Health Consultation

BACHMAN SPILL SITE
WASHINGTON TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA

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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

BACHMAN SPILL SITE
WASHINGTON TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA

Prepared by:

Pennsylvania Department of Health
Division of Environmental Health Epidemiology
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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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Executive Summary

At the request of the Pennsylvania Department of Environmental Protection (PADEP), the Pennsylvania Department of Health (PADOH) prepared this health consultation to determine if residents from a single home near the Bachman Spill Site were exposed to volatile organic compounds (VOCs) in their indoor air at levels that would harm their health. The PADOH worked under a cooperative agreement with the Agency of Toxic Substances and Disease Registry (ATSDR) when completing this health consultation.

Based on three rounds of indoor air sampling, we do not expect adverse health effects from any of the VOCs detected in the indoor air of the single residence near the Bachman Spill Site. Indoor air concentrations of benzene and 1,2,4-trimethylbenzene in this home were further evaluated since levels of these contaminants were above health-based comparison values for these chemicals. However, after additional consideration of sites-specific conditions and the available scientific literature on these chemicals, we believe exposures to benzene and 1,2,4-trimethylbenzene at this site are also unlikely to cause adverse health effects. Relatively low levels of cumene, ethylbenzene, methyl tertiary butyl ether, 1,3,5-trimethylbenzene, toluene, xylenes, and other VOCs were also detected in residents' indoor air at levels that were well below the health-based comparison values (CVs).

The interpretation, conclusions, and recommendations regarding the Bachman Spill Site for this health consultation are site-specific and do not necessarily apply to any other site.

Background and Statement of Issues

Site Description and History

The Bachman Spill Site (the site) encompasses approximately 1.0 acre and is located in a rural area of Washington Township, Lehigh County, Pennsylvania (Figures 1- 4). The site is approximately one mile north of the village of Slatedale. A wetland and undeveloped woodlands are located to the north and east of the site, residential dwellings to the south, and North Loop Road and undeveloped woodlands to the west surround the site.

In April 2003, a diesel fuel spill occurred at the Haas Trucking facility when Bachman Fuels spilled an unknown volume of product onto the ground during a fuel delivery. Estimates of the quantity of diesel fuel spilled reportedly ranged from 275 gallons up to approximately 2,000 gallons. The spill was not reported to the PADEP until one week after it occurred. By that time, the contamination had migrated into the soils, shallow groundwater, and surface water of nearby wetlands, and may have impacted a nearby residence south of the site. The responsible party hired a remediation crew to install inversion dams to prevent further migration of the contamination and sampled two nearby residential wells to determine if they were impacted by the spill. The residential well sample results did not reveal any contamination to private groundwater wells at that time. Subsequently, the responsible party notified the PADEP that their insurance denied coverage for the spill and that they did not have the financial resources to fund the remainder of the remediation [1].

The PADEP then hired an Emergency Response contractor to contain the release of diesel fuel. This remediation began on April 23, 2003. PADEP extended the interceptor trench on the property, pumped out the free-product, excavated the contaminated soil, removed the contaminated soil and arranged for offsite disposal, recovered free-product from the wetland area, reconstructed two previously installed inversion dams, and removed fuel residue and seepage in the basement of the nearby residence [1].

In July of 2003, the PADEP conducted site characterization activities to determine the extent of subsurface soil and shallow groundwater contamination. Subsurface soil contamination was detected in the vicinity of the residence. When there is a rainfall event, oil and water are observed entering the basement of the residence at approximately five feet below ground surface. This is the location of a dense clay layer in the subsurface soil and where the highest photo-ionization detector readings were found in the subsurface soil borings [1].

To determine if there was a potential health threat to the residents living in the home via vapors from the underground spill, three rounds of indoor air samples were collected from the home. For this health consultation, PADOH, at the request of PADEP, evaluated the results of indoor air samples collected at the residence. The indoor air samples were collected from the basement and a bedroom and analyzed for the presence of VOCs. PADOH's objective throughout this health consultation is to determine whether exposures to these contaminants are at levels that would be considered a health hazard.

Site Visits

In May 2004, a representative of the PADOH Toxicology Program viewed the site with the PADEP Project Officer. A hydrogeologist, representing the resident's insurance company was also present during the site visit. PADOH staff took notes and discussed site background information with the PADEP Project Officer. PADOH also interviewed the residents whom reside at the adjacent property.

In June 2004, a representative of the PADOH Health Assessment Program viewed the site with the PADEP Project Officer. The fuel oil contamination plume was delineated, and results of the Site Characterization were discussed. PADOH staff took notes and discussed site background information with the PADEP Project Officer. During this visit, PADOH also interviewed the residents in the vicinity of the site.

Sample Events

In April, November, and December 2004, PADEP conducted indoor air sampling at the private residence in the vicinity of the site [2,3,4]. The purpose of the indoor air sample collection was to determine if VOCs were entering the indoor air of the residence at detectable concentrations, and any possible significance for public health. PADEP utilized summa canisters to collect air samples from inside the residential location. These air samples were submitted to an independent laboratory and analyzed for VOCs using EPA methodology.

Sample Results

Low levels of benzene, toluene, ethylbenzene, xylenes, cumene, methyl tertiary butyl ether (MTBE), 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and other VOCs were detected in the indoor air (Tables 1 and 2) of this residence [2,3,4]. Benzene was detected at a maximum concentration of 4.7 parts per billion by volume (ppbv) and 2.5 ppbv in the basement and bedroom air, respectively, of the residential location. 1,2,4-trimethylbenzene was detected at a maximum concentration of 3.3 ppbv in the bedroom. The maximum detectable concentrations of some other VOCs were as follows: acetone 51 ppbv, toluene 15 ppbv, and total xylenes (ortho-, meta-, and para structures) 12 ppbv. Ethylbenzene was also detected in the residence at an estimated concentration of 6.9 ppbv. In this health consultation, PADOH evaluated these indoor air sampling data and determined the public health significance of the data.

Quality Assurance and Quality Control

In preparing this health consultation, ATSDR and PADOH relied on the information provided in referenced documents. We reviewed the quality assurance and quality control measures that were followed regarding data gathering, chain-of-custody, laboratory procedures, and data reporting. We expected that to ensure high quality data, extreme care

was taken during all aspects of sample collection. We expected that the laboratory only used certified, clean-sample collection devices. Once samples were collected, we expected they were stored according to the method protocol and were delivered to the analytical laboratory as soon as possible. Finally, we expect that laboratory Standard Operating Procedures and other procedures and guidance for sample analysis, reporting, and chains of custody were followed. The analyses, conclusions, and recommendations in this health consultation are valid only if the referenced documents are complete and reliable.

Discussion

In this section, PADOH evaluates the indoor air data and determined whether the residents are being exposed to harmful levels of the VOCs detected in the indoor air of their home. PADOH considers how occupants came into contact with the VOCs as well as the frequency of exposure. PADOH also considers whether the contaminants were present at harmful levels.

To determine the likelihood of possible health effects of site-specific chemicals, ATSDR has developed health-based comparison values (CVs). These CVs include Minimal Risk Levels (MRLs) for non-cancerous health effects, Cancer Risk Evaluation Guides (CREGs) for cancerous health effects, and Environmental Media Evaluation Guides (EMEGs).

ATSDR established MRLs based upon an evaluation of the toxicological literature for a given substance. MRLs are not established as thresholds of toxicity, but were developed as screening tools, below which non-cancer adverse health effects are unlikely. In that framework, a lifetime of exposure below a chronic MRL would not be expected to result in adverse health effects. However, exposure to levels above the MRL may not necessarily lead to adverse health effects. There is a wide range of uncertainty between levels known to cause adverse health effects and the MRLs. Therefore, the MRL does not establish the maximum "safe" level, nor is it intended to imply that exposure is not likely to be harmful. If environmental exposures occur at concentrations exceeding the MRL then further evaluation is necessary to determine the health risks of those exposures.

In certain cases, when ATSDR-derived CVs are not available to screen a site-specific chemical, PADOH uses other sources to evaluate the contaminants that were detected in samples. In the following section, when ATSDR CVs were not available for a specific chemical, the PADOH utilized the United States Environmental Protection Agency (USEPA) Region III Risk-Based Concentration (RBC) Table. The RBC Table contains Reference Doses (RfDs) and Cancer Slope Factors for 400 – 500 chemicals. The RfD is an estimate of a daily oral exposure to the human population that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. These toxicity factors have been combined with "standard exposure" scenarios to calculate RBCs or chemical concentrations corresponding to fixed levels of risk in multiple types of sample media that include water, air, fish tissue, and soil [5].

Contaminant Evaluation

At the sampled levels, exposures to acetone, benzene, ethylbenzene, toluene, and total xylenes in the indoor air, were below their corresponding MRLs for chronic or intermediate exposure [6] and should not cause non-cancerous effects to the residents at the levels detected (Table 1). Therefore, these contaminants (with the exception of benzene) will not be further addressed in this health consultation. Benzene is a known carcinogen [7], and was detected in concentrations that were in exceedance of the chronic CREG for benzene (0.03 ppbv), which necessitates further evaluation. 1,2,4-trimethylbenzene was also selected for further evaluation because the detected level of 3.3 ppbv was greater than 1.3 ppbv – EPA Region III's RBC for1,2,4-trimethylbenzene in air.

Benzene

Benzene is commonly found in the environment. Industrial processes are the main sources of benzene in the environment. Benzene levels in the air can increase from coal and oil burning emissions, benzene waste and storage operations, motor vehicle exhaust, and evaporation from gasoline service stations. Since tobacco smoke contains high levels of benzene, tobacco smoke is another source of benzene in air. Benzene can also pass into air from water and soil surfaces contaminated with benzene. Once in the air, benzene reacts with other chemicals and breaks down within a few days [8].

The maximum concentration of benzene was detected in the basement of this home at a level of 4.7 ppbv. Exposure to contaminants detected in basement air does not represent an accurate exposure scenario in this situation because the basement isn't a livable space, and the residents do not spend much time in this level of their home. The maximum concentration of benzene (2.5 ppbv) detected in the upper floor of the home is below a level that ATSDR and PADOH consider a threat to health. The range of detected benzene concentrations also falls within the normal background concentrations (0.02 to 34 ppbv) that have been reported for ambient air [8]. The exposure to benzene at the levels found in the indoor air is not expected to cause noncarcinogenic adverse health effects in residents.

PADOH estimates the maximum theoretical excess cancer risk for lifetime exposure (24 hours per day) to benzene at 2.5 ppbv (8 $\mu g/m^3$) is one additional cancer per 10,000 people or a low increased risk. Our theoretical calculation is based on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the theoretical calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. Also assuming that residents spend less than 24 hours per day in their homes, the overall theoretical cancer risk would further decrease. While benzene is linked to causing leukemia, no detectable excess leukemia is observed in workers exposed to benzene at levels of 1,000 ppbv or less for 40 years [9]. Given the relatively low level of the maximum detected concentration of benzene (2.5 ppbv) in comparison to studies that associated benzene to leukemia, and given an intermittent

residential exposure environment, it is unlikely that the estimated exposure would result in increased cancer.

1,2,4-Trimethylbenzene

The primary use of 1,2,4-trimethylbenzene is as a gasoline additive, which is approximately 99% of its production volume. Uses of the remaining 1% include those as a solvent in coatings, cleaners, pesticides, printing, and inks [10]. 1,2,4-trimethylbenzene is also found in the production of coal tar oils [11].

At elevated concentrations (5,000,000 – 9,000,000 ppbv), acute exposure to 1,2,4-trimethylbenzene in air can cause headache, fatigue, and drowsiness. Short-term inhalation of vapor can also cause chemical pneumonitis [11]. Long-term or chronic exposure to solvents containing 1,2,4-trimethylbenzene could cause nervousness, tension, and bronchitis. Trimethylbenzene might also cause alterations in blood clotting [10]. No information or studies were found on the carcinogenicity of 1,2,4-trimethylbenzene.

USEPA Region III's RBC for 1,2,4-trimethylbenzene in air is 6.2 $\mu g/m^3$ (approximately 1.3 ppbv) [12]. All air samples collected during April 2004, November 2004, and December 2004 sampling events yielded detectable concentrations of 1,2,4-trimethylbenzene, with a maximum concentration of approximately 3.3 ppbv (Table 1). The results from last round of samples collected throughout the home during the December 2004 sampling event indicated a decreased level of 1,2,4-trimethylbenzene, below USEPA's RBC. Because some of the detected concentrations exceeded the USEPA's RBC for 1,2,4-trimethylbenzene, an estimated exposure dose was calculated for the maximum detected concentration and compared to the inhalation RfD for 1,2,4-trimethylbenzene. Lifetime exposure to 1,2,4-trimethylbenzene at concentrations of 3.3 ppbv would result in an estimated exposure dose of 0.00343 mg/kg/day for an adult. The provisional inhalation RfD for 1,2,4 trimethylbenzene is 0.00170 mg/kg/day [12].

As mentioned previously, high levels of uncertainty are incorporated into the development of RfDs for some chemicals like 1,2,4-trimethylbenzene. Lack of chronic studies, extrapolation of animal studies to human studies, and projections of health effects from different routes of exposure all tend to increase the level of uncertainty in the RfD. Given the high level of margin of safety in developing the health screening values and health studies researched by PADOH, chronic exposure to 3.3 ppbv of 1,2,4-trimethylbenzene would not be expected to result in adverse health effects.

Child Health Considerations

PADOH and ATSDR recognize that infants and children are more vulnerable to chemical exposure than adults. As part of their child health considerations, PADOH and ATSDR are committed to evaluating exposure scenarios that potentially involve children. Considering exposure to indoor residential air near the Bachman Spill Site, children may have an increased vulnerability due to many factors including: 1) children weigh less than adults, resulting in

higher doses of chemical exposure relative to body weight, 2) children have higher rates of respiration, 3) metabolism and detoxification mechanisms differ in both the very young and very old and may increase or decrease susceptibility, and 4) the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. PADOH and ATSDR considered child-specific doses in the analysis for this health consultation document.

Conclusions

1. PADOH and ATSDR conclude that the levels of benzene, 1,2,4-trimethylbenzene and other VOCs detected in indoor air represent no apparent public health hazard for children or adults living in the home discussed in this health consultation.

2. Past exposures to VOCs in indoor air in the residential location in the vicinity of the site represent an indeterminate health hazard because historical indoor air sampling data is not available.

3. Future potential exposures to VOCs via contaminated indoor air and drinking water from this site represent an indeterminate public health hazard. After the initial site remediation, some subsurface soil and groundwater at the site remained contaminated from benzene and other diesel fuel constituents.

Recommendations

1. PADOH and ATSDR recommend the continuation of monitoring and/or mitigating groundwater, indoor air, soils (subsurface and surface), and sediments for impacts from diesel fuel, especially for benzene and 1,2,4-trimethylbenzene. If the monitoring results reveal increased levels of contamination to the sampled environmental media, a future health consultation should be prepared by PADOH and ATSDR that determines the public health significance of exposures to those levels.
2. PADOH and ATSDR recommend that residents should properly use, store, and dispose of VOC-containing household products.

Public Health Actions Completed

1. PADEP characterized the site with special emphasis on defining the groundwater and subsurface soil contamination plume to determine if VOCs or other contaminants are present in groundwater and subsurface soils. PADOH and PADEP identified residents that were exposed to contaminants through indoor air vapor intrusion and these exposures were addressed in this health consultation.

2. PADOH and PADEP contacted the affected residents identified in this health consultation and discussed the public health significance of their exposure to VOCs in their indoor air. PADOH and PADEP encouraged proper use, storage, and disposal of

household products containing VOCs. PADOH will continue to be available to answer residents' health questions.

Public Health Actions Planned

1. ATSDR and PADOH will make this health consultation available to the residents at the Bachman Spill Site.

2. PADOH will review and evaluate potential future environmental data requested at this site.

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9. Rinsky RA, Alexander BS, et al. Benzene and Leukemia: An Epidemiologic Risk Assessment. New England Journal of Medicine, 316: 1044 – 1050, 1987.

10. US Environmental Protection Agency. Chemical Summary for 1,2,4-trimethylbenzene. Washington DC: Office of Pollution Prevention and Toxics; August 1994. Available at: http://www.epa.gov/opptintr/chemfact/s_trimet.txt. Last accessed April 26, 2005.

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Certification

This health consultation for the Bachman Spill Site was prepared by the PADOH under a cooperative agreement with the ATSDR. 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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LCDR Alan G. Parham, MPH, REHS

Technical Project Officer, CAT, SPAB, DHAC, ATSDR

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

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Team Leader, CAT, SPAB, DHAC, ATSDR

Appendix A

Tables

TABLE 1. SUMMARY OF FUEL-RELATED COMPOUNDS DETECTED IN AIR SAMPLES COLLECTED INSIDE THE RESIDENCE NEAR THE BACHMAN FUEL SPILL SITE (All units are in ppbv)

compound	round 1 (04/2004)		round 2 (11/2004)		round 3 (12/2004)		comparison value (CV)	CV source
	basement		basement	bedroom	basement	bedroom		
benzene	**2.0**	**3.0**	**4.7**	**1.6**	**3.4**	**2.5**	0.03	chronic CREG
cumene	0.2 (J)	0.2 (J)	0.1 (U)	0.1 (U)	0.1 (U)	0.04 (U)	80	intermediate RfC
ethylbenzene	1.4	1.4	3.2	6.9	0.9	0.5	1000	intermediate EMEG/MRL
methyl t-butyl ether (MTBE)	2.5	2.5	0.8	0.6	0.3	0.1 (U)	700	chronic EMEG/MRL
1,2,4-trimethylbenzene	**2.6**	**2.4**	**2.8**	**3.3**	1.2	1.0	1.3	EPA Region III RBC
1,3,5-trimethylbenzene	0.8	0.8	1.0	1.2	0.4	0.4	1.3	EPA Region III RBC
toluene	6	6	15	8	5	3	80	chronic EMEG/MRL
xylenes (total)	2	2	4	12	0.4	1	100	chronic EMEG/MRL

Bolded sample results are in exceedance of CV. Exposures to these levels were further evaluated in this health consultation.

TABLE KEY

intermediate	Contact with a substance that occurs over a 14 - 365 day period
chronic	Contact with a substance that occurs over a long time (>365 days)
CREG	Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
MRL	Minimal Risk Level (ATSDR)
EPA Region III RBC	EPA Region III Risk-based Concentration Table - Ambient Air
J	Compound was detected, but below quantitation limit
U	Compound was undetected at the specified quantitation limit

TABLE 2. SUMMARY OF NON-FUEL-RELATED COMPOUNDS DETECTED IN AIR SAMPLES COLLECTED INSIDE THE RESIDENCE NEAR THE BACHMAN FUEL SPILL SITE (All units are in ppbv)

Compound	Round 1 (04/2004)	Round 2 (11/2004)		Round 3 (12/2004)		Comparison Value (CV)	CV Source
	basement	basement	bedroom	basement	bedroom		
acetone	not analyzed for non-fuel-related compounds	28	21	51	24	13,000	chronic EMEG/MRL
2-butanone		7.5	3.4	16.6	3.4	1,700	RfC
chloromethane		1.5	1.5	0.5	1.0	50	chronic EMEG/MRL
methylene chloride		2.9	11.5	4.0	3.2	300	chronic EMEG/MRL
tetrachloroethene (PCE)		0.1 (U)	1.3	0.03 (U)	0.3	40	chronic EMEG/MRL
trichloroethene (TCE)		0.7	0.6	1.3	0.3	100	intermediate EMEG/MRL

TABLE KEY

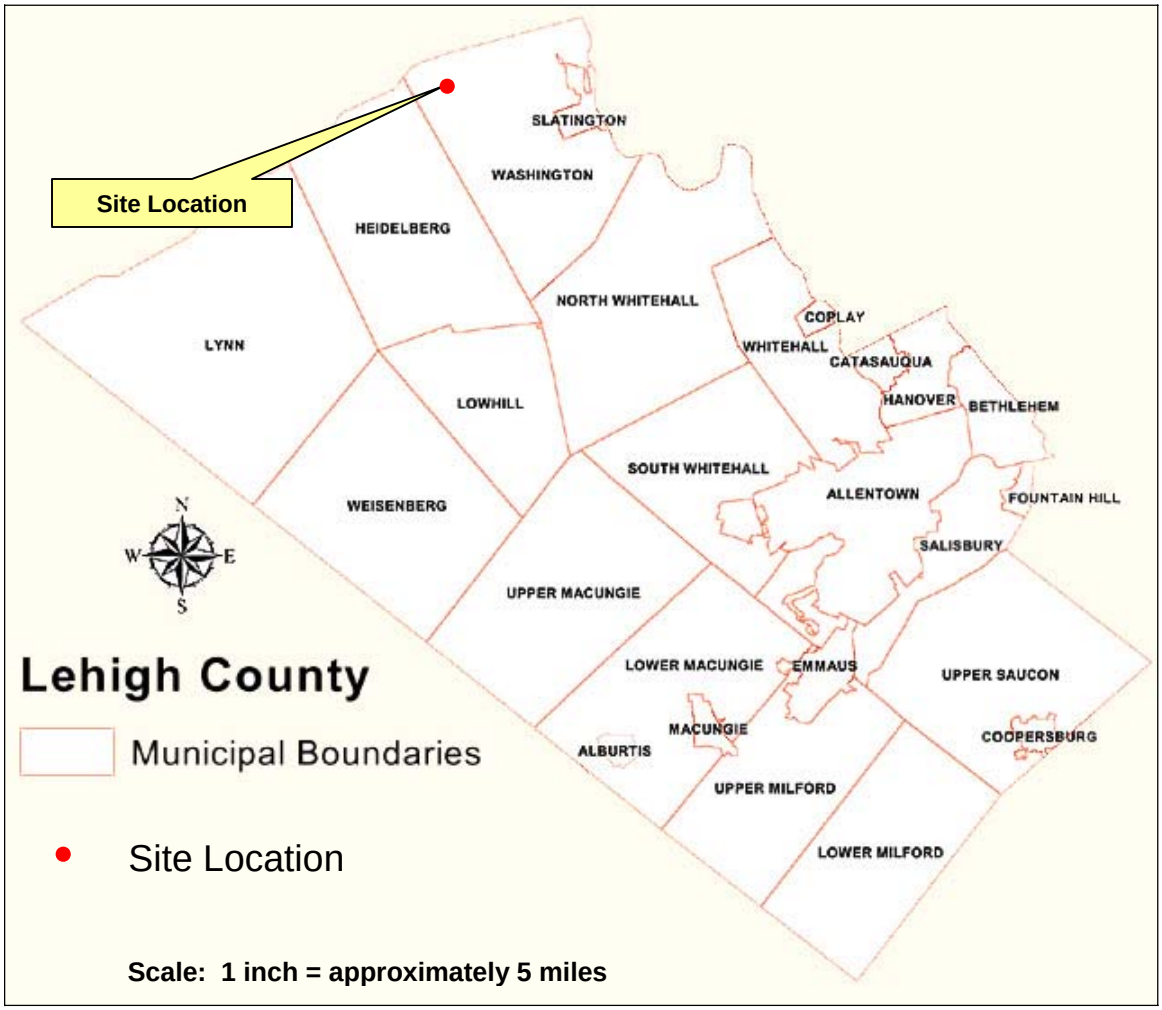
intermediate	Contact with a substance that occurs over a 14 - 365 day period
chronic	Contact with a substance that occurs over a long time (>365 days)
CREG	Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk (ATSDR)
EMEG	Environmental Media Evaluation Guide (ATSDR)
MRL	Minimal Risk Level (ATSDR)
RfC	Reference Concentration (EPA)
U	Compound was undetected at the specified quantitation limit

Appendix B

Figures

Figure 1

Bachman Spill Site Location Map



Source: Lehigh County, PA Website

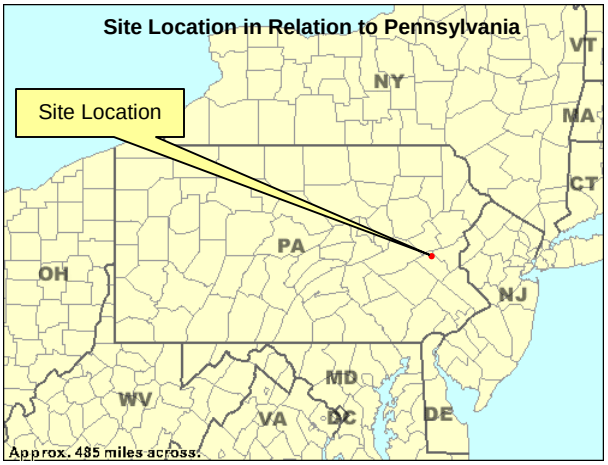
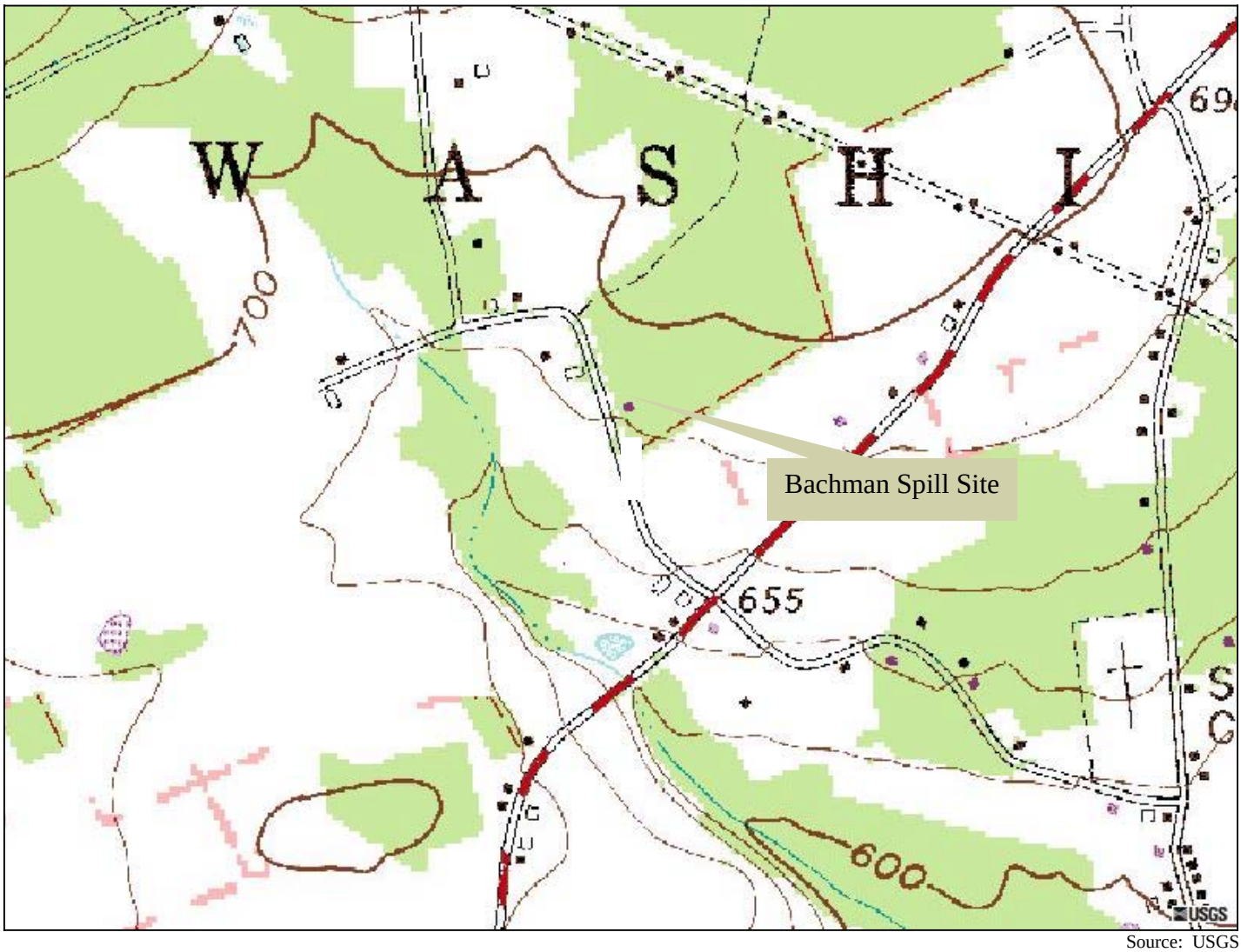
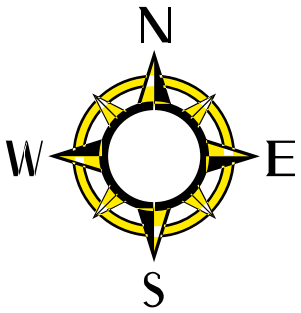


Figure 2

Bachman Spill Site Topographic Location Map (July 1995)



Source: USGS

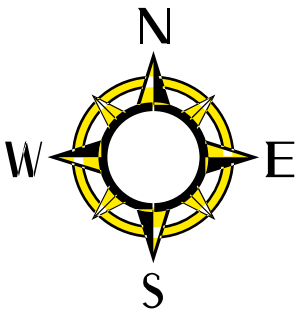


Scale: 1 inch = 200 yards

Figure 3

Bachman Spill Site from Aerial Photograph (April 1999)

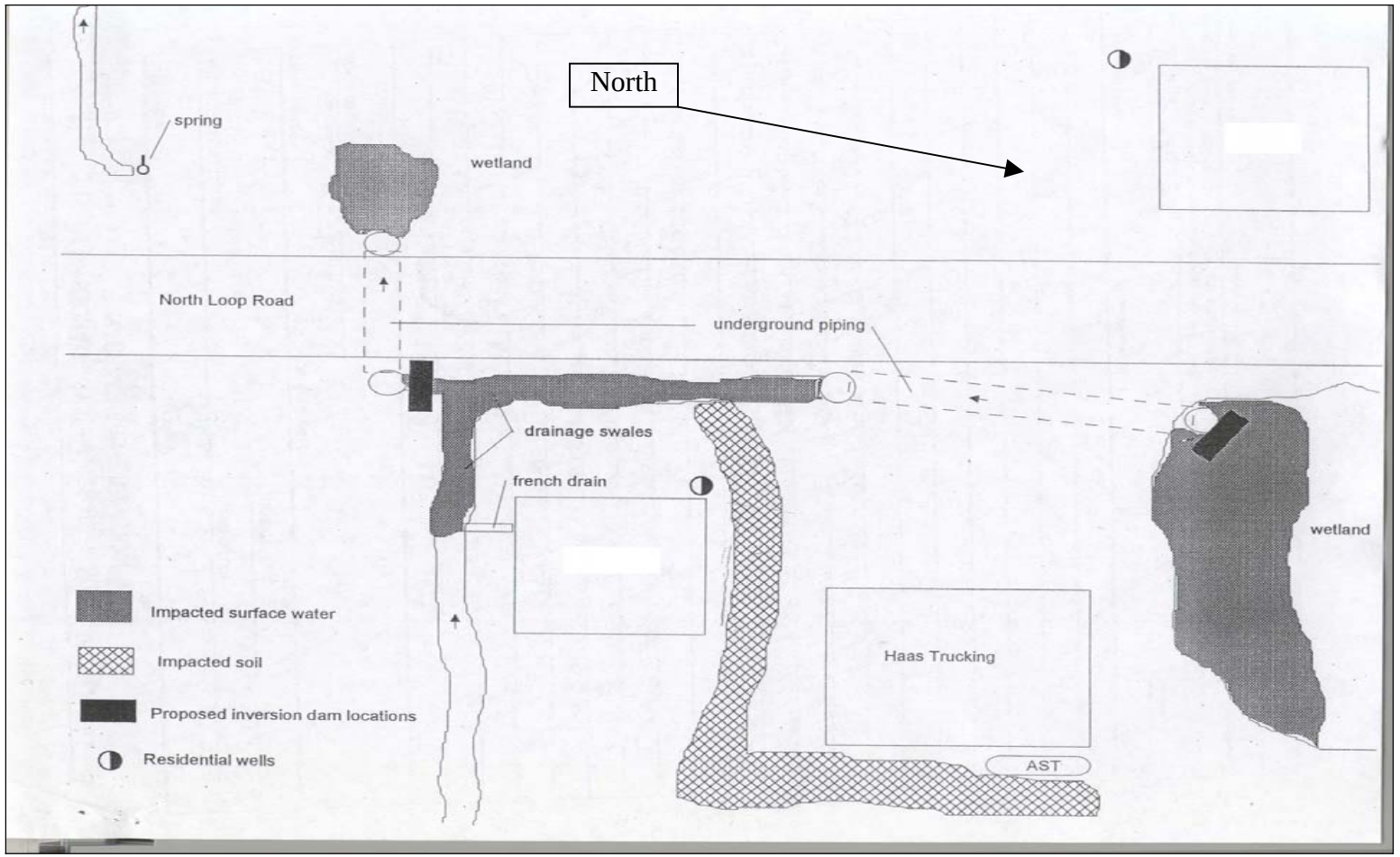
Source: USGS



Scale: 1 inch = 240 yards

Figure 4

Bachman Spill Site – Areas Impacted



Source: PADEP District Files

Scale: NTS