AFM products. **We particularly recommend that users always test in small inconspicuous areas before application to the entire surface.**

AMERICAN FORMULATING AND MANUFACTURING
3251 Third Avenue, San Diego, CA 92103 • Tel: 619-239-0321 Fax: 619-239-0565

Appendix B

New Jersey Department of Health & Senior Services
Letter Dated June 28, 2006

State of New Jersey
DEPARTMENT OF HEALTH AND SENIOR SERVICES
CONSUMER AND ENVIRONMENTAL HEALTH SERVICES
PO BOX 369
TRENTON, N.J. 08625-0369
www.nj.gov/health

JON S. CORZINE
Governor

FRED M. JACOBS, M.D., J.D.
Commissioner

June 28, 2006

Thomas Voss, RPG
Viron Consulting Group, LLC
88 South Findley Avenue
P.O. Box 508
Basking Ridge, NJ 07920

RE: Adrow Chemical Company
2 Lines Avenue
Wanaque, NJ
ISRA Case #E20020450

Dear Mr. Voss:

The New Jersey Department of Health and Senior Services, Consumer and Environmental Health Services (NJDHSS), has reviewed the Viron report dated February 9, 2006, which outlined the remediation activities and air sampling conducted at the former Adrow Chemical Company site. The NJDHSS also visited the site on April 26, 2006 to view the site following the renovations.

The February 9th report describes the remedial activities conducted at the Adrow Chemical site during 2005 to reduce the metallic mercury vapors within the building. Specifically, Viron has noted that during September and November of 2005 a clear gloss sealer was applied to the concrete floor and other surfaces inside the building and caulking was applied in various areas to seal cracks. Air sampling was conducted in December 2005 and the results indicated that mercury vapor concentrations were below the suggested Agency for Toxic Substances and Disease Registry (ATSDR) Minimum Risk Level (MRL) of 3.0 $\mu g/m^3$ for a commercial setting. Viron has recommended that based on the remedial efforts completed and subsequent air sampling results that no further remedial work is necessary and the building can now be reoccupied for commercial use.

To assess the current conditions of the site as described in the February 9th report, NJDHSS staff visited the property on April 26th. A visual assessment of the site revealed a newly renovated space with new carpet and floor tiles and new sheetrock walls and ceiling as described in the report. Below the building is a crawl space which contains an area which was not addressed in the February 9th report. This portion of the crawl space appears to not have been cleaned or evaluated during any phase of the remedial activities conducted at the site. This

portion of the crawl space adjoins to an open basement below a mixed use property. Also noted in this area is what appears to be a newly installed PVC ventilation pipe. The pipe appears to originate at the base of the concrete slab floor and vents to the outside through the roof on the north side of the building. At this time no information was provided which identified the purpose of the pipe, its installation date or if it is a passive or mechanical system.

While the mercury vapor concentrations in the newly renovated space are below the ATSDR MRL for a commercial space, additional remedial investigative work to permanently control the metallic mercury vapors is necessary. The NJDHSS investigated the Safecoat Hard Seal product which was applied as the sealant to the interior concrete floor and other surfaces within the building. Discussions with technical representatives of AFM Safecoat, the manufacturer of Safecoat Hard Seal, revealed that this product is not designed for use on concrete surfaces (see attached letter and data sheet). The product is designed to control off-gassing of volatile organic compounds from wood products, vinyl and tiles. Conversations with Viron on April 26th confirm that company representatives were aware of the product's use and that the manufacturer will not guarantee the product to control the mercury vapor emissions. AFM Safecoat advised the NJDHSS that they manufacture other products for use on concrete but make no claim to control emissions.

The use of a sealant as a remediation technique was specifically addressed in the NJDHSS letter to Viron Consulting dated February 2, 2005. In that letter, as well as in conversations with Viron, the NJDHSS noted that the use of a sealant as a long term engineering control was questionable, unproven and was not recommended. The NJDHSS also noted that abrasion and normal wear and tear could compromise the sealant's physical and chemical bond to the substrate causing it to fail. This remains a significant concern since the product applied is not designed for use on concrete nor does it eliminate the source of the contamination. As such the NJDHSS does not concur that the engineering control applied sufficiently addresses the permanent control of mercury vapors within the building interior.

The NJDHSS recommends against re-occupancy of the building and further recommends additional evaluation of the building as described below.

1. If a sealant remains as the primary strategy to control the mercury vapors, then it must be approved for use on concrete and to control mercury vapor. In conjunction with this strategy an ongoing monitoring and maintenance program will need to be developed, implemented and maintained for the life of the building. The Wanaque Department of Health will need to evaluate this monitoring program.

2. The portion of the crawl space which extends from the rear of the building to the previously excavated area must be investigated for residual mercury contamination. This would encompass the areas below the entrance room, bathroom and kitchen floors. No investigation has occurred in this area of the crawl space and we have notified the DEP of the need to further evaluate this area.

3. Air samples should be collected in the crawl space area in conjunction with the investigation. Since the crawl space is adjacent and open to the basement of the

adjoining building this area should be included in the investigation and air sampling activities.

4. The purpose and use of the PVC piping identified in the crawl space must be investigated. If its purpose is determined to be the control of any residual mercury vapors it must be included in any ongoing monitoring and maintenance program developed.

The NJDHSS recommends that Viron re-evaluate the overall remediation strategy implemented and consider long-term public health protection for future occupants of the site. The NJDHSS continues to recommend the removal of the mercury contamination from the building as the goal in any future remediation strategies.

Please feel free to contact staff in the Indoor Environments Program for additional information or questions.

Sincerely,

James A. Brownlee, M.P.H.
Director
Consumer and Environmental Health Services

c: Christopher Chapman, Wanaque Health Department
Eddy A. Bresnitz, MD., MS., State Epidemiologist/Deputy Commissioner
Joe Eldridge, Program Manager, Indoor Environments Program
Gary Centifonti, Project Manager, Indoor Environments Program
Karen Lesto, NJDEP, Bureau of Northern Case Management

Appendix C

New Jersey Department of Health & Senior Services
Letter Dated February 2, 2005

State of New Jersey
DEPARTMENT OF HEALTH AND SENIOR SERVICES
DIVISION OF PUBLIC HEALTH PROTECTION AND EMERGENCY PREPAREDNESS
CONSUMER AND ENVIRONMENTAL HEALTH SERVICES
PO BOX 369
TRENTON, N.J. 08625-0369
www.nj.gov/health

RICHARD J. CODEY
Acting Governor

FRED M. JACOBS, M.D., J.D.
Acting Commissioner

February 2, 2005

Thomas Voss, RPG
Viron Consulting Group, LLC
88 South Finley Avenue
P.O. Box 508
Basking Ridge, New Jersey 07920

RE: Adrow Chemical Company
2 Lines Avenue, Wanaque Borough, Passaic County
ISRA Case #E20020450
Re-Occupancy Issues for Building Interior

Dear Mr. Voss:

The New Jersey Department of Health and Senior Services (NJDHSS), Consumer and Environmental Health Services, has reviewed and evaluated your letter of December 8, 2004 to Mr. Gary Centifonti of my staff, and the following documents pertaining to the above referenced site:

1. Response and Comments Letter New Jersey Department of Environmental Protection to Viron Consulting Group, LLC. regarding Remedial Investigation Report (July 22, 2003), dated November 19, 2003.
2. Response Letter Wanaque Board of Health to All Parties dated April 15, 2004.
3. Letter Report Viron Consulting Group, LLC. to Wanaque Board of Health regarding air sampling results for Mercury, dated June 4, 2004.
4. Response Letter Wanaque Board of Health to Viron Consulting Group, LLC. dated July 1, 2004.
5. Memo Pat Mastrincola to Gary Centifonti, New Jersey Department of Health & Senior Services via facsimile, not dated.
6. Various ISRA Supporting Documentation

The NJDHSS was asked by the NJDEP and the Wanaque Board of Health to determine if remedial actions implemented to abate asbestos and mercury contamination within all building interiors has been completed to a degree which will not pose undue risk to human health for re-occupancy of the building.

In your December 8 letter, Viron Consulting Group, LLC (Viron), consultant to Adrow Chemical Company, Inc., has concluded that "...the former Adrow building is safe to occupy for commercial use..." In earlier documents, Viron claims all remedial measures completed have abated the asbestos and mercury contamination to warrant re-occupancy of the building. Viron states the remediation of all mercury contamination is complete based on removal of impacted soils and the application of engineering controls to limit the migration of vapors from mercury contamination remaining within the building interior. Viron states that post-remediation air sampling results indicate that mercury vapor concentrations are below the OSHA Permissible Exposure Limit of 100 micrograms per cubic meter ($\mu g/m^3$) or the ACGIH occupational standard of 25 $\mu g/m^3$ and, therefore, does not pose a health risk to future building occupants.

NJDHSS REVIEW

Adrow Chemical operations at the facility consisted of the chemical distillation of metallic mercury. The area of concern under NJDHSS review is the entire building interior which is comprised of three rooms identified in the supplied documentation as Rooms 1, 2 and 3.

In conducting this evaluation, the NJDHSS reviewed information available from various governmental sources including the Agency for Toxic Substances and Disease Registry (ATSDR), the United States Environmental Protection Agency (EPA), the American Conference of Governmental Industrial Hygienists (ACGIH) and the Occupational Health and Safety Administration (OSHA).

Asbestos Abatement

Based on the statements provided by NJDEP in letter dated November 19, 2003, the abatement of the asbestos contamination within Rooms 1 and 2 was performed by a New Jersey licensed asbestos abatement contractor. The wood floors were sealed with an epoxy coating and post-remedial air samples indicate that no asbestos fibers were present. There was no information provided pertaining to the specifics of the post-remedial air sampling (i.e. sample locations, number of samples), the size of remediated area nor the volume of asbestos containing materials removed.

Mercury Contamination

Remedial Measures Conducted

Mercury "beads" and "puddles" were observed in all rooms during remedial activities. Based on this discovery, the wood floors for Rooms 1 and 2 were removed to allow testing of underlying soils. (It is not clear from the documents reviewed whether the wood flooring was put back or replaced.) Mercury impacted soils located beneath Rooms 1 and 2 were removed to levels below the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC). Soils below Room 3 were not evaluated due to the

extreme thickness of the concrete floor. Floor wipe samples of Room 3 indicated mercury contamination was present.

Partial removal (scarification) of the concrete floor surface to a depth of ¼-inch was conducted for Room 3 as a remedial measure to address the mercury contamination. Post-scarification floor wipe samples of Room 3 indicated mercury contamination was still present. An epoxy sealer was applied to the concrete floor surface as an engineering control to prevent the migration of mercury vapors. No wipe sampling was conducted following the application of the epoxy sealant.

Air Sampling Results

Post-remedial air sampling was conducted in April and May 2004 to assess the effectiveness of remedial measures implemented. Sample locations were not provided and were collected within the building interior. Concentrations of mercury vapor were observed by direct reading instrumentation ranging from 11 $\mu g/m^3$ to 22 $\mu g/m^3$ and by analytical testing ranging from 3.11 $\mu g/m^3$ to 3.56 $\mu g/m^3$.

Mercury vapor concentrations were measured again in September 2004 using NIOSH Method 6009 at four locations within the building. Concentrations ranged from 13.4 $\mu g/m^3$ to 22.3 $\mu g/m^3$.

Remedial Action Concerns

Based on the review of the provided information, the NJDHSS has the following concerns over the remedial practices implemented to address the mercury contamination for the building interior.

Based on the results of the April/May and September 2004 post-remedial air sampling results, mercury vapors remain present throughout the entire building interior. Mercury beads were observed in all rooms prior to implementing remedial measures. The scarification remedial measure implemented for Room 3 was determined to be ineffective based on the results of the post-scarification floor wipe samples.

The purpose of the epoxy application is for use as a sealant of non-volatile contaminants such as asbestos and lead. Therefore, the application of the epoxy sealer as an engineering control for mercury contamination is questionable.

Abrasion, wear and impacts to be expected for floor surfaces during occupancy of the building may jeopardize the integrity of the seal, allowing mercury vapors to escape into the building interior. Even if the epoxy seal was determined to be effective in preventing the migration of mercury vapors in the short term, the NJDHSS feels that there cannot be an adequate level of assurance through a maintenance and monitoring plan that all coated surfaces can be properly evaluated for areas of failure during the life of the seal.

Recommended Exposure Levels – Mercury Vapors

NJDHSS has reviewed information provided by the sources identified below regarding recommended exposure levels for mercury vapors for residential and non-residential settings.

U.S. EPA Reference Concentrations – Mercury Vapors[1]

The U.S. EPA Integrated Risk Information System (IRIS) specifies a reference concentration (RfC) of 0.3 $\mu g/m^3$ for chronic exposure to mercury vapors. The RfC is defined as an estimate (with uncertainty spanning about an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime. This exposure level is based on human occupational inhalation studies. The RfC is intended to be protective against adverse health effects including hand tremor, increases in memory disturbance, and autonomic nervous system dysfunction.

ATSDR Suggested Action Levels – Mercury Vapors

Residential Settings

ATSDR has established both a chronic inhalation Minimal Risk Level (MRL) for mercury vapors at ≤ 0.2 $\mu g/m^3$. The MRL is defined as "an estimate of daily human exposure to a substance that is likely to be without an appreciable risk of adverse effects (non-carcinogenic) over a specified duration of exposure" and represents "safe levels of exposures for all populations, including sensitive subgroups."[2] ATSDR recommends that no one be chronically exposed to mercury vapor concentrations above the MRL. [2,3,4] The MRL was developed based on a study of workers exposed to an average Lowest Observed Adverse Effect Level (LOAEL) of 25 $\mu g/m^3$ over an average of 15 years. This level was adjusted from a 40 hour per week work schedule to a 168 hour per week exposure then divided by an uncertainty factor of 30 to account for the use of the LOAEL and the different sensitivities of individuals.

In a specific situation involving currently occupied residences, ATSDR suggested a residential re-occupancy level of ≤ 1.0 $\mu g/m^3$ to account for occupied residences requiring remediation citing that remedial operations to attain the MRL level can be extremely disruptive to individuals and family quality of life. Therefore, ATSDR created the residential re-occupancy level to facilitate time effective remedial operations. [5]

Non-Residential Settings - No Mercury Handling Operations

ATSDR has established suggested action levels for mercury vapors in commercial re-occupancy settings for post-remedial actions involving mercury in any structure at 3.0 $\mu g/m^3$ for operations where there is no use of metallic mercury. [4,5] This level was established by ATSDR at approximately "one order of magnitude below levels of known

human health effects, provided no visible metallic mercury is present to act as an attractive nuisance or source for more vapors." [4,5]

Non-Residential Settings With Mercury Handling Operations

ATSDR has established suggested action levels for mercury vapors in commercial settings at 25 $\mu g/m^3$ for operations where mercury is used in daily operations. [4,5] This level was adopted by ATSDR from the Threshold Limit Value established by the ACGIH and assumes hazard communications programs as per OSHA including evaluating protective equipment upgrades for response workers subject to mercury concentrations above this level.

NJDHSS Conclusions

The NJDHSS has completed its review and makes the following determinations regarding re-occupancy of this building.

Asbestos Remediation

Based on the information provided in NJDEP's November 19, 2004 letter, the asbestos abatement of Rooms 1 and 2 have been completed to the satisfaction of NJDHSS with the stipulation that all asbestos remedial procedures (including post-remedial air sampling and disposal practices) were followed in accordance with State of New Jersey regulatory requirements and abatement policies.

Mercury Remediation

There are currently no exposure limits in New Jersey for mercury inhalation concentrations outside mercury handling workplace settings. However, the federal agencies USEPA and ATSDR have developed health-protective comparison values appropriate for the general population. Therefore, in order to ensure the adequate protection of public health, the NJDHSS considers USEPA's and ATSDR's recommended levels to be appropriate comparison values for the evaluation of measured mercury levels in the indoor environment of the Adrow Chemical building.

The OSHA Permissible Exposure Limit (PEL) for workplace exposure to individuals in occupational settings where mercury is handled during operations was established in 1972. Additionally, this workplace setting is based on a work environment where the mercury vapor source comes strictly from *controlled operations* in a clean environment and *not* from sources contaminated by spills. Further, OSHA promotes the cleanup of any hazardous substances for spills that occur in the workplace as to not create a contaminated environment. Similarly, the ACGIH guideline, as applied by ATSDR, is intended for commercial settings with ongoing mercury handling operations. Neither the OSHA nor the ACGIH comparison values are appropriate for use in a residential setting or a nonresidential/commercial setting without ongoing mercury handling operations.

Therefore, to assure the protection of public health, the NJDHSS concludes that the indoor mercury vapor concentrations remaining within the building are unacceptable and may pose a risk to future building occupants. The NJDHSS recommends against re-occupancy of this building until further remedial measures are implemented to abate the vapor concentrations as follows:

1. The MRL set forth by ATSDR for building interior mercury vapors at ≤ 0.2 $\mu g/m^3$ for all building interiors should be the minimum remediation achievement goal if the property will be converted for residential use or as a child-occupied facility. The ATSDR residential re-occupancy level for mercury vapor of ≤ 1.0 ug/m^3 is not an appropriate remediation goal since the facility is not currently occupied and is, therefore, not creating a disruptive environment to occupants and family quality of life for which this action level was developed.

2. The MRL suggested by ATSDR for commercial settings of ≤ 3.0 $\mu g/m^3$ for all building interiors should be the minimum remediation achievement goal for any non-residential (commercial or industrial) use. The basis for this determination is that the OSHA PEL was developed on the basis for worker exposure limited to concentrations produced during operations and not from a contaminated environment, and the ACGIH guideline is more appropriately applied in settings with ongoing mercury operations. If the remediation goal is set for commercial settings, the NJDHSS recommends that institutional control be put in place to prevent residential use of the building.

3. The abatement method for applying the epoxy sealant to prevent vapor intrusion and its potential as a long-term engineering control is questionable. Post-scarification floor wipe samples in Room 3 demonstrate Mercury contamination remains within the concrete floor as may be acting as the source for post-remedial indoor mercury vapor concentrations, and indoor air measurements indicate that the seal is ineffective at reducing mercury levels to acceptably low concentrations. Additionally, even if the epoxy sealant were an effective vapor barrier in the short term, its long-term effectiveness might be compromised by abrasion and normal wear and tear. Seal failure could therefore occur, resulting in building occupant exposure. It is uncertain whether a maintenance and monitoring plan could effectively detect seal failures. Thus, alternative measures need to be implemented to either provide permanently effective encapsulation or, preferably, to remove the mercury contamination from the building.

4. If wooden floors or other potentially contaminated materials in Rooms 1 and 2 were not replaced after remediation of mercury contaminated underlying soils, they may be acting as additional vapor sources for the building interior. This possibility should be evaluated and eliminated.

Please let me know if you have any questions regarding this evaluation by the NJDHSS Consumer and Environmental Health Services.

Sincerely,

James A. Brownlee, M.P.H.
Director
Consumer and Environmental Health Services

c: Christopher Chapman, Wanaque Health Department
Karen Lesto, NJDEP Bureau of Northern Case Management

References

1. U.S. Environmental Protection Agency, Integrated Risk Information System, http://www.epa.gov/iris/index.html, 1995.
2. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Mercury," March 1999.
3. Agency for Toxic Substances and Disease Registry, "ATSDR Minimal Risk Levels," January 2004.
4. U.S. Environmental Protection Agency – Region 5, "Mercury Response Guidebook," March 2001.
5. Agency for Toxic Substances and Disease Registry, "Suggested Action Levels for Indoor Mercury Vapors in Homes or Businesses with Indoor Gas Regulators," 2000.

Appendix D

ATSDR Conclusion Categories

Summary of ATSDR Conclusion Categories

Category	Definition
1: Urgent Public Health Hazard	Applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects and require quick intervention to stop people from being exposed.
2: Public Health Hazard	Applies to sites that have certain physical hazards or evidence of chronic, site-related exposure to hazardous substances that could result in adverse health effects.
3: Indeterminate Public Health Hazard	Applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard.
4: No Apparent Public Health Hazard	Applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels expected to cause adverse health effects.
5: No Public Health Hazard	Applies to sites where no exposure to site-related hazardous substances exists.

Appendix E

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, 1-888-42-ATSDR (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.

CAP [see Community Assistance Panel.]

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 or mixture 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 [contrast with prevalence].

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. Morbidity is 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 [contrast with incidence].

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 Center for Environmental Health (CDC)
(http://www.cdc.gov/nceh/dls/report/glossary.htm)

National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

For more information on the work of ATSDR, please contact:

Office of Policy and External Affairs
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E. (MS E-60)
Atlanta, GA 30333
Telephone: (404) 498-0080