Health Consultation

Review of Soil Gas, Indoor Air and Potable Well Data

SHERWIN-WILLIAMS/HILLIARDS CREEK SITE
GIBBSBORO, CAMDEN COUNTY, NEW JERSEY

EPA FACILITY ID: NJD980417976

Prepared by:
New Jersey Department of Health and Senior Services

DECEMBER 14, 2010

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

Health Consultation: A Note of Explanation

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

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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Summary

Introduction

In 2009, the Agency for Toxic Substances and Disease Registry (ATSDR), through a cooperative agreement with the New Jersey Department of Health and Senior Services (NJDHSS) prepared a Public Health Assessment for the Sherwin-Williams/Hilliards Creek site. Additional data have been collected on contaminant levels in soil gas, indoor air and potable private wells.

The NJDHSS prepared this Health Consultation (HC) to review and evaluate exposure pathways associated with soil gas, indoor air and potable well water. ATSDR and NJDHSS's top priority is to ensure that the community around the site has the best information possible to safeguard its health.

Conclusions

The ATSDR and NJDHSS reviewed the data and have reached three conclusions in this HC:

Conclusion 1

The ATSDR and NJDHSS conclude that the potable wells are not contaminated. No one is being exposed to site-related contamination through ingestion; therefore, there is no harm to people's health.

Basis for Conclusion

The water samples collected from potable wells did not show presence of any contamination.

Conclusion 2

The ATSDR and NJDHSS conclude that potential exposures to contaminants in the residential indoor air are not expected to harm people's health.

Basis for Conclusion

An evaluation of potential exposures associated with calculated concentrations of contaminants in the indoor air of residences indicated that health effects are unlikely to occur, and no increase in cancer risk is expected.

Conclusion 3

The ATSDR and NJDHSS conclude that past and current exposures through inhalation of indoor air at the businesses located in the former Sherwin-Williams facility are not expected to harm people's health.

Basis for Conclusion	Since the groundwater and soil gas under the on-site buildings are contaminated with volatile petroleum products, the contaminants may migrate to indoor air through vapor intrusion. The concentrations of contaminants detected in the indoor air of businesses did not exceed the health-based comparison values. The lifetime excess cancer risks associated with the contaminants were considered to be very low.
Next Step	The USEPA should complete the remedial investigation of groundwater contamination and remediation of the site as soon as feasible.
For More Information	Questions about this HC should be directed to the NJDHSS at (609) 826-4984.

Statement of Issues

On April 18, 2006, the US Environmental Protection Agency (USEPA) proposed to add the Sherwin-Williams/Hilliards Creek site, Gibbsboro, Camden County (see Figure 1) to the National Priorities List (NPL). As required by the 1986 Superfund Amendments and Reauthorization Act (SARA), the Agency for Toxic Substances and Disease Registry (ATSDR), through a cooperative agreement with the New Jersey Department of Health and Senior Services (NJDHSS) prepared a Public Health Assessment (PHA) for the site (ATSDR 2009). The site was added to the NPL in March 19, 2008. Between 2007 and 2009, additional investigation and delineation of contamination in soil gas under residential and commercial buildings, indoor air of commercial office spaces and potable private wells in the vicinity of the site were conducted.

The ATSDR and NJDHSS prepared this Health Consultation to review and assess the site related contamination in the soil gas, indoor air and potable private well water.

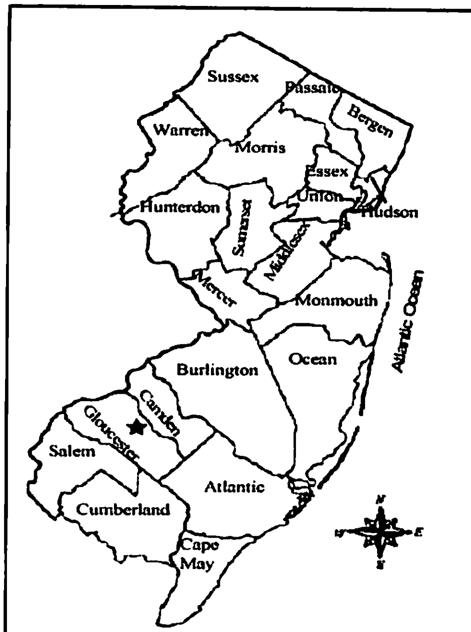

Figure 1: Location of Sherwin-Williams/ Hilliards Creek Site

Background

Site Description and History

The Sherwin-Williams/Hilliards Creek site is located in a residential and commercial area of Gibbsboro, Camden County (see Figure 2). The site encompasses approximately 60 acres and is bordered to the north by the Silver Lake, to the east and west by residential dwellings and small businesses and to the south by the Hilliards Creek, open space and woodlands.

The facility operated from 1849 to 1976 and manufactured primarily white lead paints, varnishes, and lacquer. In 1981, the property was sold to a private developer. Development of the property (known as the Paint Works Corporate Center) included demolition and/or renovation of existing structures and construction of new office, manufacturing, warehouse spaces and re-grading of adjacent areas. In 1983, presence of seepage of an "oily substance" ("the petroleum seep") was reported to the New Jersey Department of Environmental Protection (NJDEP). It was reported that the petroleum seep was emanating from the parking lot at the facility, flowing overland to a storm water catch basin in the parking lot and discharging through Riprap to the Hilliards Creek. Investigations of the petroleum seep indicated the presence of hazardous substances in the soil and groundwater underlying the former facility. The buildings are currently being used as office space and light industrial operations.

Demographics

Using 2000 United States Census data, the ATSDR estimates that there are about 16,000 individuals residing within a one mile radius of the Sherwin-Williams/Hilliards Creek site (see Figure 3).

Community Health Concerns

Several homeowners expressed concern about the migration of contamination from the Sherwin-Williams site to their private wells. One individual stated that although the residences are supplied with public water, they used well water for household use. The NJDHSS staff also received letters and phone calls from current and former employees of businesses located in the Paint Works Corporate Center after release of the PHA in 2009. Individuals who worked in the office building were concerned about the indoor air quality of the buildings and their impact on health.

Past ATSDR/NJDHSS Involvement

In 1999, the ATSDR and NJDHSS prepared a health consultation for Hilliards Creek (ATSDR 1999). The ATSDR and NJDHSS evaluated the analytical data collected in 1998 where lead was detected at 221,900 mg/kg in a sediment sample collected in the Hilliards Creek Wildlife Refuge. The ATSDR and NJDHSS concluded that an urgent health hazard exists to children and adults who use the refuge. Subsequently, the USEPA Region 2 and Sherwin-Williams signed and implemented an Administrative Order of Consent (AOC) to remediate the contamination.

In 2009, the ATSDR and NJDHSS prepared a PHA for Sherwin-Williams/Hilliards Creek site (ATSDR 2009). The ATSDR and NJDHSS concluded that likely lead exposures associated with sediment and floodplain soil of Hilliards Creek in the past may have harmed people's health. The recommendations included off-site sampling of potable water, indoor air and biota.

The ATSDR and NJDHSS have completed two health consultations and one PHA for the related US Avenue Burn and the Route 561 Dump sites[1]. Two data reviews were also conducted for the sites.

[1]The US Avenue Burn and the Route 561 Dump sites are located near the Sherwin-Williams/Hilliards Creek site and were used by the facility for disposal of waste.

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 environmental guideline CVs available for the screening of 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 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. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water, and USEPA Risk-Based Screening Levels (SLs). SLs are contaminant concentrations corresponding to a fixed level of risk (i.e., a hazard quotient[2] of 1, or lifetime excess cancer risk of one in one million, whichever results in a lower contaminant concentration) in water, air, biota, and soil. For soils and sediments, other CVs include the New Jersey Residential and Non-Residential Direct Contact Soil Cleanup Standard (RDCSCS, NRDCSCS). Based primarily on human health impacts, these criteria may also take into account natural background concentrations, analytical detection limits, and ecological effects.

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.

[2]The ratio of estimated site-specific exposure to a single chemical in a particular medium from a site over a specified period to the estimated daily exposure level at which no adverse health effects are likely to occur.

Residences

Soil Gas: In May 2008, nine sub-slab soil gas samples were collected from eight residential buildings near the site. Maximum concentrations of benzene, methylene chloride and tetrachloroethene detected in the soil gas exceeded their respective environmental guideline CVs (see Table 1); they were retained for further evaluation.

Potable Wells: A well search was performed (Weston 2001) to determine whether wells used for potable water purposes existed in the vicinity of the site. The survey identified several domestic wells within one-half mile of the site. A number of these potable wells are located to the east of United States Avenue (see Figure 2).

Between 2007 and 2009, the Sherwin-Williams collected water samples from several of these potable wells. The wells were selected based on proximity to the waste site and likely groundwater flow direction. The following well locations were selected for sampling:

- north of the Clements Lake (near Route 561 Dump site),
- east of US Avenue near Foster Avenue,
- just south of the Bridgewood Lake, and,
- about 5,000 feet west of Bridgewood Lake along the Hilliards Creek.

The results did not show any site-related or other contamination.

Former Facility Buildings

Soil Gas: In May and December 2008 and March 2009, sub-slab soil gas samples were collected from commercial buildings located along Foster Avenue, United States Avenue and Clementon Road (see Figure 2). The type and high concentration[3] of volatile organic compounds detected in the soil gas indicates that the on-site groundwater is contaminated with petroleum products and chlorinated organic compounds (see Table 2)[4].

Indoor Air: In March 2009, 27 indoor air samples were collected from five commercial buildings (see Table 3). Maximum concentrations of benzene, methylene chloride, trichloroethene and tetrachloroethene detected in the indoor air exceeded their respective environmental guideline CVs; they were retained for further evaluation.

A brief discussion of the toxicologic characteristics of the COC is presented in Appendix A.

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[3]With reference to Environmental Guideline Comparison Value (see Table 2)
[4]The Environmental Guideline CVs were presented (see Table 2) for reference only. Since the indoor air data were available, the soil-gas data were not retained for further evaluation

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 (ATSDR 2005). 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.

Based on sampling results and knowledge of accessibility of the media to the population, exposure pathways for individuals who live (or lived) in the area of the Sherwin-Williams/Hilliards Creek site were identified as follows:

Completed Exposure Pathways

Inhalation of indoor air (past, present, future). Soil gas and indoor air sampling indicated the presence of contaminants. The groundwater sampling results also indicated the presence of non-aqueous phase products (ATSDR 2009). Currently the on-site buildings are occupied by various businesses. Employees and residents may have been in the past or are currently being exposed to groundwater contaminants through inhalation of indoor air of the on-site buildings via vapor intrusion[5].

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[5]Volatile chemicals in groundwater can migrate through subsurface soils and into indoor air spaces of overlying buildings. The vapor intrusion pathway may be important for buildings with or without a basement. Vapors can accumulate in occupied spaces to concentrations that may pose safety hazards, health effects, or aesthetic problems.

Public Health Implications

Once it has been determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed 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 comparison values (CVs). Health guideline CVs are based on data drawn from the epidemiologic and toxicologic literature and often 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 based largely on toxicological studies in animals and on reports of human occupational (workplace) exposures. 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 levels include:

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

NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals. LOAEL is the lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals. In order to provide additional perspective on these health effects, the calculated exposure doses were then compared to observed effect levels (e.g., NOAEL, 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.

To ensure that MRLs are sufficiently protective, the extrapolated values can be several hundred times lower than the observed effect levels in experimental studies. When MRLs for specific contaminants are unavailable, other health based comparison values such as USEPA Reference Dose (RfD) may be used. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Inhalation – Indoor Air

Residences

Since indoor air samples were not collected from these residences, an attenuation factor was used to estimate likely indoor air contaminant concentration (NJDEP 2010). The ATSDR and NJDHSS used an attenuation factor of 50 (NJDEP 2010) to estimate the indoor air concentrations (see Table 4).

The maximum estimated concentration of benzene, methylene chloride, and tetrachloroethene in the indoor air were lower than the corresponding health guideline CVs (see Table 4). As such, past exposures to these chemicals are unlikely to cause any non-cancer adverse health effects.

Former Facility Buildings

As indicated earlier, the former manufacturing building was mostly used for office space for various businesses. The maximum concentration of benzene, methylene chloride, and tetrachloroethene detected in the indoor air were lower than the corresponding health guideline CVs (see Table 5). As such, exposures to these chemicals are unlikely to cause non-cancer adverse health effects.

Cancer Health Effects

The site-specific lifetime excess cancer risk (LECR) indicates the potential of contaminants to increase the risk of cancer. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 46 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges approximately between 1 in 100 and 10 in 100 (SEER 2005). Typically, health guideline CVs developed for carcinogens are based on a lifetime risk of one excess cancer case per 1,000,000 individuals.

According to the United States Department of Health and Human Services (USDHHS), the cancer class of contaminants detected at a site is as follows:

1 = Known human carcinogen
2 = Reasonably anticipated to be a carcinogen
3 = Not classified

NJDHSS considers estimated cancer risks of less than one additional cancer case among one million persons exposed as no expected increased risk (expressed exponentially as 10^{-6}). The NJDHSS uses the following lifetime excess cancer risk descriptions for health assessments:

Lifetime Excess Cancer Risk Description used by the New Jersey Department of Health and Senior Services

LECR	Risk Description
10^{-3} to $\geq 10^{-1}$	Increase
10^{-4} to $<10^{-3}$	Low increase
10^{-6} to $<10^{-4}$	Very low increase
$< 10^{-6}$	No expected increase

Inhalation – Indoor Air

The inhalation LECRs associated with air exposures were calculated by using the following formula:

$$Inhalation\ Cancer\ Risk = C \times EF \times \frac{ED}{AT} \times IUR$$

where C = concentration of contaminant in air (μg/m^3);
EF = exposure factor representing the site-specific exposure scenario;
ED = exposure duration (year);
AT = averaging time, 70 years;
IUR = inhalation unit risk (μg/m^3)$^{-1}$.

Inhalation unit risk (IUR) is defined as the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 μg/m^3 in air.

Residences

The cancer class of the contaminants likely to be present in the indoor air of residences is given in Table 6. Based on the mean estimated indoor air concentration (the likely exposure scenario), the LECRs associated with benzene, methylene chloride and tetrachloroethene exposures were below 1 in 1,000,000 among the exposed population, which is considered by the NJDHSS to pose no expected increase in cancer risk[6].

Former Facility Buildings

The cancer class of the contaminants detected in the office space is given in Table 7. The following site-specific exposure assumptions were used to calculate past LECRs:

Exposure Point	Number of Days Per Year	Number of Hours Per Day	Number of Years Exposed
Indoor Air	250	8	30

[6]A sample cancer risk calculation is presented in Appendix B

Based on the mean concentration (the likely exposure scenario) of contaminants detected in the indoor air, the calculated LECRs ranged from 2 in 1,000,000 to 2 in 100,000,000 to exposed population which are considered by the NJDHSS to pose very low to no increase in cancer risk.

Child Health Considerations

The NJDHSS and ATSDR recognize 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 types of exposures to hazardous substances. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of 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.

The NJDHSS and ATSDR evaluated the potential risk for children residing in the area who may have been exposed to site contaminants. The potential concentration of contaminants in the indoor air of residences did not exceed the health-based CVs; no non-cancer adverse health effect in children is expected. Based on the mean concentrations of contaminants, this report found no expected increase in cancer risk (including children).

Conclusion

There was a completed exposure pathway via the inhalation of indoor air at the Sherwin-Williams/Hilliards Creek site. The exposed population included residents in the vicinity of the site and individuals working as employees of businesses of the Paint Works Corporate Center. Contaminants of concern are benzene, methylene chloride, tetrachloroethene and trichloroethene in the indoor air. The ATSDR and NJDHSS reached three conclusions in this report.

The NJDHSS and ATSDR conclude that the off-site potable wells are not affected by site-related contamination; therefore, there is no harm to people's health. The water samples collected from potable wells did not show presence of contaminants.

The NJDHSS and ATSDR conclude that exposures to potential indoor air contaminants at residences are not expected to harm people's health. Since indoor air contaminant concentrations were not measured, the NJDHSS and ATSDR used an attenuation factor to predict likely indoor air concentrations at the residences. An evaluation of exposure to indoor air indicated that adverse non-cancer health effects are unlikely to occur. For cancer health effects, lifetime excess cancer risks were calculated based on mean contaminant concentrations. The LECRs associated with contaminants were below one excess cancer case per 1,000,000 individuals which is considered by the NJDHSS to be no expected increase in cancer risk.

The NJDHSS and ATSDR conclude that although the soil gas under the on-site buildings are contaminated with petroleum products, exposures to indoor air contaminants at the businesses is not expected to harm people's health. The concentration of contaminants detected in the indoor air of businesses did not exceed the health-based CVs; it is unlikely that adverse non-cancer health effects would occur. The LECRs associated with contaminants detected in the indoor air were below two excess cancer cases per 1,000,000 individuals, which is considered by the NJDHSS to be very low increase in cancer risk.

Recommendations

The USEPA should complete the remedial investigation of groundwater contamination[7] and remediation of the site areas as soon as feasible.

Public Health Action Plan (PHAP)

The purpose of a PHAP is to ensure that this health assessment not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and NJDHSS to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by the NJDHSS and the ATSDR are as follows:

Public Health Actions Undertaken by NJDHSS and ATSDR

1. The ATSDR and NJDHSS evaluated the sub-slab soil gas, indoor air and potable well water data associated with Sherwin Williams/Hilliards Creek site.

Public Health Actions Planned by NJDHSS and ATSDR

1. Copies of this Health Consultation will be provided to concerned residents in the vicinity of the site via the township library and the Internet.

2. If requested, in cooperation with the USEPA, public meetings will be scheduled to discuss the findings of this report and to determine and address any additional community concerns.

[7]The delineation of groundwater contamination may help better manage vapor intrusion problem.

References

[ATSDR 1999] Agency for Toxic Substances and Disease Registry. 1999a. Hilliards Creek site, Gibbsboro, Camden County, New Jersey, September 30, 1999.

[ATSDR 2005] Agency for Toxic Substances and Disease Registry. 2005. Public Health Assessment Guidance Manual. US Department of Health and Human Services, Atlanta, Georgia.

[ATSDR 2009] Agency for Toxic Substances and Disease Registry. 2009. Public Health Assessment: Sherwin-Williams/Hilliards Creek Site, Gibbsboro, Camden County, New Jersey, US Department of Health and Human Services, Atlanta, Georgia.

[NJDEP 2010] New Jersey Department of Environmental Protection. 2010. NJDEP Vapor Intrusion Guidance, Site Remediation Program. Accessed March 30, 2010 at: http://www.state.nj.us/dep//srp/guidance/vaporintrusion/vig.htm.

[SEER 2005] Surveillance Epidemiology and End Results 2005. SEER Cancer Statistics Review, 1975 - 2002. Accessed February 3, 2006 at: http://seer.cancer.gov/csr/1975_2002/.

Weston. 2001. Remedial Investigation Report, The Paint Works Corporate Center, Gibbsboro, Camden County, NJ. Vol. 1, February, 2001.

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CERTIFICATION

The Health Consultation for the Sherwin-Williams/Hilliards Creek site, Gloucester 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 completed by the cooperative agreement partner.

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

Alan Yarbrough
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Agency for Toxic Substances and Disease Registry

ATSDR Glossary of Terms

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

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:
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Table 1: Sub-slab Soil Gas Results from Residential Properties

Contaminant	Number of Detections	Concentration Range (µg/m³)	Arithmetic Mean (µg/m³)	Standard Deviation (µg/m³)	Environmental Guideline CV (µg/m³)	COC[a]
Benzene	6	ND - 0.85	0.28	0.3	0.1 (CREG [b])	**Yes**
Ethylbenzene	7	ND - 1.3	0.64	0.42	1,000 (RfC [c])	No
Hexane	1	ND - 2.1	0.23	0.7	2,000 (EMEG[d])	No
m/p-Xylene	8	ND – 4.6	3.2	1.33	730 (EPA SL[e])	No
Methylene Chloride	3	ND - 11	1.6	3.6	3 (CREG)	**Yes**
o-Xylene	4	ND - 1.4	0.4	0.52	730 (EPA SL)	No
Tetachloroethene	5	ND - 13	3.5	4.8	0.41 (EPA SL)	**Yes**
Toluene	8	ND - 601	4.23	1.8	5,000 (RfC)	No

[a]Contaminant of Concern; [b]Cancer Risk Evaluation Guide; [c]USEPA Reference Concentration; [d]Environmental Media Evaluation Guide; [e]USEPA Screening Level

Table 2: Results of Sub-slab Soil Gas Samples Collected from on-site Commercial Buildings

Contaminant	Number of Detections	Maximum Concentration (µg/m³)	Arithmetic Mean (µg/m³)	Standard Deviation (µg/m³)	Environmental Guideline CV[a] (µg/m³)
1,2,4-Trimethylbenzene	38	39,000	4,044	8,567	7.3 (EPA SL[b])
1,3,5-Trimethylbenzene	26	30,000	3,750	7,665	NA[c]
Benzene	56	370,000	16,826	59,549	0.1 (CREG[d])
Cyclohexane	39	510,000	62,355	120,759	6,000 (RfC[e])
Ethylbenzene	38	370,000	19,815	62,180	1,000 (MRL[f])
Hexane	32	360,000	20,119	56,931	2,000 (MRL)
m,p-Xylene	52	3,000,000	85,071	403,438	200 (MRL)
Methylene Chloride	17	13,000	508	1,715	2 (CREG)
o-Xylene	18	680,000	18,350	105,325	200 (MRL)
Tetachloroethene	29	250	10	36.75	0.41 (EPA SL)
Toluene	34	10,000	280	1,489	300 (MRL)
Trichloroethene	2	11	0.18	1.36	1.2 (EPA SL)
Vinyl Chloride	10	2,100	130	400	0.1 (CREG)

[a]Comparison Value; [b]USEPA Screening Level; [c]Not Available; [d]ATSDR Cancer Risk Evaluation Guide; [e]USEPA Reference Concentration in air; [f]ATSDR Minimal Risk Level

Table 3: Indoor Air Sampling Results of on-site Commercial Buildings

Contaminant	Number of Detections	Conc. Range ($\mu g/m^3$)	Mean ($\mu g/m^3$)	Standard Deviation ($\mu g/m^3$)	Environmental Guideline CV ($\mu g/m^3$)	COC
1,2,4-Trimethylbenzene	22	ND - 6.1	1.41	1.2	7.2 (EPA SL[a])	No
1,3,5-Trimethylbenzene	3	ND - 7.5	0.37	1.46	NA[b]	NA
Benzene	24	ND - 35	2.53	6.54	0.1 (CREG[c])	**Yes**
Cyclohexane	24	ND - 39	9.39	8.78	6,300 (EPA SL)	No
Ethylbezene	23	ND - 15	2.55	2.88	1,000 (RfC[d])	No
Hexane	15	ND - 12	3.14	3.71	2,000 (EMEG[e])	No
m,p-Xylene	25	ND - 130	12.68	24.5	730 (EPA SL)	No
Methylene Chloride	2	ND - 9.1	0.59	2.15	3 (CREG)	**Yes**
o-Xylene	22	ND - 150	8.39	28.4	730 (EPA SL)	No
Tetachloroethene	23	ND - 6.2	2.4	1.36	0.41 (EPA SL)	**Yes**
Toluene	27	ND - 170	59.34	52.4	300 (EMEG)	No
Trichloroethene	16	ND - 18	5.68	5.8	1.2 (EPA SL)	**Yes**

[a]USEPA Screening Level; [b]Not Available; [c]Cancer Risk Evaluation Guide; [d]USEPA Reference Concentration; [e]Environmental Media Evaluation Guide

Table 4: Comparison of Calculated[a] Indoor Air Concentrations at Residences with Health Guideline CVs

Contaminant	Calculated Indoor Air Concentration (µg/m³)		Health Guideline CV (µg/m³)	Potential for Non-cancer Health Effects
	Max.	Mean		
Benzene	0.017	0.006	10 (MRL[b])	No
Methylene Chloride	0.22	0.032	1,000 (MRL)	No
Tetachloroethene	0.26	0.071	300 (MRL)	No

[a]An attenuation factor of 50 was used to calculate the indoor air concentration; [b]Minimal Risk Level

Table 5: Comparison of Indoor Air Concentrations Detected at the On-site Commercial Buildings with Health Guideline CVs

Contaminant	Conc. Range (µg/m³)	Mean (µg/m³)	Health Guideline CV (µg/m³)	Potential for Non-cancer Health Effects
Benzene	ND - 35	2.53	10 (MRL[a])	No
Methylene Chloride	ND - 9.1	0.59	1,000 (MRL)	No
Tetachloroethene	ND - 6.2	2.4	300 (MRL)	No
Trichloroethene	ND - 18	5.68	40 (MRL)	No

[a]Minimal Risk Level

Table 6: Calculated LECR associated with the Potential Contaminants in the Indoor Air of Residences

Contaminant	DHSS Cancer Class	Calculated Mean Indoor Air Concentration ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	LECR[b]
Benzene	1	0.006	7.8×10^{-6}	4.68×10^{-8}
Methylene Chloride	2	0.032	4×10^{-7}	1.28×10^{-8}
Tetachloroethene	2	0.071	5.9×10^{-6}	4.2×10^{-7}

[a]Inhalation Unit Risk; [b]Lifetime Excess Cancer Risk (residential exposure scenario)

Table 7: Calculated LECR associated with the Contaminants detected in the Indoor Air of Commercial Buildings

Contaminant	DHSS Cancer Class	Mean ($\mu g/m^3$)	IUR[a] $(\mu g/m^3)^{-1}$	LECR[b]
Benzene	1	2.53	7.8×10^{-6}	1.9×10^{-6}
Methylene Chloride	2	0.59	4×10^{-7}	2.3×10^{-8}
Tetachloroethene	2	2.4	5.9×10^{-6}	1.38×10^{-6}
Trichloroethene	2	5.68	2×10^{-6}	1.1×10^{-6}

[a]Inhalation Unit Risk; [b]Lifetime Excess Cancer Risk based on 8 hour, 250 days and 30 year exposure scenario

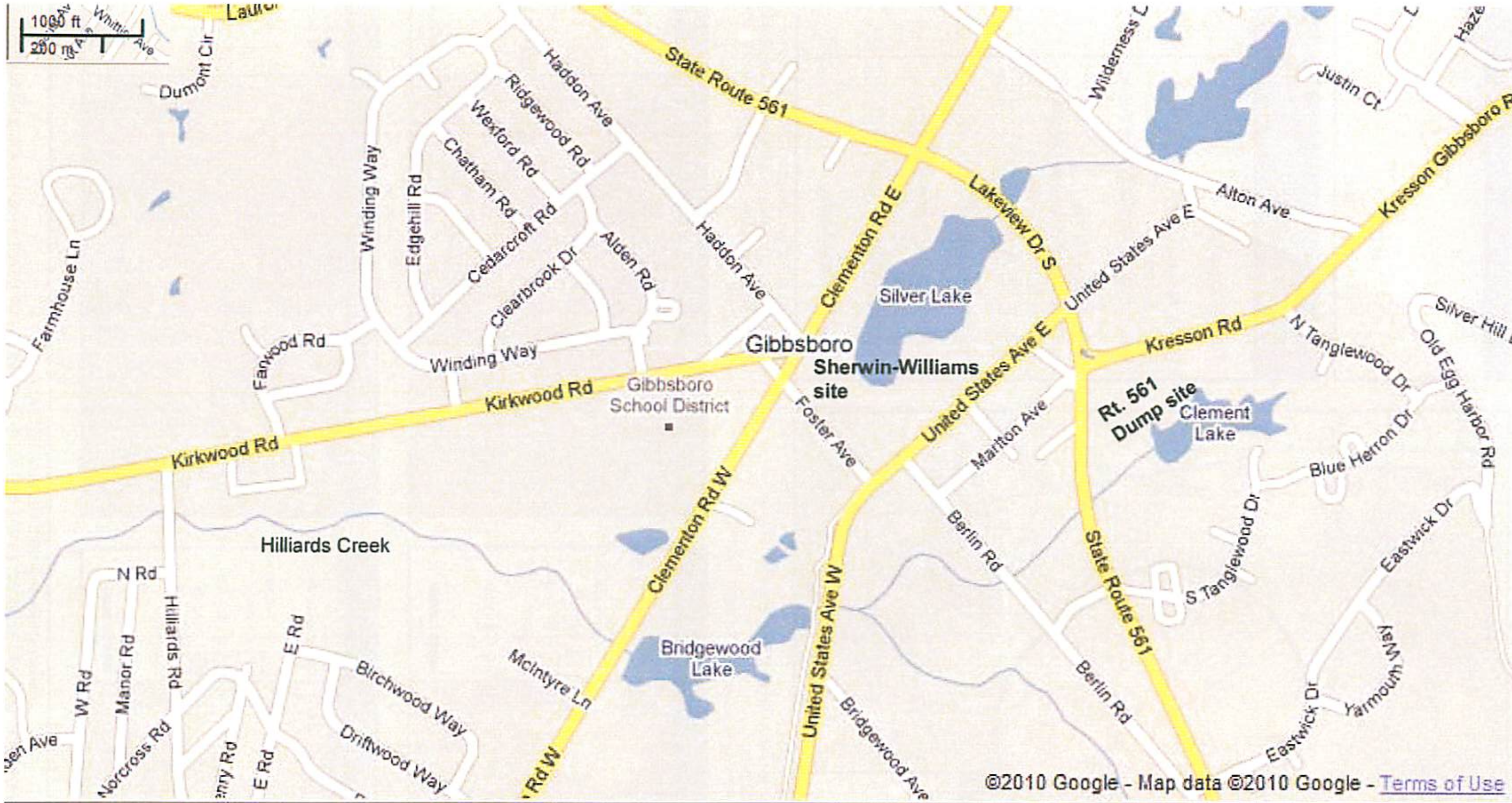
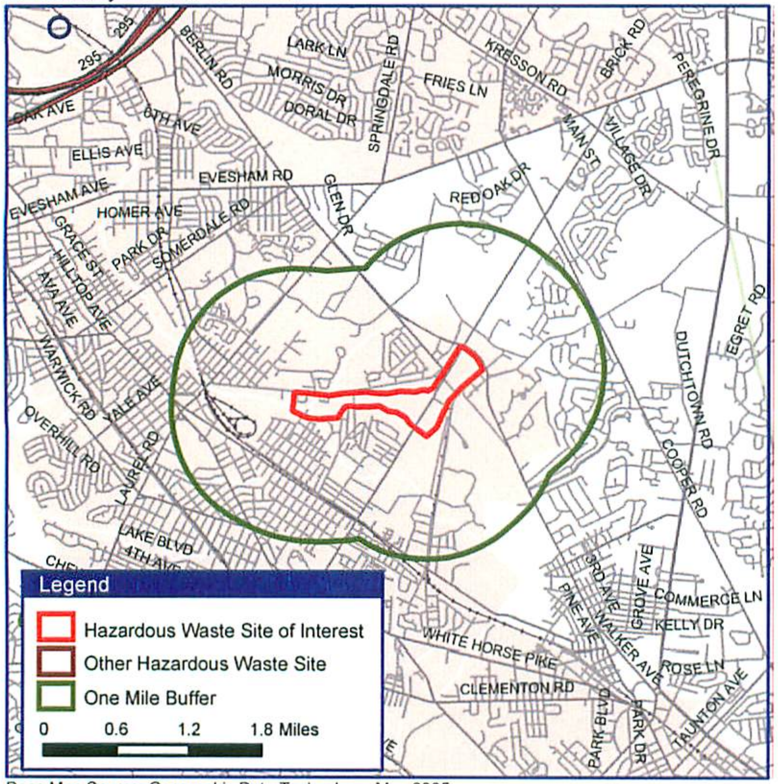


Figure 2: Site Location Map

Sherwin-Williams/Hilliards Creek
Gibbsboro, NJ

ATSDR

EPA Facility ID: NJSFN0204181



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Site Location: Camden County, NJ

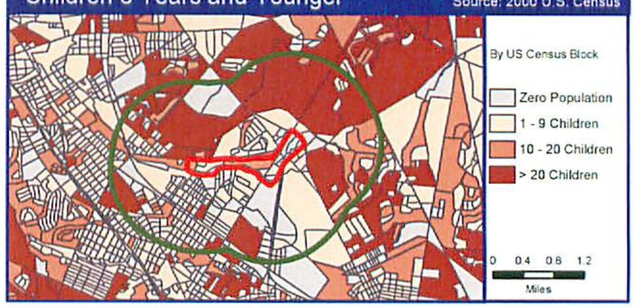
Demographic Statistics
Within One Mile of Site*

Total Population	15,892
White Alone	11,566
Black Alone	2,416
Am. Indian & Alaska Native Alone	42
Asian Alone	1,341
Native Hawaiian & Other Pacific Islander Alone	3
Some Other Race Alone	168
Two or More Races	357
Hispanic or Latino**	629
Children Aged 6 and Younger	1,377
Adults Aged 65 and Older	1,809
Females Aged 15 to 44	3,600
Total Housing Units	6,871

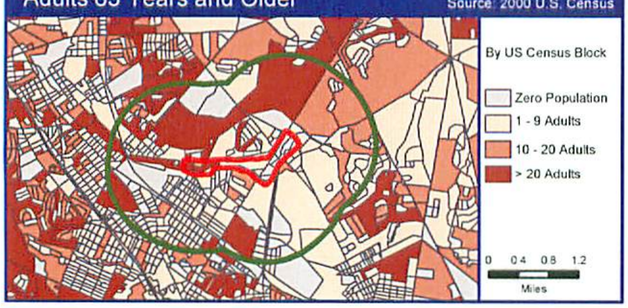
Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

Population Density
Source: 2000 U.S. Census

Children 6 Years and Younger
Source: 2000 U.S. Census



Adults 65 Years and Older
Source: 2000 U.S. Census



Females Aged 15 to 44
Source: 2000 U.S. Census

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Figure 3: Demographic Information of the Sherwin-Williams/Hilliards Creek site

Appendix A

Toxicologic Summaries

The toxicological summaries provided in this appendix are based on ATSDR's ToxFAQs (http://www.atsdr.cdc.gov/toxfaq.html). Health effects are summarized in this section for the chemicals of concern found at the site. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

Benzene Benzene is a colorless liquid with a sweet odor. It evaporates into the air very quickly and dissolves slightly in water. It is flammable and is formed from both natural processes and human activities. Benzene is widely used in the United States; it ranks in the top 20 chemicals for production volume. Some industries use benzene to make other chemicals such as plastics, resins, and nylon and synthetic fibers. Benzene is also used to make rubber, lubricants, dyes, detergents, drugs, and pesticides. Natural sources of benzene include volcanoes and forest fires. Benzene is also a natural constituent of crude oil, gasoline, and cigarette smoke. Outdoor air contains low levels of benzene from tobacco smoke, automobile service stations, exhaust from motor vehicles, and industrial emissions. Indoor air generally contains higher levels of benzene from products such as glues, paints, furniture wax, and detergents.

Breathing very high levels of benzene can result in death, while high levels can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion, and unconsciousness. Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate, and death. The major effect of benzene from long-term (365 days or longer) exposure is on the blood. Benzene causes harmful effects on the bone marrow and can cause a decrease in red blood cells leading to anemia. It can also cause excessive bleeding and can affect the immune system, increasing the chance for infection. Some women who breathed high levels of benzene for many months had irregular menstrual periods and a decrease in the size of their ovaries. It is not known whether benzene exposure affects the developing fetus in pregnant women or fertility in men. Animal studies have shown low birth weights, delayed bone formation, and bone marrow damage when pregnant animals breathed benzene.

The USDHHS has determined that benzene is a known human carcinogen. Long-term exposure to high levels of benzene in the air can cause leukemia, cancer of the blood-forming organs.

Methylene Chloride Methylene chloride is a colorless liquid with a mild, sweet odor. It is used as an industrial solvent and as a paint stripper. It may also be found in some aerosol and pesticide products and is used in the manufacture of photographic film. The most likely way to be exposed to methylene chloride is by breathing contaminated air.

Breathing in large amounts of methylene chloride may cause dizziness, nausea, and tingling or numbness of fingers and toes. A person breathing smaller amounts of methylene chloride may become less attentive and less accurate in tasks requiring hand-eye coordination. We do not know if methylene chloride can affect the ability of people to have children or if it causes birth defects. Some birth defects have been seen in animals inhaling very high levels of methylene chloride.

We do not know if methylene chloride can cause cancer in humans. An increased cancer risk was seen in mice breathing large amounts of methylene chloride for a long time. The USDHHS has determined that methylene chloride can be reasonably anticipated to be a cancer-causing chemical, and the USEPA has determined that methylene chloride is a probable cancer-causing agent in humans.

Tetrachloroethene (PCE) PCE is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell PCE when it is present in the air at a level of 1 part per million (1 ppm) or more, although some can smell it at even lower levels. People are commonly exposed to PCE when they bring clothes from the dry cleaners.

High concentrations of PCE can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been exposed to high concentrations. In industry, most workers are exposed to levels lower than those causing obvious nervous system effects, although more subtle neurological effects are possible at the lower levels. The health effects of breathing in air or drinking water with low levels of PCE are not known. Results from some studies suggest that women who work in dry cleaning industries where exposures to PCE can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that PCE can cause liver and kidney damage. Exposure to very high levels of PCE can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

The U.S. Department of Health and Human Services (USDHHS) has determined that PCE may reasonably be anticipated to be a carcinogen. PCE has been shown to cause liver tumors in mice and kidney tumors in male rats.

Trichloroethene (TCE): is a nonflammable, colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is used mainly as a solvent to remove grease from metal parts, but it is also an ingredient in adhesives, paint removers, typewriter correction fluids, and spot removers. TCE is slightly soluble in water, and can remain in groundwater for a long time, but it quickly evaporates from surface water, so it is commonly found as a vapor in the air. People can be exposed to TCE by breathing air in and around the home which has been contaminated with TCE vapors from shower water or household products or vapor intrusion, or by drinking, swimming, or showering in water that has been contaminated with TCE.

Breathing small amounts of TCE may cause headaches, lung irritation, dizziness, poor coordination, and difficulty concentrating. Breathing large amounts of TCE may cause impaired heart function, unconsciousness, and death. Breathing it for long periods may cause nerve, kidney, and liver damage. Drinking large amounts of TCE may cause nausea, liver damage, unconsciousness, impaired heart function, or death. Drinking small amounts of TCE for long periods may cause liver and kidney damage, impaired immune system function, and impaired fetal development in pregnant women, although the extent of some of these effects is not yet clear. Skin contact with TCE for short periods may cause skin rashes.

Some studies with mice and rats have suggested that high levels of TCE may cause liver, kidney, or lung cancer. Some studies of people exposed over long periods to high levels of TCE in drinking water or in workplace air have found evidence of increased cancer. The National Toxicology Program has determined that TCE is "reasonably anticipated to be a human carcinogen," and the International Agency for Research on Cancer (IARC) has determined that TCE is "probably carcinogenic to humans".

Appendix B:

Sample Lifetime Excess Cancer Risk calculation

Sample LECR calculation

For residential exposure scenario, the inhalation LECRs associated with benzene (See Table 6) was calculated by using the following formula:

$$\textit{Inhalation Cancer Risk} = \text{C x EF x} \frac{\text{ED}}{\text{AT}} \text{x IUR}$$

where C = concentration of benzene = 0.006 $\mu g/m^3$
EF = 1
ED = exposure duration = 70 years
AT = averaging time = 70 years;
IR = inhalation unit risk = 7.8 $x10^{-6}$ $(\mu g/m^3)^{-1}$

Substituting the values –

$$\textit{Inhalation Cancer Risk} = \text{C x EF x} \frac{\text{ED}}{\text{AT}} \text{x IUR}$$

$$= (0.006\ \mu g/m^3) \text{ x 1 x} \frac{70\ \textit{years}}{70\ \textit{years}} \text{x } [7.8 \text{ x}10^{-6}\ (\mu g/m^3)^{-1}]$$

$$= 4.68 \text{ x } 10^{-8}$$