ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

HAMDEN MIDDLE SCHOOL
(a/k/a NEWHALL STREET FIELD)
HAMDEN, NEW HAVEN COUNTY, CONNECTICUT
EPA FACILITY ID: CTD982544355
JANUARY 8, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment 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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PUBLIC HEALTH ASSESSMENT

Evaluation of Soil, Groundwater, Soil Gas and Indoor Air Data

HAMDEN MIDDLE SCHOOL
(a/k/a NEWHALL STREET FIELD)

HAMDEN, NEW HAVEN COUNTY, CONNECTICUT

EPA FACILITY ID: CTD982544355

Prepared by:

Connecticut Department of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E60), Atlanta, GA 30333.

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The conclusions and recommendations in this public health assessment are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will review additional information when received. The review of additional data could change the conclusions and recommendations listed in this document.

SUMMARY

The Hamden Middle School is a 55,000 square foot complex consisting of four interconnected building constructed in 1955. The school and grounds cover approximately 25 acres. During the 1940s and early 1950s (prior to construction of the school), the area now occupied by the school and school grounds was used for the disposal of domestic and industrial wastes.

The purpose of this public health assessment is to evaluate the environmental sampling data and current conditions at the Hamden Middle School to determine whether the school and school grounds present a public health hazard. The Connecticut Department of Public Health (CT DPH), under its cooperative agreement with the Agency for Toxic Substances and Disease Registry, previously has prepared health consultations for several areas immediately adjacent to the Hamden Middle School (athletic fields located behind the middle school, Newhall Street School, Rochford Field, Mill Rock Park). This public health assessment builds upon information contained in these previous consultations but the data analyzed in this public health assessment has not been evaluated previously.

Environmental investigations at the Hamden Middle School have focused on surface soil, subsurface soil, indoor air in the school and soil vapor. Investigations have shown elevated levels of metals, polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons in soils at depth (to 16 feet below ground surface) on the school grounds. In surface soils, some areas with elevated PAHs, lead and arsenic were found. Those areas were capped in 2001 to eliminate potential contact with contaminants. Indoor air quality investigations showed that contaminants from the landfill waste constituents are not present in indoor air at the school. Soil vapor studies showed the presence of elevated methane below the floor in the boiler room of the school. A methane alarm was installed as a safety precaution.

To evaluate public health implications from contaminants at the Hamden Middle School, CT DPH first considered the available environmental data and how people might become exposed to contaminants. If there is no exposure, there is no threat to public health. In cases where exposure is possible, CT DPH compared maximum concentrations of contaminants with health-protective comparison values. This screening step rules out exposures that have little likelihood of causing adverse health impacts. When contaminant concentration exceeded comparison values, CT DPH further evaluated the exposures to determine the likelihood that such exposures would result in adverse health impacts.

The possible ways people could be exposed to landfill contaminants at the Hamden Middle School are through direct contact with contaminated soil (ingestion of soil, skin contact, inhaling

soil particles). Under current conditions, no exposure is occurring because soils with elevated levels of contaminants have been capped. In the past, students and staff could have been exposed while walking or running on the pathways across school grounds or while picnicking at outdoor tables near the cafeteria.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories. Based on a review of the available environmental data, CT DPH has determined that the Hamden Middle School presents "No Apparent Public Health Hazard." Although past exposures to contaminants in surface soils likely did occur, the exposures were not at levels that would result in health effects.

CT DPH did not evaluate health outcome data in this public health assessment. Based on its evaluation of the extensive environmental data, CT DPH concluded that the type, intensity and frequency of exposure to contaminants at the Hamden Middle School are not significant enough to have caused measurable adverse health effects.

CT DPH received community health concerns during numerous public and private meetings with school staff, parents and area residents. Their concerns have been identified and addressed in this public health assessment document.

Based on its evaluation of the environmental data, CT DPH's recommended actions include the following: digging into the soil on the Hamden Middle School grounds should be avoided; the soil cap and the methane alarm should be regularly inspected and maintained and followup testing of indoor air at the Middle School for the same parameters tested in 2000 should be performed.

CT DPH provided the public an opportunity to comment on this document from September 29, 2003 to December 1, 2003. CT DPH also held a public availability session in October 2003 to receive comments on this document. During the comment period, no comments were received from the public.

A. PURPOSE

The purpose of this public health assessment is to evaluate environmental sampling data and current site conditions to determine whether the Hamden Middle School and school grounds present a public health hazard. This public health assessment builds upon the results of health consultations previously prepared by ATSDR for the playing fields behind the Hamden Middle School and for the Newhall Street School, located next to the Hamden Middle School (these two health consultations are included in Attachment A). Environmental data from inside the Middle School buildings and from the Middle School grounds were not included in either of the previously prepared health consultations in provided in Attachment A.

This public health assessment evaluates the results of environmental investigations inside the Hamden Middle School and on the school grounds. Pathways by which people could be exposed to environmental contamination have been identified and evaluated. Community health concerns are also identified and addressed.

B. BACKGROUND

The Connecticut Department of Public Health (CT DPH) was asked by the Quinnipiack Valley Health District, the Town of Hamden and the CT Department of Environmental Protection (CT DEP) to evaluate the public health significance of environmental data that has been collected at the Hamden Middle School.

The Hamden Middle School is located at 560 Newhall Street in Hamden, Connecticut. The Middle School is a 55,000 square foot complex consisting of four interconnected buildings constructed in 1955 (FSS 2000, DEP 2000). The school was previously referred to as the Michael J. Whalen Junior High School. The school and adjacent grounds cover approximately 25 acres. The school grounds have parking areas, paved driveways and a grass athletic field approximately 10 acres in size. The athletic field is located behind the Middle School and consists of paved tennis courts, soccer fields, baseball fields and a small paved track area. The athletic field behind the Middle School was the subject of a health consultation completed in September 2001 by ATSDR (see Attachment A). Located next to the Middle School is the Newhall Street School, which houses community programs for children and youth, a day care and also has classrooms that are used by Hamden Middle School students. The Newhall Street School was also the subject of a past health consultation completed in April 2001. (See Attachment A). An aerial map of the school is included in Attachment B to this document (Figure 1).

Since the late 1970s, several environmental investigations have been conducted at the Middle School site. The earliest investigations focused on the athletic field, also known as the Newhall Street Field. During the 1940s and early 1950s (prior to construction of the Middle School in 1955), the Field was allegedly used by local residents for disposal of domestic waste and by the Winchester Repeating Arms Division for the disposal of old batteries (NUS 1991). As previously mentioned, an evaluation of environmental data collected from the athletic field is the subject of a separate health consultation, which is included in Attachment A.

In 1993, soil samples were collected adjacent to the south side of the school in an area being considered for an expansion to the school buildings. The results of the 1993 sampling event indicated that landfill waste materials are present beneath the school buildings, with results similar to the athletic field behind the school (FSS 2000). Expansion of the school was not initiated.

In 2000, the school again considered expanding its facility. A Phase I Environmental Site Assessment (ESA) was completed for the school in August 2000 and in November 2000, a Phase II ESA was completed. The Phase II field investigations included:

- 15 soil borings to depths 36 feet below grade around the school buildings and in the area of a fuel oil underground storage tank (UST);

- soil vapor samples from 23 locations beneath and adjacent to the school buildings to determine the presence of landfill-related and fuel oil UST-related gases; and

- surface soil samples (0-2 inches and 3-6 inches) in 13 locations near school buildings.

Results from the Phase II soil borings indicate that domestic and industrial wastes are present primarily at depth (greater than 2 feet below ground surface), beneath and adjacent to the school buildings. Elevated levels of metals, some polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons were found associated with cinders and ash-containing fill materials. The highest petroleum hydrocarbon levels were found close to the fuel oil UST (FSS 2000). Results from the Phase II soil vapor survey showed that there are elevated concentrations of methane beneath the floor of the boiler room inside the school building. One of the levels measured was within the explosive range for methane (methane forms an explosive mixture with air at concentrations between 5 percent and 15 percent). No methane was detected in ambient air in the boiler room or in indoor air elsewhere in the school. The school has installed a methane alarm in the boiler room as a safety precaution. Phase II surface soil results showed the presence of elevated PAHs in several locations near school buildings.

In response to the Phase II soil results, CT DEP recommended that a consultant hired by the Middle School (Facility Support Service) sample the school grounds in a grid pattern to better understand whether accessible surface soils have been contaminated by landfill contaminants. In December 2000 , the consultant collected approximately 75 surface soil samples (0.2-0.5 feet below ground surface) from the school grounds. Although the focus of this sampling effort was surface soils, deeper soil samples (1-1.25 feet below ground surface) were collected at approximately 23 locations. The sampling effort revealed one small area with elevated lead, one small area with elevated arsenic and larger areas with high PAHs in surface soils. Several of these areas were not grassed and received frequent pedestrian traffic. As a temporary measure to reduce exposure to these elevated contaminant levels, another contractor hired by the school covered three areas immediately surrounding the school buildings with a multi-layer cap. The cap consisted of a geotextile layer, clean soil and mulch or grass seed. This work was performed in January 2001. In August 2001, a fourth area was capped. The capped areas are indicated in the map in Attachment B.

Separate from the Phase II activities, indoor air quality evaluations were performed at the school in November/December 2000 because of: (1) concerns expressed by staff and students regarding health symptoms they believed were related to indoor air quality; and (2) to further investigate the potential for infiltration of landfill gases into the school. Air sampling locations included basement and crawlspace areas as well as classrooms and offices where staff and students spend their time.

Typical indoor air quality parameters such as carbon dioxide, temperature and relative humidity were monitored at 26 locations inside the school. Metals and volatile organic compounds (VOCs) were sampled at 7 locations inside the school and 2 locations outside. Measurements were also taken at 58 locations for mercury, hydrogen sulfide, carbon monoxide and combustible gas. PAHs were sampled in indoor air in 11 rooms of the school, one location on the roof and one outside location. With the exception of elevated PAHs in the auditorium, results from the indoor air quality testing were unremarkable. PAH results will be evaluated in the Discussion Section. The results of the indoor air quality evaluation indicated that moisture incursion had occurred in several locations within the school. Also noted was that air handling units in the school may not be working properly and air supply and return ducts and plenums have not been regularly cleaned and maintained.

In January 2001, after the cap was installed over contaminated surface soils immediately surrounding the school buildings, the school hired a contractor to thoroughly clean the school, including the heating and ventilation system. In addition, certain changes were made to the ventilation system to improve the amount of fresh outside air brought inside the school. At a public meeting held after these activities were completed, several Middle School staff stated that they noticed an improvement in comfort and fewer health symptoms among students and other staff after the cleaning and maintenance was performed.

In January 2001, the town made a decision to find a new location for the middle school rather than expand in its current location. Until a new school is ready, the town has stated that it will continue to maintain the soil cap as needed to ensure its integrity and will continue a program of regular cleaning and maintenance of the school and the school's heating and ventilation systems.

Environmental investigations to further define the nature and extent of the former landfill have extended into an 11-block section of the residential neighborhood surrounding the Hamden Middle School and into two town parks (Rochford Field and Mill Rock Park). Environmental data from the 11-block residential area is currently being evaluated by CT DPH and a public health assessment is in progress. A health consultation focusing on one residential property was completed in July 2001(ATSDR 2001b). A health consultation has also been prepared for Rochford Field and Mill Rock Park (ATSDR 2003).

1. Demographics

Hamden Middle School has approximately 1000 students (aged 11-14) and approximately 100 staff.

2. Site Visits and Health Education/Community Involvement Activities

Since fall 2000, CT DPH, in conjunction with the Quinnipiack Valley Health District and CT DEP, have conducted community involvement and health education activities regarding the Hamden Middle School, the Newhall Street School (adjacent school facility and daycare center), and the surrounding neighborhood.

- In December 2000, a public meeting was held regarding contaminated soil around the school. Over 300 teachers and parents attended.
- A fact sheet was developed to address health concerns and distributed at the December meeting and subsequent meetings.
- In December 2000, a meeting of school and community leaders was held to develop a plan to educate the school community about school contamination issues.
- In January 2001, DPH, in conjunction with the Quinnipiack Valley Health District and CT DEP, conducted a special educational presentation for all middle school students about site contamination issues.
- A fact sheet (*Environmental Hazards at Hamden Middle School: Q & A for Students*) was developed for middle school students and distributed to all students.
- Two public availability sessions were held for school community and town residents, both followed by public meetings (1/11/01, 4/10/01).
- A public meeting was conducted in February 2001 by state and local agencies regarding preliminary neighborhood sampling data.
- In May and June 2001, home visits were conducted by CT DPH and EPA with over 60 residents to deliver sampling results and answer health concerns.

Fact sheets mentioned above are included in Attachment C.

C. DISCUSSION

1. Environmental Data

In this section, results from sampling at the Hamden Middle School are presented by environmental medium. Environmental data are presented along with relevant health-based comparison values. Comparison values are screening levels, below which, there is little likelihood of adverse health effects from exposure. Exposure pathways (i.e., way people could come into contact with contaminants) and the public health significance of the exposures are discussed in later Sections of this document.

Subsurface Soils

Approximately 54 subsurface soil samples have been collected from the grounds of the Hamden Middle School. As discussed previously, the Town's Phase II activities included 15 soil borings with subsurface soil samples analyzed from various depths. Field observations during sampling indicate that fill materials consisting of cinders, ash, brick, wood, glass, copper, brass, wire and metal parts were encountered at depths greater than 2 feet at almost all boring locations. In addition, Facility Support Services, contractor to the Middle School, collected approximately 23 samples from a depth of 1 to1.25 feet deep in many locations around the school. The presence of ash was noted at many sample locations.

Table 1 below summarizes maximum concentrations for only those contaminants found in subsurface soil at levels above health protective comparison values. Lead, arsenic, petroleum hydrocarbons (TPH), chromium and several PAHs were found at levels exceeding comparison values. TPH was found at very high levels (500 times greater than the comparison value) in one sampling location, 15-16 feet below ground. This sample location is very close to the fuel oil UST and is likely related to a current or former leak in the tank. Lead and arsenic were also found at elevated levels near the UST.

Table 1. Summary of Subsurface Soil Data, Hamden Middle School Grounds, samples collected in 2000 and 2001.

Contaminant	Sample Depth (feet)	Maximum Conc. (mg/kg)	Health-based Comparison Value (mg/kg)	Comparison Value Source	Number of samples exceeding Comparison Value
Lead	15-16	14,000	400^	CT DEP site-specific cleanup criteria^	18/54
Arsenic	15-16	57	10	CTRSR RESDEC#	8/54
Chromium	1-1.25	260	trivalent 3900 hexavalent 100	CTRSR RESDEC	1/54
TPH*	15-16	250,000	500	CTRSR RESDEC	12/18
PAHs					
Benzo(a)anthracene	1-1.25	180	1	CTRSR RESDEC	13/32
Benzo(b)fluoranthene	1-1.25	220	1	CTRSR RESDEC	16/32
Benzo(k)fluoranthene	1-1.25	93	1	CTRSR RESDEC	9/23
Benzo(a)pyrene	1-1.25	150	1	CTRSR RESDEC	14/32
Indeno(1,2,3-cd)pyrene	1-1.25	74	1	CTRSR RESDEC	10/32
Dibenz(a,h)anthracene	1-1.25	21	1	CTRSR RESDEC	1/23

#CTRSR RESDEC = CT Remediation Standard Regulations Residential Direct Exposure Criteria for soil. This soil standard is developed to be protective of young children and adults with frequent, intense contact with soil over the long term (CT Remediation Standard Regulations, 12/13/95).

*TPH = Total Petroleum Hydrocarbons.

^CT DEP site-specific cleanup criterion at the Hamden Landfill sites. This criterion will eventually become part of the CT Remediation Standard Regulations and will be used statewide.

Surface Soils

Approximately 100 surface soil samples have been collected from the Hamden Middle School grounds by the Town of Hamden and by CT DEP. Field observations during sampling noted the presence of coal-like slag material on the ground surface in an area just east of the tennis courts. This area has since been capped (see map in Attachment B). Also noted was ash material in surface soils in several locations on the school grounds that have also been capped (see map in Attachment B). Table 2 summarizes maximum concentrations for contaminants found in surface soil at levels above health protective comparison values.

Table 2. Summary of Surface Soil Data, Hamden Middle School Grounds, samples collected in 2000 and 2001.

Contaminant	Sample Depth (inches)	Maximum Conc. (mg/kg)	Health-based Comparison Value (mg/kg)	Comparison Value Source	Number of samples exceeding Comparison Value
Lead	3-6	1000	400^	CTRSR RESDEC#	1/102
Arsenic	0-3	44	10	CTRSR RESDEC	3/102
PAHs					
Benzo(a)anthracene	3-6	33	1	CTRSR RESDEC	30/86
Benzo(b)fluoranthene	3-6	40	1	CTRSR RESDEC	44/86
Benzo(k)fluoranthene	3-6	28	1	CTRSR RESDEC	25/86
Benzo(a)pyrene	3-6	30	1	CTRSR RESDEC	35/86
Indeno(1,2,3-cd)pyrene	3-6	13	1	CTRSR RESDEC	18/86
Dibenz(a,h)anthracene	3-6	3.3	1	CTRSR RESDEC	7/86

#CTRSR RESDEC = CT Remediation Standard Regulations Residential Direct Exposure Criteria for soil. This soil standard is developed to be protective of young children and adults with frequent, intense contact with soil over the long term.

^CT DEP site-specific cleanup criterion at the Hamden Landfill sites. This criterion will eventually become part of the CT Remediation Standard Regulations and will be used statewide.

Soil Vapor

As mentioned previously, a survey was conducted by the Town of Hamden in October 2000 to determine whether any vapors from the landfill or the fuel oil UST are impacting the soil beneath the school buildings or the soil near the school buildings. Soil vapor samples were collected from 2 to 3 feet below ground surface at four locations within school buildings and 10 locations on school property near school buildings. Samples were analyzed instantaneously in the field for methane, hydrogen sulfide, carbon dioxide, oxygen and hydrocarbon vapors. Samples were also analyzed in the laboratory for VOCs, methane and hydrogen sulfide. The only detection was a finding of methane at 4.2 percent in the sample taken from beneath the boiler room floor. Followup sampling from nine points beneath the boiler room floor in November 2000 indicated the presence of methane at four locations at levels ranging from 2.3 percent to 5.4 percent. Landfill waste has not been conclusively shown to be the source of the methane, although it has not been ruled out as a possibility.

It is interesting to note that the boiler room is the only room in the school with concrete foundation. All other parts of the school have an asphalt-like surface in the crawl spaces. The asphalt surface in the crawl spaces has numerous cracks and would not be effective in trapping methane or other vapors and allowing them to build up beneath the foundation. On the other hand, the boiler room foundation appears to be intact and might be very effective trapping methane. This is a possible explanation for why methane was detected at elevated levels only beneath the boiler room floor.

Indoor Air

Indoor air samples in five of the 26 rooms tested indicated the presence of carbon dioxide at levels slightly above the recommended level set by the American Society of Heating, Ventilating, and Air Conditioning Engineers (ASHRAE) (ASHRAE 1999). ASHRAE recommends that indoor levels of carbon dioxide be kept below the combined total of 700 ppm plus the outdoor level. For Hamden Middle School, the recommended level is 1,125 ppm (based on outdoor measurements taken during the indoor air quality survey). Sample results for VOCs showed relatively low levels of toluene in five of the seven rooms tested. Concentrations ranged from 8 to102 ppb (30 to 380 ug/m3). One sample in one room was above the CT Residential Target Air Concentration (TAC) for toluene (56 ppb). Toluene is a common solvent used in cleaning products, inks, paints and adhesives and the findings are likely due to background sources not waste contamination.

Indoor air in eight rooms in the Middle School were also tested for PAHs. Two PAHs (naphthalene and phenanthrene) were detected in the auditorium of the Middle School. Table 3 presents the concentrations detected along with relevant health-protective comparison values. For the naphthalene sample, the laboratory reported breakthrough, meaning that the adsorption media in the sample collection tube failed to collect all of the naphthalene that was present in the air sample. However, according to the consultant who performed the sampling, the breakthrough was slight and the sample result should not reflect a significant underestimate of the actual naphthalene concentration in the air sample (Personal communication, December 27, 2000).

Table 3. Summary of PAH concentrations in Indoor Air, Auditorium, Hamden Middle School, 2000.

Contaminant	Concentration Detected (ug/m^3)	Health-based Comparison Value (ug/m^3)	Comparison Value Source
Naphthalene	2	3 10 1 50	EPA RfC[#] ATSDR chronic MRL[&] CT proposed chronic HLV[*] CT proposed acute HLV[*]
Phenanthrene	0.7	NA	-------

[#] EPA RfC = Environmental Protection Agency (EPA) Reference Concentration is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to humans (including sensitive subgroups) that is likely to be without an appreciable risk of adverse noncancer health effects during a lifetime.

[&] ATSDR chronic MRL = ATSDR chronic Minimal Risk Level is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects based on exposure duration of 365 days or longer (chronic).

[*] CT proposed HLVs = CT proposed Hazard Limit Values are limits for outdoor ambient air that are derived for use in permitting air pollution sources. Chronic values assume continuous exposure for 30 years and are protective of both cancer and noncancer effects. Acute value assumes short-term exposure (hours to several days) and are also protective of both cancer and noncancer effects.

NA = not established

Groundwater

Groundwater data collected from the Middle School indicate that groundwater has been impacted by landfill materials. Low levels of several volatile organic chemicals (VOCs) have been detected in groundwater on the Middle School grounds. However, groundwater is not used as a drinking water source and thus, there is no exposure to groundwater through ingestion. Despite this fact, staff and students at the Middle School expressed concerns about the quality of drinking water at the School. In response, the Regional Water Authority tested drinking water at the school in November 2000. With the exception of samples drawn from two, little-used water fountains, all samples were within established safe standards and guidelines. The samples from the water fountains were elevated with lead. Repeat testing after running the water in the fountain showed lead results well below the standard; thus, the source of lead was concluded to be from the plumbing.

With regard to the possibility of volatilization of VOCs from groundwater into indoor air, current data indicate that groundwater concentrations are below levels that could pose a risk to indoor air (i.e., CT Groundwater Volatilization Criteria).

2. Exposure Pathways

To evaluate potential exposures at the Hamden Middle School, CT DPH considered the available environmental data for the site and how people might come into contact with contaminants. In order to be exposed, there must be a source of hazardous contaminants, a way for people to come into direct contact with the contaminants and a way for the contaminants to enter the body. At the Hamden Middle School, contaminants have been detected in surface soil, subsurface soil, soil vapor and, to a minor extent, indoor air. Contaminants have been detected in groundwater at the Middle School property, however, groundwater is not used for drinking water and there are no other ways people could be exposed to groundwater.

For surface soils at the school, possible ways people could be exposed is by ingestion (eating soil particles adhered to fingers or food items), dermal contact (skin contact with soil during activities such as walking on paths through the school ground) and inhalation (inhaling soil particles). At the Hamden Middle School, there are various paths and walkways across and around the school grounds. There is also a courtyard and picnic bench area. Most of these areas are not well-grassed and would provide the opportunity for students and staff to come into direct contact with surface soils. In January 2001, a cap was placed over three large areas on school grounds which have elevated levels of contaminants in surface soil. Included in this capped area was the courtyard and picnic bench area. In August 2001, a cap was placed over a smaller area on the school grounds (adjacent to the tennis courts) which has elevated contaminants in surface soils. Figure 1 in Attachment B shows these areas. The caps provide a barrier against exposure to surface soils. Thus, under current conditions, there is no exposure to contaminants in surface soils. Under past conditions (before the cap was installed), there was a potential for exposure to surface soils.

Although the athletic field behind the middle school is not evaluated in this Public Health Assessment, it warrants mentioning because the exposure scenario for the field is quite different from the paths and walkways on the school grounds. The potential for contact with surface soil on the field is much greater due to the sports activities that take place there (soccer, baseball and other recreational sports). It must be emphasized that existing surface soils which were added as part of capping of the field have been tested and are not contaminated[1]. The athletic field at the Hamden Middle School was evaluated previously in a health consultation (ATSDR 2001) and was found to present no public health threat, as long as digging through the soil cap did not occur.

Subsurface soils were also found to have elevated levels of contaminants. Possible ways people could be exposed to subsurface soils are the same as those discussed above (ingestion, dermal contact and inhalation). However, exposure to subsurface soils will not occur as long as excavation, digging or other activities that penetrate into deep soils does not occur.

Environmental data collected from Hamden Middle School indicate the presence of contaminants in indoor air and soil vapor in limited areas of the school. People could be exposed to contaminants in indoor air by inhalation. Methane was found in soil gas under the school but exposure would not occur unless there was infiltration into occupied spaces of the school buildings.

If there is no actual or potential for exposure to contaminants, then it can be concluded that there is no possibility of adverse health effects from the contaminants. If there is exposure or a potential for exposure, contaminant concentrations are then compared with health-protective comparison values. Comparison values are screening levels, below which, there is little likelihood of adverse health effects from exposure. When contaminant concentrations exceed

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[1]The athletic field has a covering of clean soil which ranges in depth from approximately 2 feet to four feet.

comparison values, exposures are evaluated further. For the evaluation in this public health assessment, comparison values were taken from several sources. One source is the Connecticut DEP residential criteria for direct exposure to soil. These values assume that contact with soil occurs every day over the long term (30 years). For soil vapor, CT DPH used the Connecticut DEP residential volatilization criteria for soil vapor. These criteria are used to determine when concentrations of contaminants in soil gas are likely to result in indoor air levels which could potentially pose a health hazard. Soil gas concentrations below the volatilization criteria are not anticipated to pose a risk to people living in residential dwellings. For indoor air data, CT DPH used Connecticut's Target Air Concentrations (TACs). The TACs are part of CT DEP's remediation standard regulations and are levels that are not expected to pose a health threat, assuming a lifetime of continuous exposures. Under Connecticut's waste site cleanup regulations, at levels above the TACs, some form of remediation is required. For the evaluation of PAH data in indoor air, CT DPH also used comparison values developed by CT DEP, EPA and ATSDR. Comparison values are explained in Tables 2 and 3.

3. Health Outcome Data

If the evaluation of exposures indicates that people have or could have come into contact with contaminants at levels thought to cause adverse health effects, CT DPH evaluates health outcome data. Health outcome data are statistics that measure disease or death rates or characterize the health status of a defined group of people. Health outcome data include local and state disease registries such as cancer and birth defects registries but do not include individual medical data . CT DPH has evaluated the extensive environmental data that has been collected for the Hamden Middle School. The types and concentrations of environmental chemicals in and around the middle school and the likely exposure to those chemicals are extremely unlikely to pose a health hazard. To receive exposures large enough to cause measurable adverse health effects, people would need to have frequent and very intense contact (for example, gardening) with the highest concentrations of contaminants found in soil, every day for a lifetime. There is no evidence that this type of exposure has occurred in the past or will occur in the future. Therefore, CT DPH did not evaluate health outcome data in this public health assessment.

4. Evaluation of public health implications to adults and children

To evaluate public health implications to adults and children from contaminants at the Hamden Middle School, CT DPH considered the available environmental data and how people might become exposed to contaminants. If there is no potential for exposure, then it can be concluded that there is no threat to public health. In cases where exposure is possible, CT DPH compared maximum concentrations of contaminants with health-protective comparison values. This is a conservative (health protective) screening step to rule out exposures that have little likelihood of causing adverse health impacts. When contaminant concentrations exceeded comparison values, exposures were evaluated further to determine the likelihood that the exposures would be significant enough to cause health effects.

Subsurface Soils

As the data in Table 1 (page 8) show, subsurface soils have lead, arsenic, chromium, TPH and PAHs at concentrations greater than comparison values. However, exposures will not occur as

long as digging, excavation or other soil disturbance does not occur. As long as such activities do not occur, there will be no exposure to contaminants in subsurface soils and no health threat.

Surface Soils - Current Conditions

With regard to surface soils, it is important to emphasize that *at the present time*, a multilayer soil cap exists in the areas around the school where elevated levels of contaminants were detected in surface soils. Part of the school grounds was capped in January 2001 and the remainder was capped in August 2001. Figure 1 in Attachment B illustrates the areas that have been capped. The cap prevents contact with contaminated surface soils. Therefore, under current conditions, there is no exposure to contaminated surface soils and thus no potential health threat.

Surface Soils - Past Conditions

Before the cap was installed, there was the potential for staff, students and children who live in the surrounding neighborhood to be exposed to contaminants in surface soil while walking or running on the paths across school grounds or picnicking at outdoor benches and tables near the cafeteria. Table 2 shows that lead, arsenic and six different PAHs are present at levels exceeding comparison values. For lead and arsenic, there were only a very few samples at the middle school that exceeded comparison values (up to 3 exceedances in 102 samples). Moreover, average[2] concentrations of lead and arsenic in surface soils at the middle school (161 mg/kg and 4.7 mg/kg, respectively) are well below comparison values and are similar to typical background levels in soil (ATSDR 1999, ATSDR 2000). An average concentration is a more realistic estimate than the maximum for what people are likely to be exposed to over time. Given that average concentrations of lead and arsenic are below health comparison values, CT DPH concludes that past exposures to lead and arsenic in surface soils at the middle school are very unlikely to pose a health threat.

Table 2 also shows that PAHs were detected in surface soils more frequently and at much higher concentrations than lead and arsenic, relative to comparison values. In some cases, PAHs are as much as 30 to 40 times above comparison values. Roughly one-half of surface soil samples had at least one PAH present at levels exceeding comparison values. The comparison values for PAHs (CTRSRs) are based on an assumption that contact with soil occurs daily for 30 years and that such contact is intense, like that which would occur in a backyard during gardening or children playing directly in the soil. Contact with surface soil at the middle school would be less intense and less frequent than what was assumed in developing the CTRSRs. Walking, running and picnicking are less likely to result in intense contact with soil than gardening or children playing directly in the soil. Exposure would also have been less likely on weekends and during the summer when school is not in session. Although staff remain at the school for more years than students, staff do not have the same activity patterns as students and therefore would not have had as much opportunity for exposure as students. One of the primary reasons is that

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[2]CT DPH calculated the 95%ile Upper Confidence Limit (UCL) on the average. The UCL is an estimate of the central tendency. It accounts for variability in the data and ensures that the mean is not underestimated. CT DPH used ProUCL (EPA, May 2001) to calculate the UCL.

students walk from one classroom or building to another several times each day using the outdoor paths and walkways on the school grounds. Children in the neighborhood would also have had access to the school grounds but as mentioned previously, likely activities would be walking, running or riding bicycles which are not likely to result in intense contact with soil.

To help put potential past exposures to contaminants in surface soil into perspective, CT DPH calculated average[2] PAH concentrations. Average[2] concentrations ranged from 0.43 mg/kg (dibenz(a,h)anthracene) to 5.1 mg/kg (benzo(b)fluoranthene). These are substantially lower than the maximum concentrations used for the screening step. As stated previously, average[2] concentrations are more realistic estimates than the maximum concentrations for the levels people would have likely been exposed to over time.

Both the average[2] and maximum PAH concentrations in surface soil at Hamden Middle School are generally within ranges of typical background for PAHs in urban soil. Automobile and diesel emissions, tire wear and asphalt are major sources of PAHs in soil, especially near roadways. Residential wood burning, power plants, and incinerators are sources of PAHs in air. PAHs stuck to particles in air can eventually settle out onto the soil. Table 4 below presents typical urban soil background levels for select PAHs and compares them with maximum and average[2] concentrations for Hamden Middle School.

Table 4. Typical Urban Soil Background Levels for PAHs and PAHs Detected in Surface Soils at Hamden Middle School (HMS), 2000 and 2001.

Contaminant	Background Level (mg/kg)	Maximum PAH Concentration in Surface soil at HMS (mg/kg)	Average (as represented by the UCL) PAH Concentration in Surface Soil at HMS (mg/kg)
Benzo(a)anthracene	0.17-59	33	3.5
Benzo(b)fluoranthene	15-62	40	5.1
Benzo(a)pyrene	0.06-14	30	3.3
Indeno(1,2,3-cd)pyrene	8-61	13	1.6

Note: Background data from ATSDR 1995

Even though PAH concentrations are generally within background ranges and potential past contact with soil is not likely to have been significant, CT DPH did risk calculations to assess the theoretical cancer and noncancer risks associated with past exposure to the average[2] concentration of PAHs detected in surface soils on the Hamden Middle School grounds. The risk calculations indicate that theoretical noncancer and cancer risks are well below levels that would cause concern for adverse health impacts[3]. Attachment D shows the detailed exposure

[3]Risks were calculated for students (aged 11-13) who were assumed to come into contact with PAHs in soil by ingestion and dermal contact. Exposure frequency was assumed to be daily during the school year (5 days/week; 40 weeks/year = 200 days per year) for the three years that students spend at the middle school. The noncancer Hazard Index was 0.001. A hazard index below 1.0 means that noncancer health effects are unlikely. Excess lifetime cancer risks were estimated to be approximately 3 in one million. This is considered to be a very small incremental cancer risk.

assumptions and risk calculations. Attachment D also includes background information about the health impacts from exposure to PAHs. This information is provided for purposes of general background and not to suggest that health effects are likely.

For all the reasons discussed above, CT DPH concludes that *past* exposures to PAHs in surface soil on the grounds of the Hamden Middle School are very unlikely to have caused a public health hazard. As previously mentioned, *current* exposures to surface soil are prevented by the multilayer cap. As long as the cap provides a barrier to direct contact with contaminants in surface soil, there will be no exposure and no health threat.

Soil Vapor

As stated previously, exposure to contaminants in soil vapor would only occur if there was infiltration of soil vapor contaminants into occupied spaces of the school buildings. Results of soil vapor tests indicated that the only finding was the presence of methane at concentrations of 2.3 percent to 5.4 percent beneath the boiler room floor, not in air of occupied spaces of the school. However, methane forms an explosive mixture with air at concentrations between 5 percent and 15 percent. Therefore, the presence of methane beneath the boiler room floor could have posed an explosion threat in the past, although it was never detected in the air of the boiler room or crawl space. When the methane threat was discovered, the school installed a continuous methane monitor with alarm in the boiler room to alert school personnel and town fire officials before methane levels reach dangerous levels.

Indoor Air

As previously stated, indoor air sample results were largely unremarkable. In several rooms, carbon dioxide levels slightly exceeded relevant guidelines; indicating that there may not be enough fresh air entering the school. In one room, the air temperature was slightly above the comfort range. These findings can cause building occupants to experience headaches and feelings of stuffiness or sleepiness. These are comfort issues and not permanent health impacts.

In one room (auditorium), naphthalene (a chemical in the PAH category) was detected at a concentration above the proposed CT Hazard Limit Value (HLV) (outdoor air limit) for chronic exposure (see Table 3). This HLV assumes continuous exposure for 30 years and is protective of both cancer and potential noncancer effects. Although the concentration found in the auditorium exceeds the proposed HLV, exposure that would occur there would not be continuous. At most, someone would spend one third of continuous exposure in the auditorium (i.e., 8 hours per day versus 24 hours per day). With this reduced exposure time, naphthalene levels detected in the auditorium are very unlikely to pose a health threat.

With regard to phenanthrene (another PAH compound), which was also detected in indoor air of the auditorium, there are no readily available health-based comparison values. However, phenanthrene is not considered an especially toxic PAH (ATSDR 1995). Thus, since levels of phenanthrene in indoor air are well below health-based comparison values for naphthalene, it can be concluded that exposure to the phenanthrene in the auditorium also does not pose a health concern.

As an additional point of reference, CT DPH reviewed literature data on typical home indoor air concentrations of PAHs. Air levels of phenanthrene measured in homes without cigarette smokers ranged from 57 to 110 ug/m3 (the presence of cigarette smoke would make the air levels even higher). Average indoor air naphthalene concentrations in homes have been reported to range from 0.1 to 1 ug/m3 (ATSDR 1995). Measured PAHs in the auditorium were 0.7 ug/m3 (phenanthrene) and 2 ug/m3 (naphthalene).

It should also be mentioned that tar-like odors were reported in the auditorium a number of years ago. At that time, a fan was installed to draw air from beneath the stage and vent it outside. It is very likely that the PAHs found in air of the auditorium were coming from creosote-soaked timbers that are present beneath the stage. A large number of PAHs are present in creosote (tar). On the day the air sampling was done in the auditorium, the fan was not operating. Follow-up samples taken while the fan was operating properly indicated that there were no detectable PAHs in the air.

The final indoor air finding was a detection of toluene in one room of the school at a level almost two times higher than the TAC for toluene. Toluene was detected in several other rooms in the school at levels well below the TAC. The TACs assume continuous exposure (24 hours per day, 7 days per week). Exposure to toluene in the school would be much less than 24 hours per day. With this reduced exposure time, exposure to toluene does not pose a health concern. As mentioned previously, toluene is a common solvent used in cleaning products, inks, paints and adhesives and the finding is likely due to background sources not waste contamination.

D. EVALUATION OF COMMUNITY HEALTH CONCERNS

Community health concerns were collected by CT DPH during numerous public meetings, meetings with school staff and students, and a public availability session. In addition, CT DPH has learned about community health concerns from the local health department, CT DEP and various contractors. Community concerns are summarized below. A response is provided following each concern.

1. Many Hamden Middle School staff report experiencing symptoms such as headaches, sinus infections, bronchitis, asthma, watery eyes, stuffy nose, congestion, and comfort issues such as room temperatures being too hot or too cold.

The indoor air quality study that was done at the Hamden Middle School in November 2000 found that in several rooms, carbon dioxide levels slightly exceeded relevant guidelines. This indicates that there may not be enough fresh air entering the school. Also reported was that air handling units in the school may not be working properly and air supply and return ducts and plenums have not been regularly cleaned and maintained. Finally, in one room, the air temperature was slightly above the comfort range. Lack of fresh air, temperatures above the comfort range, and excessive dust in the air could be related to the symptoms reported by school staff. The indoor air study also noted evidence of moisture incursion in several locations within

the school. Sources of moisture that are not addressed promptly can lead to mold growth, which can cause building occupants to experience a host of respiratory symptoms.

After the November 2000 indoor air study was completed, the school performed cleaning and maintenance on its air handling system. The inside of the school was also thoroughly cleaned. After this work was performed, many staff reported improvements in the symptoms they had previously experienced.

2. School staff members are concerned that the rate of cancer among staff is higher than expected and that this could be due to exposure to environmental chemicals from the landfill beneath the school.

There has been extensive environmental sampling inside and outside the Hamden Middle School. The types and concentrations of environmental chemicals in and around the middle school and the likely exposure to those chemicals is extremely unlikely to pose a health hazard. To receive an exposure to soil contaminants large enough to present a possible health hazard, a person would need to have frequent and very intense contact (for example, gardening) with the highest concentrations of contaminants every day for a lifetime. There is no evidence that this type of exposure has occurred in the past or will occur in the future.

With regard to cancer, it is important to recognize that cancer is not a single disease but many different diseases. The causes and risk factors for one type of cancer are different from the causes and risk factors for another type of cancer. Environmental exposures are more likely to be suspected in situations that involve only one or two types of cancer. It is also important to understand that cancer is relatively common. One of every three persons will be diagnosed with cancer at some point in their lifetime.

3. School staff requested that a health study be done at the school to address the question of whether there are elevated rates of cancer at Hamden Middle School and whether there is any association with the landfill. They are disappointed that such a health study has not been initiated.

Before CT DPH begins a health study to determine if hazardous contaminants at a site has caused health impacts, it must first establish that exposure to the hazardous contaminants has occurred and then determine whether that exposure is great enough to cause disease. At the Hamden Middle School, CT DPH has reviewed existing environmental data and has determined that exposure sufficient to cause disease has ***not*** *occurred. This is the primary reason why CT DPH has not initiated a health study at the school.*

4. Staff, students and parents are concerned that methane from beneath the school building may enter the building, posing a risk of explosion.

Methane was detected in two rounds of sampling, in several locations beneath the boiler room floor. Methane was never found in the air anywhere in occupied spaces in the school. As a safety precaution, a continuous methane monitor was installed in the boiler room and it has detected no methane at any time. This device is equipped with alarms that will sound ***before***

methane levels reach potentially explosive levels. In addition, improved ventilation practices in the boiler room and crawlspaces have been instituted to reduce the potential for methane to build up to dangerous levels.

5. School staff and parents have expressed concerns about how long the cap will be protective as a barrier against exposure to contaminated soils.

Although the cap is technically referred to as an "interim" cap, it will continue to be an effective barrier against soil contact for as long as it is maintained.

6. School staff and parents have complained about tar-like odors in the auditorium. They have questioned whether it is safe for people to spend time in the auditorium.

Air sampling done in the auditorium in December 2000 detected the presence of two PAHs, naphthalene and phenanthrene. It is very likely that the PAHs found in air of the auditorium were coming from creosote-soaked timbers that are present beneath the stage. A large number of PAHs are present in creosote (tar). As discussed previously, levels of PAHs in the auditorium were relatively low and people would not be likely to spend their entire school day, every day, in the auditorium. Thus, levels of PAHs in indoor air of the auditorium are very unlikely to pose a health threat. Moreover, when odors were first observed in the auditorium a number of years ago, a system was installed to draw air from beneath the stage and vent it outside. On the day the PAHs were detected, the fan was not operating. Follow-up samples taken while the fan was operating properly indicated that there were no detectable PAHs in the air. Limited sampling data indicates that even when the fan is not operating, it is safe for people to spend time in the auditorium. However, the venting system provides an extra measure of safety and should continue to be used.

7. CT DPH has been asked by concerned parents and staff whether Hamden Middle School should remain open and if contamination is present in the school at dangerous levels.

Based on a review of available environmental data, CT DPH concludes that the school can remain open and that contaminants from the landfill are not present in the school at dangerous levels.

E. CONCLUSIONS

Extensive environmental sampling at the Hamden Middle School indicates that contaminants associated with landfill waste are present in surface and subsurface soil beneath and around school buildings. There is no exposure and no risk from contaminants in subsurface soil as long as digging or other disturbance of soils at depth does not occur. Surface soils are currently covered with a multilayer cap which prevents exposure. As long as the cap is maintained, there is no exposure and no risk from contaminants in surface soils. Regarding past exposures to surface soils, there was the potential for exposure to PAHs, arsenic and lead but not at levels that would result in adverse health impacts.

Landfill waste has not impacted indoor air in the school. With some minor exceptions, general indoor air quality parameters such as temperature, carbon dioxide and relative humidity are within recommended guidelines. Although naphthalene was detected in indoor air in the auditorium at levels above health-based comparison values, exposures are very unlikely to pose a health threat. Sampling data indicates that the existing venting system which draws air from beneath the stage and vents it outside, is reducing PAHs in the auditorium to nondetectable levels. Also, the source of the PAHs in the auditorium is not landfill waste but is likely to be from the creosote-soaked timbers present beneath the stage.

Groundwater appears to be impacted by landfill waste, but since groundwater is not used for drinking water, there is no exposure to groundwater. Soil vapor sampling indicates the presence of methane in one area beneath the boiler room floor. The methane could have posed an explosion threat in the past but a methane monitor has been installed as an early warning system.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories. ATSDR conclusion categories are included as Attachment E to this report. CT DPH has concluded that based on a review of existing environmental data, the Hamden Middle School presents no apparent public health hazard.

F. RECOMMENDATIONS

1. The multilayer soil cap installed over portions of contaminated surface soil on the school grounds should be regularly inspected by the Town of Hamden and maintained to ensure that it continues to provide an effective barrier against exposure to soil.

2. The methane alarm for the boiler room should be checked routinely by the Town of Hamden to ensure that it is working properly.

3. The Town of Hamden should ensure that air handling units in the school are regularly inspected, cleaned and maintained so that proper amounts of fresh air are being brought into the school.

4. Sources of moisture incursion in the school should be identified and corrected by the Town of Hamden as soon as possible to minimize the growth of mold.

5. The Town of Hamden should ensure that digging, excavation or other activity which penetrates into the soil anywhere on the school grounds, occur only with appropriate coordination with CT DEP.

6. The Town of Hamden should ensure that follow up indoor air testing be done in the school. This testing should include the parameters originally tested in November 2000 and should be done annually, or other reasonable time frame. The testing will indicate whether school indoor air quality has changed since November 2000.

G. PUBLIC HEALTH ACTION PLAN

Actions Taken

Since fall 2000, CT DPH staff, in conjunction with Quinnipiack Valley Health District and CT DEP, have conducted community involvement and health education activities regarding the Hamden Middle School, an adjacent school facility and daycare center (the Newhall Street School), and the surrounding neighborhood.

1. In December 2000, a public meeting was held regarding contaminated soil around the school. Over 300 teachers and parents attended.

2. A fact sheet was developed to address health concerns and distributed at the December meeting and subsequent meetings.

3. In December 2000, a meeting of school and community leaders was held to develop a plan to educate the school community about school contamination issues.

4. In January 2001, DPH, in conjunction with the Quinnipiack Valley Health District and CT DEP, conducted a special educational presentation for all middle school students about site contamination issues.

5. A fact sheet (*Environmental Hazards at Hamden Middle School: Q & A for Students*) was developed for middle school students and distributed to all students.

6. Two public availability sessions were held for school community and town residents, both followed by public meetings (1/11/01, 4/10/01).

7. A public meeting was conducted in February 2001 by state local agencies regarding preliminary neighborhood sampling data.

8. In May and June 2001, home visits were conducted to over 60 residents living in the neighborhood surrounding the Hamden Middle School to deliver sampling results and answer health concerns. These home visists were conducted by CT DPH and EPA staff.

9. On October 22, 2003, a public availability session was held to receive questions and comments on the draft release of this Public Health Assessment.

Actions Planned

1. CT DPH will continue to work with the Quinnipiack Valley Health District and CT DEP to provide technical assistance regarding developing sampling plans and evaluating data.

2. CT DEP will continue to participate in public meetings, availability sessions and other avenues for communicating health information about the site to the public.

3. CT DPH will evaluate new environmental sampling data as it becomes available.

4. CT DPH will conduct a community needs assessment in the neighborhood surrounding the Hamden Middle School. This needs assessment will focus on the the neighborhood rather than the Middle School because of the decision by the Town of Hamden to find a new location for the Middle School.

5. CT DPH will work with the Quinnipiack Valley Health District, the Town of Hamden and CT DEP as necessary to ensure that recommendations made in this Public Health Assessment are carried out in a reasonable timeframe.

6. CT DPH will prepare a written health consultation to document that recommendations were carried out and planned activities in the Public Health Action Plan were accomplished.

REFERENCES

ASHRAE 1999. Ventilation for Acceptable Indoor Air Quality, Atlanta, GA, American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE Standards 62-1999).

ATSDR 1995, Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs), US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, August 1995.

ATSDR 1999, Toxicological Profile for Lead, US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, July 1999.

ATSDR 2000, Toxicological Profile for Arsenic, US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 2000.

ATSDR 2001. Health Consultation "Public Health Evaluation of Soil Data from the Newhall Street School, prepared by CT Department of Public Health under a cooperative agreement with ATSDR, April 18, 2001.

ATSDR 2001a. Health Consultation "Public Health Evaluation of Soil Data on Athletic Field behind Hamden Middle School, prepared by CT Department of Public Health under a cooperative agreement with ATSDR, September 21, 2001.

ATSDR 2001b. Health Consultation "Public Health Evaluation of Soil Data from beneath an asphalt driveway at 1067 Winchester Avenue, Hamden, CT, prepared by CT Department of Public Health under a cooperative agreement with ATSDR, July 30, 2001.

ATSDR 2002. Public Health Assessment Guidance Manual (Update), Draft for Public Comment, March 2002.

ATSDR 2003. Health Consultation of Surface Soils in Rochford Field and Mill Rock Park, prepared by CT Department of Public Health under a cooperative agreement with ATSDR, May 19, 2003.

DEP 2000. Hamden Middle School/Newhall Street Field: Site history and ownership, Memo prepared by Shannon Windisch, CT DEP, November 2000.

EPA 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa, August 1997.

EPA 2001. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim, Review Draft - For Public Comment, EPA/540/R/99/05, September 2001.

EPA May 2001. ProUCL software

FSS 2000. Environmental Soil Quality Assessment, Soil Vapor Survey and Basement and Crawlspace Air Monitoring of Hamden Middle School. Prepared by Facility Support Services, November 2000.

NUS 1991. Final Screening Site Inspection, NUS Corporation, July 23, 1991

Personal communication, Meg Harvey, CT DPH and Gil Cormier, Occupational Risk Control Services, Inc., December 27, 2000.

CERTIFICATION

This Public Health Assessment for Soil, Soil Gas, Groundwater and Indoor Air Data at the Hamden Middle School was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Public Health Assessment was initiated.

Technical Project Officer, SPS,SSAB,DHAC

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

for RE

Chief, SPS, SSAB,DHAC,ATSDR

PREPARER OF PUBLIC HEALTH ASSESSMENT

Margaret L. Harvey, MPH
Epidemiologist
Environmental Epidemiology and Occupational Health
Connecticut Department of Public Health

ATSDR Regional Representative:

William Sweet
EPA/New England

ATSDR Technical Project Officer:

Greg V. Ulirsch
Superfund Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

ATTACHMENT A

April 18, 2001 Health Consultation
September 21, 2001 Health Consultation

Health Consultation

Public Health Evaluation of Soil Data

NEWHALL STREET SCHOOL

HAMDEN, CONNECTICUT

APRIL 18, 2001

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

Public Health Evaluation of Soil Data

NEWHALL STREET SCHOOL

HAMDEN, CONNECTICUT

Prepared by:

Connecticut Department of Public Health
under cooperative agreement with the
Agency for Toxic Substances and Disease Registry

The conclusions and recommendations in this health consultation are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will review additional information when received. The review of additional data could change the conclusions and recommendations listed in this document.

BACKGROUND AND STATEMENT OF ISSUE

The Connecticut Department of Public Health (CT DPH) was asked by the Quinnipiak Valley Health District, the Town of Hamden and the CT Department of Environmental Protection (CT DEP) to evaluate the public health significance of environmental contamination in soil around the Newhall Street School, located at 490 Newhall Street in Hamden, Connecticut. The Newhall Street School is located at the corner of Newhall and Morse Streets and is immediately adjacent to the Hamden Middle School. The Hamden Middle School is the focus of a larger environmental investigation which includes the interior of the school building, the property grounds and the athletic field behind the school. Those investigations have expanded beyond the Middle School property to Rochford Park located across Newhall Street, the surrounding residential area, and the Newhall Street School, which is the subject of this health consultation. Additional health consultations will be prepared for the other areas being investigated.

The Newhall Street School houses community programs for children and adults. There is a daycare with a total licensed capacity of 60 children, ages 3-12 years. There is also a drop-in youth center for children in grades 7 through 12 (ages 11 through 18) and a boxing program for ages 12 through adult. Numbers of participants in the drop-in and boxing programs vary from day to day. Numbers of participants in the two programs vary from a low of approximately 4 to a high of approximately 30 participants.

Environmental Data

In response to soil contamination discovered at the Hamden Middle School in November 2000, 14 surface soil samples (top 6 inches) were collected around the Newhall Street School. Samples were collected on December 16, 2000 and December 29, 2000 by contractors supervised by CT DEP and by CT DPH. Samples were tested for a large suite of semi-volatile compounds and metals. Table 1 summarizes the soil data and Attachment A is a map of soil sample locations. Soil results indicate the presence of elevated arsenic in 2 of the 14 samples (SS-6 and 68). The maximum detected concentration of arsenic was 31.3 ppm. However, a duplicate analysis of this sample showed 20.7 ppm. In 6 of the 14 samples, there were elevated levels of four polycyclic aromatic hydrocarbons (PAHs); benzo(a)anthracene, benzo(b)fluoranthene, indeno(123-cd)pyrene and benzo(a)pyrene. The maximum concentrations of benzo(a)anthracene, benzo(b)fluoranthene, indeno(123-cd)pyrene and benzo(a)pyrene are 4.2 ppm, 5.4 ppm, 2.9 and 2.2 ppm, respectively. Elevated PAHs were found at sample locations SS-1, SS-2, SS-3, SS-4, SS-5 and 64.

TABLE 1. Surface soil sample results from Newhall Street School, Hamden, CT

Contaminant	Maximum Concentration; ppm	CT RSR[@]; ppm	Number of samples exceeding CT RSR
Arsenic	31.3*	10	2 of 14
Benzo(a)anthracene	4.2	1	5 of 14
Benzo(b)fluoranthene	5.4	1	6 of 14
Indeno(123-cd)pyrene	2.9	1	5 of 14
Benzo(a)pyrene	2.2	1	1 of 14

[@] CT Remediation Standard Regulations; direct contact residential soil cleanup standards. Based on 365 d/y exposure for 30 years.
* A duplicate analysis of this result showed 20.7 ppm.

DISCUSSION

Evaluation of public health implications to adults and children

When determining the public health implications of exposure to hazardous contaminants, CT DPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective comparison values. When contaminant levels are below comparison values, we can say with relative certainty that health impacts from exposure to those levels are unlikely. When contaminant levels exceed comparison values, it does not mean that health impacts are likely. Rather, it means that exposures should be evaluated further. CT DPH has determined that the most appropriate comparison values to use for the chemicals detected at the Newhall Street School are the Connecticut Remediation Standard Regulations direct contact residential soil standards (CT RSRs). There are comparison values developed by ATSDR for arsenic and benzo(a)pyrene but they are below commonly achieved detection limits so they are of limited use in evaluating health implications at this site. CT DPH notes that using the CT RSRs does not result in arsenic and benzo(a)pyrene being eliminated from further evaluation.

In order to be exposed to contaminants in soil, you must come into direct contact with the soil by touching the soil, inhaling soil particles or eating soil adhered to fingers or food items. At the Newhall Street School, possible pathways of exposure are skin contact with soil and ingestion of soil. Inhalation of soil particles is not considered to be an important pathway because soil is vegetated and there is a very low potential for excessively dry and dusty soil conditions.

On the grounds of the Newhall Street School, there is no playground or other recreation area to attract children to frequently come into direct contact with soil. There are various paths and walkways around the property. The most heavily used area for walking is the "half courtyard" portion of the building. Paths and walkways lead from entrances in this portion of the building to the parking lot behind the building and to the Middle School. Walking across the soil appears to be the only activity that could result contact with soil.

As Table 1 indicates, arsenic and PAHs are the contaminants of interest at the Newhall Street school and will be evaluated further as described in the following paragraphs.

Arsenic

Arsenic is an element that is found naturally in soil at low levels. The arsenic that occurs naturally in soil is inorganic arsenic. Inorganic arsenic has been recognized as a human poison since ancient times. Eating very large doses of inorganic arsenic can produce death. At lower levels of exposure, over the long term, arsenic can produce a characteristic pattern of skin changes including darkening of the skin and lung and throat irritations. Arsenic is recognized as a known human carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver and lung. Attachment C provides a fact sheet with supplementary information about the health impacts from arsenic exposure.

It is important to emphasize that arsenic is found naturally in soils. Background arsenic concentrations in soil range from about 1 to 40 ppm (ATSDR 2000). Arsenic in soils may also originate from past use of pesticides containing arsenic. The history of the Newhall Street School site indicates that part, if not all of the building was built prior to construction of the Hamden Middle School and prior to wastes being placed at the Middle School site. In addition, the Newhall Street School is at a higher elevation than the Middle School. This historical information strongly suggests that landfilled waste was not deposited at the Newhall Street School site. Results from the 14 samples collected around the Newhall School support the historical information. Arsenic was found in a limited area at the Newhall Street School but is not a contaminant that is associated with waste found at the Middle School.

Arsenic was detected in two locations at levels approximately 3 times higher than the CT RSRs of 10 ppm for arsenic in residential soils (see Table 1). However, it is important to note that the residential RSRs were developed to be protective of young children playing frequently (7 days per week) and intensely in soil for many years in a setting such as a backyard or playground. CT DPH believes that such frequent and intense contact with the soil in the area where arsenic was found at the Newhall Street School is extremely unlikely. The area of elevated arsenic is on the southeast side of the building (closest to the corner of Newhall and Morse Streets). People do not walk through this area frequently because the building entrance on this side of the building is rarely, if ever used (personal communication, Susan Rabino, January 17, 2001). Moreover, if children or adults did walk through the area, little or any direct contact with the soil would occur, unless the person sat and played in the soil or dug into the soil with their hands.

Even though contact with the soil is unlikely, CT DPH did a risk calculation to assess the theoretical cancer and noncancer risks associated with a child's exposure to the maximum concentration of arsenic detected (31.3 ppm), assuming that the child was exposed to the soil 5 days per week for 18 years. CT DPH stresses that this exposure scenario is extremely unlikely. Nevertheless, if such frequent, direct contact with soil did occur, exposure to arsenic at the Newhall Street School represents a very low increased cancer risk. Regarding noncancer risks, exposures are well below the level of concern. Attachment B shows the detailed risk calculations.

Polycyclic Aromatic Hydrocarbons (PAHs)
PAHs are a group of over 100 different chemicals that are formed when coal, oil, garbage, tobacco, food or any other organic substances are burned. Some PAHs have caused cancer in laboratory animals when they were exposed for long periods of time. Some people who breathed or touched mixtures of PAHs and other chemicals for long periods of time developed cancer. Regarding noncancer effects from exposure to PAHs, animal studies have shown that PAHs can cause harmful effects on the skin, body fluids and immune system but these effects have not been seen in people. Attachment C provides a fact sheet with supplementary information about the health impacts from exposure to PAHs.

PAHs are present in soil almost everywhere. PAH levels found at the Newhall Street School are within the range of background reported for rural soils and are well below the range of background for urban soils (ATSDR 1995). Automobile and diesel emissions, tire wear and asphalt are major sources of PAHs in soil, especially near roadways. PAHs are produced when any organic materials are burned. Residential wood burning, power plants and incinerators are sources of PAHs in air. PAHs stuck to particles in air can eventually settle out onto the soil.

Elevated levels of some PAHs (benzo[a]anthracene, benzo[a]pyrene, indeno[123-cd]pyrene and benzo[b]fluoranthene) were detected in a small number of locations around the Newhall Street School. Some of the soil samples had exceedances of the CT RSRs (see Table 1). As stated above, RSRs are developed to be protective of young children exposed to soil on a regular and continuing basis. It should be noted that PAH levels found at the Newhall Street school are significantly lower than the levels of PAHs found at the Middle School.

In evaluating the potential for exposure to PAHs at the Newhall Street School, CT DPH focused on PAH concentrations found in the 'half-courtyard' area of the school grounds that is the most heavily used for walking. This area encompasses soil samples SS-1, SS-2, SS-3, 64 and 57. CT DPH calculated the average PAH concentration for that area. A table showing the average and how it was calculate is included in Attachment B as Table B-1. The average concentration for all PAHs in the half-courtyard area is 1.77 ppm. This exceeds CT RSRs for PAHs by less than two times. Even though the average concentration of PAHs slightly exceeds CT RSRs, CT DPH believes that PAHs present in the soil do not approach levels which might cause adverse health impacts, given the type of activities that occur here (walking).

Even though PAH levels in soil are extremely unlikely to cause adverse health impacts, CT DPH did risk calculations to assess the theoretical cancer and noncancer risks associated with a child's exposure to average concentrations of PAHs detected in the "half courtyard" area. Exposure assumptions used in the risk calculations are the same as those used in the calculation for arsenic. The exposure scenario evaluated is extremely unlikely. Nevertheless, if such frequent, direct contact with soil did occur, exposure to PAHs at the Newhall Street School represents an insignificant increased cancer and noncancer risk. Attachment B shows the detailed risk calculations.

EVALUATION OF COMMUNITY HEALTH CONCERNS

Parents and staff of the daycare program have asked whether hazardous waste found in soil at the Hamden Middle School is also present at the Newhall Street School. They also questioned whether there is any danger to children and staff and whether the daycare program should be moved to another site. On December 27, 2000, the Quinnipiak Valley Health District sent a letter to the daycare stating that based on available information, waste materials do not appear to be present at the Newhall Street Building and there is no reason to move the program. The letter also said that additional data would be collected to supplement what was already known. Additional data were collected, and are evaluated in this health consultation. Based on an evaluation of all available data, there is no danger to children and staff and no reason for the daycare to move to another location.

CONCLUSIONS

Soil samples taken around the Newhall Street School building show the presence of some PAHs and arsenic. At a few sample locations, concentrations exceed very conservative health-based comparison values that were developed to be protective of frequent, long-term contact with soil by young children.

There is very little opportunity for direct contact with contaminated soil. Walking across the soil is not likely to result in much, if any exposure to soil. CT DPH did calculations of the theoretical risks from exposure to arsenic and PAHs, making very conservative assumptions about exposure. **These exposure assumptions far exceed exposures actually expected to occur at the site.** The calculations indicate that theoretical risks are not high enough to pose a concern.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories. ATSDR conclusion categories are included as Attachment D to this report. CT DPH has concluded that soils around the Newhall Street School building present no apparent public health hazard.

RECOMMENDATIONS

1. As an additional measure of protection, areas that are heavily used for walking should have well-maintained grass cover or be covered with gravel or wood chips. CT DPH notes that this is not a measure it considers necessary in order for the area to be considered safe. Rather, it is an action that can easily be taken and provides an added level of protection.

PUBLIC HEALTH ACTION PLAN

Actions Taken

1. The local health department sent a letter to the daycare responding to their questions and concerns regarding whether the daycare program should move to another location.

2. CT DPH has participated in all of the public meetings held to date regarding contamination at the Hamden Middle School and surrounding sites, including the Newhall Street School.

Actions Planned

1. CT DPH will make this health consultation available to parents and staff at the Newhall Street School.

2. CT DPH will continue to participate in public meetings regarding contamination at the Hamden Middle School and surrounding sites, including the Newhall Street School.

3. CT DPH will work with CT DEP and the local health department to respond to health questions and concerns regarding hazardous contaminants at the Newhall Street School.

REFERENCES

ATSDR 2000, Toxicological Profile for Arsenic, US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, September 2000.

ATSDR 1995, Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs), US Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, August 1995.

ATSDR 1993. Public Health Assessment Guidance Manual, Agency for Toxic Substances and Disease Registry, 1993.

EPA 1999 **draft** Superfund Dermal Risk Guidance, December 1999

EPA 1997. Exposure Factors Handbook. EPA/600/P-95/002Fa, August 1997.

IRIS. EPA Integrated Risk Information System, www.epa.gov/iris/subst/index.html.

CERTIFICATION

The Health Consultation for Soil Data at the Newhall Street School in Hamden Connecticut was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Technical Project Officer, SPS,SSAB,DHAC

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

Chief, SSAB,DHAC,ATSDR

PREPARER OF HEALTH CONSULTATION

Margaret L. Harvey, MPH
Epidemiologist
Environmental Epidemiology and Occupational Health
Connecticut Department of Public Health

ATSDR Regional Representative:

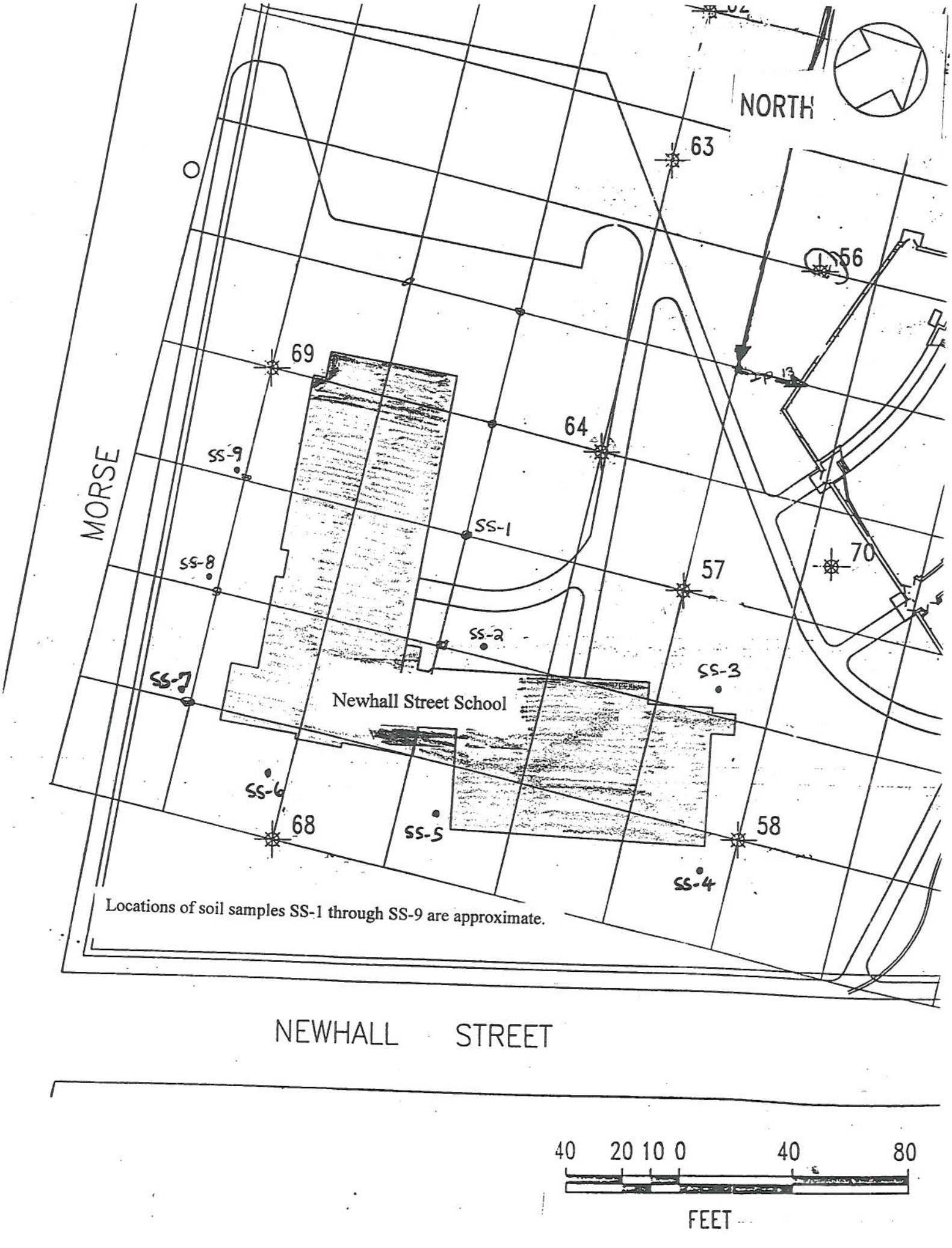
William Sweet
EPA/New England

ATSDR Technical Project Officer:

Greg V. Ulirsch
Superfund Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

ATTACHMENT A

Map of Sampling Locations at the Newhall Street School, Hamden, CT


NORTH
63
56
69
64
MORSE
SS-9
SS-1
SS-8
57
70
SS-2
SS-7
SS-3
Newhall Street School
SS-6
68
SS-5
58
SS-4
Locations of soil samples SS-1 through SS-9 are approximate.
NEWHALL STREET
40 20 10 0 40 80
FEET

ATTACHMENT B

ATTACHMENT B Theoretical Risk Calculations

The exposure assumptions made in these risk calculations are extremely conservative. Actual exposures are almost certain to be much lower. These risk calculations were done to assess the magnitude of theoretical risks, given very conservative exposure assumptions. If theoretical risks using a very conservative exposure scenario are not of concern, then risks associated with actual exposures will not be of concern either.

A. Noncancer risks, child aged 1-6 years

1a. Ingestion Dose-Arsenic

$ADD_i = IR_c * [Soil] * EF * ED * C1 * C2 * 1/BW_c * 1/AT_{nc}$

ADD_i = 100mg/d * 31.3 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 1.3 E-4 mg/kg/day

1b. Ingestion Dose-PAHs

ADD_i = 100mg/d * 1.77 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 7.58 E-6 mg/kg/day

2a. Dermal Dose-Arsenic

$ADD_d = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * 1/BW * 1/AT_{nc}$

ADD_d = 31.3 mg/kg * 0.06 mg/cm2/-ev * 0.03 * 358 cm2 * 250 d/y * 6 y * 1 ev/d * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 8.6E-7 mg/kg/day

2b. Dermal Dose-PAHs

ADD_d = 1.77 mg/kg * 0.06 mg/cm2/-ev * 0.13 * 358 cm2 * 250 d/y * 6 y * 1 ev/d * 10-6 kg/mg * y/365 d * 1/16 kg * 1/6 yr
= 2.1 E-7mg/kg/day

3a. Noncancer Hazard Index - Arsenic

$HI = ADD_i + ADD_d/RfD$

HI= (1.3E-4 mg/kg/day + 8.6E-7 mg/kg/day) / 3E-4 mg/kg/day

HI = 0.4

3b. Noncancer Hazard Index - PAHs

HI= (7.58E-6 mg/kg/day + 2.1 E-7 mg/kg/day) /0.02 mg/kg/day

HI = 0.0004

A Hazard Index of 1 means that the estimated dose is equal to the safe dose. A Hazard Index less than 1 indicates that the estimated dose is below the safe dose and noncancer health impacts are unlikely. A Hazard Index greater than 1 indicates that the estimated dose is above the safe dose and noncancer health impacts cannot be ruled out. In this case, Hazard Indices for both arsenic and PAHs are well below 1. This indicates that noncancer health impacts from arsenic and PAH exposure are unlikely.

B. Cancer Risks, child/adult age 1-18

1a. Ingestion Dose- Arsenic

$LADD_c$ = IR_c * [Soil] * EF * ED * C1 * C2 * 1/BW * $1/AT_c$

$LADD_c$ = 100 mg/d * 31.3 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/70 yr
= 1.1 E-5 mg/kg/day

$LADD_a$ = IR_a * [Soil] * EF * ED * C1 * C2 * 1/BW * $1/AT_c$

$LADD_a$ = 50 mg/d * 31.3 mg/kg * 250 d/y * 12 yr * 10-6 kg/mg * y/365 d * 1/70 kg * 1/70 yr
= 2.6E-6 mg/kg/day

1b. Ingestion Dose- PAHs

$LADD_c$ = 100 mg/d * 0.394 mg/kg * 250 d/y * 6 yr * 10-6 kg/mg * y/365 d * 1/16 kg * 1/70 yr
= 1.4 E-7 mg/kg/day

$LADD_a$ = 50 mg/d * 0.394 mg/kg * 250 d/y * 12 yr * 10-6 kg/mg * y/365 d * 1/70 kg * 1/70 yr
= 3.3 E-8 mg/kg/day

2. Dermal Dose

Noncancer risk calculations shown above indicate that only a very small fraction (1% or less) of the total estimated dose comes from dermal pathway, and the vast majority of the dose comes from the ingestion pathway. For this reason, dermal exposures were not evaluated in the cancer risk calculations.

3a. Cancer Risk- Arsenic

ELCR $= LADD_c + LADD_a * CSF$

ELCR = 1.36 E-5 * 1.5 (mg/kg/day)-1

ELCR = 2 E-5

3b. Cancer Risk- PAHs

ELCR $= LADD_c + LADD_a * CSF$

ELCR = 1.7 E-7 * 7.3 (mg/kg/day)-1

ELCR = 1 E-6

The estimated Excess Lifetime Cancer Risk for arsenic is 2 E-5 (2 in 100,000). This means that if 100,000 people were exposed to arsenic in soil at the concentration, frequency and duration of exposure assumed in the calculation detailed above, there would be a theoretical increase of 4 cancers above the number of cancers that would normally be expected to occur in the population of 100,000. Background rates of cancer in the U.S. are one in 2 or 3(American Cancer Society, 1996). This means that in a population of 100,000, background numbers of cancer cases would be approximately 33,000 to 50,000. Arsenic exposures could result in a theoretical increase of 2 cancer cases above the background number of 33,000 to 50,000 cancer case. This represents a very low increased cancer risk.

The estimated Excess Lifetime Cancer Risk for PAHs is 1 E-6 (1 in 1,000,000). This means that if 1,000,000 people were exposed to PAHs in soil at the concentration, frequency and duration of exposure assumed in the calculation detailed above, there would be a theoretical increase of 1 cancer above the number of cancers that would normally be expected to occur in the population of 1,000,000. Background rates of cancer in the U.S. are one in 2 or 3 (American Cancer Society,1996). This means that in a population of 1,000,000, background numbers of cancer cases would be approximately 330,000 to 500,000. PAH exposures could result in a theoretical increase of 1 cancer case above the background number of 330,000 to 500,000 cancer case. This represents an insignificant increased cancer risk.

WHERE:

ADD_i = average daily dose from ingestion
ADD_d = average daily dose from dermal contact
$LADD_c$ = lifetime average daily dose from ingestion for child, aged 1-6 years
$LADD_a$ = lifetime average daily dose from ingestion for adult, aged 7-18 years
IR_c = soil ingestion rate for a child; 100 mg/day (EPA 1997, ATSDR 1993)*
IR_a = soil ingestion rate for an adult; 50 mg/day (EPA 1997, ATSDR 1993)*
AF = skin-soil adherence factor for central tendency residential child; 0.06 mg/cm^2-ev (EPA 1999)

ABS_d = Soil dermal absorption fraction
Arsenic: 0.03 (EPA 1999)
PAHs: 0.13 (EPA 1999)

SA_c = Skin surface area, 50th %ile hands, child aged 1-6; 358 cm^2 (EPA 1997)

[Soil] = soil concentration
Arsenic: 31.3 mg/kg (maximum concentration detected)
PAHs, noncancer calculation: 1.77 mg/kg (average for all PAHs in 'half courtyard' area, see Table B1)
PAHs, cancer calculation: 0.394 mg/kg (TEF-adjusted average for all PAHs in 'half courtyard' area, see Table B1)

EF = exposure frequency; 250 d/y (5 days/week, 50 weeks/year)

F = event frequency; 1 ev/d

ED = exposure duration; 6 years for noncancer, 18 years for cancer

C1 = conversion factor; 10-6 kg/mg

C2 = conversion factor; 1 year/365 days

BW_c = child 50th %ile body weight for age 1-6 yrs (ATSDR 1993); 16 kg

BW_a = adult 50th %ile body weight (ATSDR 1993); 70 kg

AT_{nc} = averaging time for noncancer risk; 6 years

AT_c = averaging time for cancer risk; 70 years

RfD = EPA Reference Dose
Arsenic: 3E-4 mg/kg/day (IRIS)
PAHs: naphthalene used as a surrogate for PAHs; 0.02 mg/kg/day (IRIS)

CSF = Cancer Slope Factor
Arsenic: 1.5(mg/kg/d)$^{-1}$ (IRIS)
PAHs: CSF for benzo(a)pyrene used with TEF-weighted PAH concentrations; 7.3 (mg/kg/d)$^{-1}$ (IRIS)

HI = Hazard Index; a measure of theoretical noncancer health risks

ELCR = Excess Lifetime Cancer Risk

** EPA (1997) recommends using soil ingestion rates of 100 mg/day for a child <6 years and 50 mg/day for a child/adult ≥ 6 years. EPA states that these values represent best estimates of average soil ingestion rates. EPA programs have used 200 mg/day and 100 mg/day as conservative estimates of average soil intake rates. CT DPH opted to use the best estimate average values of 100 mg/day and 50 mg/day rather than the more conservative estimates for the sake of consistency with other parameters describing the receptor which are also central estimates (for example, body weight, skin surface area and skin-soil adherence).*

TABLE B1. Values used to calculate average PAH concentrations for cancer and noncancer risk calculations.

PAH	TEF[a]	SS3		SS2		SS1		64		57	
		Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.	Detected Conc. (mg/kg)	TEF-adjusted conc.
Benzo(a)anthracene	0.1	4.2	0.42	2.78	0.278	1.54	0.154	0.6	0.06	0.2	0.02
Benzo(b)fluoranthene	0.1	5.4	0.54	4.45	0.445	2.25	0.225	1.3	0.13	0.6	0.06
Benzo(a)pyrene	1	2.2	2.2	0.54	0.54	0.91	0.91	0.76	0.76	0.4	0.4
Indeno(123-cd)pyrene	0.1	2.93	0.293	2.42	0.242	1.37	0.137	0.5	0.05	0.2	0.02

TEF[a] = Toxic Equivalency Factor (ATSDR 1995)

Average detected concentration for all PAHs at all locations = 1.77 mg/kg (used for noncancer calculations)
Average TEF-adjusted concentration for all PAHs at all locations = 0.394 mg/kg (used for cancer calculations)

ATTACHMENT C

Supplementary Information on Health Effects from Exposure to Arsenic and PAHs

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry — September 1996

This fact sheet answers the most frequently asked health questions about polycyclic aromatic hydrocarbons. For more information, you may call 404-639-6000. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polycyclic aromatic hydrocarbons?

(Pronounced pŏl′ĭ-sī′klĭk ăr′ə-măt′ĭk hī′drə-kar′bənz)

Polycyclic aromatic hydrocarbons (PAHs) are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

What happens to PAHs when they enter the environment?

- PAHs enter the air mostly as releases from volcanoes, forest fires, burning coal, and automobile exhaust.
- PAHs can occur in air attached to dust particles.
- Some PAH particles can readily evaporate into the air from soil or surface waters.
- PAHs can break down by reacting with sunlight and other chemicals in the air, over a period of days to weeks.
- PAHs enter water through discharges from industrial and wastewater treatment plants.
- Most PAHs do not dissolve easily in water. They stick to solid particles and settle to the bottoms of lakes or rivers.
- Microorganisms can break down PAHs in soil or water after a period of weeks to months.
- In soils, PAHs are most likely to stick tightly to particles; certain PAHs move through soil to contaminate underground water.
- PAH contents of plants and animals may be much higher than PAH contents of soil or water in which they live.

How might I be exposed to PAHs?

- Breathing air containing PAHs in the workplace of coking, coal-tar, and asphalt production plants; smokehouses; and municipal trash incineration facilities.
- Breathing air containing PAHs from cigarette smoke, wood smoke, vehicle exhausts, asphalt roads, or agricultural burn smoke.
- Coming in contact with air, water, or soil near hazardous waste sites.
- Eating grilled or charred meats; contaminated cereals, flour, bread, vegetables, fruits, meats; and processed or pickled foods.

POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

- ☐ Drinking contaminated water or cow's milk.
- ☐ Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

How can PAHs affect my health?

Mice that were fed high levels of one PAH during pregnancy had difficulty reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. It is not known whether these effects occur in people.

Animal studies have also shown that PAHs can cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure. But these effects have not been seen in people.

How likely are PAHs to cause cancer?

The Department of Health and Human Services (DHHS) has determined that some PAHs may reasonably be expected to be carcinogens.

Some people who have breathed or touched mixtures of PAHs and other chemicals for long periods of time have developed cancer. Some PAHs have caused cancer in laboratory animals when they breathed air containing them (lung cancer), ingested them in food (stomach cancer), or had them applied to their skin (skin cancer).

Is there a medical test to show whether I've been exposed to PAHs?

In the body, PAHs are changed into chemicals that can attach to substances within the body. There are special tests that can detect PAHs attached to these substances in body tissues or blood. However, these tests cannot tell whether any health effects will occur or find out the extent or source of your exposure to the PAHs. The tests aren't usually available in your doctor's office because special equipment is needed to conduct them.

Has the federal government made recommendations to protect human health?

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar, and mineral oil.

Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns. For more information, contact: Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333, Phone: 404-639-6000, FAX: 404-639-6315. ATSDR Internet home page via WWW is http://atsdr1.atsdr.cdc.gov:8080/atsdrhome.html

ATSDR

ARSENIC

Agency for Toxic Substances and Disease Registry **April 1993**

This fact sheet answers the most frequently asked health questions about arsenic. For more information, you may call 404-639-6000. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

SUMMARY: Exposure to higher than average levels of arsenic happens mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. Arsenic is a powerful poison. At high levels, it can cause death or illness. This chemical has been found in at least 781 of 1,300 National Priorities List sites identified by the Environmental Protection Agency.

What is arsenic?
(Pronounced ar′ sè - nik)

Arsenic is found in nature at low levels. It's mostly in compounds with oxygen, chlorine, and sulfur. These are called inorganic arsenic compounds. Arsenic in plants and animals combines with carbon and hydrogen. This is called organic arsenic. Organic arsenic is usually less harmful than inorganic arsenic.

Most arsenic compounds have no smell or special taste.

Inorganic arsenic compounds are mainly used to preserve wood. They are also used to make insecticides and weed killers. You can check the labels of treated wood and insecticides to see if they contain arsenic.

Copper and lead ores contain small amounts of arsenic.

What happens to arsenic when it enters the environment?

- ❑ It doesn't evaporate.
- ❑ Most arsenic compounds can dissolve in water.
- ❑ It gets into air when contaminated materials are burned.
- ❑ It settles from the air to the ground.
- ❑ It doesn't break down, but can change from one form to another.
- ❑ Fish and shellfish build up organic arsenic in their tissues, but most of the arsenic in fish isn't toxic.

How might I be exposed to arsenic?

- ❑ Breathing sawdust or burning smoke from wood containing arsenic
- ❑ Breathing workplace air
- ❑ Ingesting contaminated water, soil, or air at waste sites
- ❑ Ingesting contaminated water, soil, or air near areas naturally high in arsenic.

How can arsenic affect my health?

Inorganic arsenic is a human poison. Organic arsenic is less harmful.

High levels of inorganic arsenic in food or water can be fatal. A high level is 60 parts of arsenic per million parts of food or water (60 ppm). Arsenic damages many tissues including nerves, stomach and intestines, and skin. Breathing high levels can give you a sore throat and irritated lungs.

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Lower levels of exposure to inorganic arsenic may cause:

- Nausea, vomiting, and diarrhea
- Decreased production of red and white blood cells
- Abnormal heart rhythm
- Blood vessel damage
- A "pins and needles" sensation in hands and feet.

Long term exposure to inorganic arsenic may lead to a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso.

Direct skin contact may cause redness and swelling.

How likely is arsenic to cause cancer?

The Department of Health and Human Services (DHHS) has determined that arsenic is a known carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver, and lung.

Is there a medical test to show whether I've been exposed to arsenic?

Tests can measure your exposure to high levels of arsenic. These tests are not routinely performed in a doctor's office.

Arsenic can be measured in your urine. This is the most reliable test for arsenic exposure. Since arsenic stays in the body only a short time, you must have the test soon after exposure.

Tests on hair or fingernails can measure your exposure to high levels of arsenic over the past 6-12 months. These tests are not very useful for low level exposures.

These tests do not predict whether you will have any harmful health effects.

Has the federal government made recommendations to protect human health?

The Environmental Protection Agency (EPA) sets limits on the amount of arsenic that industrial sources can release. It restricted or canceled many uses of arsenic in pesticides and may restrict more. EPA set a limit of 0.05 parts per million (ppm) for arsenic in drinking water. EPA may lower this further.

The Occupational Safety and Health Administration (OSHA) established a maximum permissible exposure limit for workplace airborne arsenic of 10 micrograms per cubic meter ($\mu g/m^3$).

Glossary

Carcinogen: Substance that can cause cancer.
Ingesting: Taking food or drink into your body.
PPM: Parts per million.
Microgram (µg): One millionth of a gram.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Toxicological profile for arsenic. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. Case studies in environmental medicine: Arsenic toxicity. Atlanta: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns. For more information, contact: Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop E-29, Atlanta, GA 30333, Phone: 404-639-6000.

ATTACHMENT D: ATSDR Public Health Hazard Categories

Category	Definition	Criteria
A. Urgent public health hazard	This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon short-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention AND/OR physical hazards at the site pose an imminent risk of physical injury
B. Public health hazard	This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon long-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention
C. Indeterminate public health hazard	This category is used for sites with incomplete information.	limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects; data or information are not available for all environmental media to which humans may be exposed AND there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health
D. No apparent public health hazard	This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.	exposures do not exceed an ATSDR chronic MRL or other comparable value AND data are available for all environmental media to which humans are being exposed AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health
E. No public health hazard	This category is used for sites that do not pose a public health hazard.	no evidence of current or past human exposure to contaminated media AND future exposures to contaminated media are not likely to occur AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health

Health Consultation

Public Health Evaluation of Soil Data
Athletic Playing Field Behind Hamden Middle School

HAMDEN MIDDLE SCHOOL
(a/k/a NEWHALL STREET FIELD)

HAMDEN, NEW HAVEN COUNTY, CONNECTICUT

EPA FACILITY ID: CTD982544355

SEPTEMBER 21, 2001

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

Public Health Evaluation of Soil Data
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EPA FACILITY ID: CTD982544355

Prepared by:

Connecticut Department of Public Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

The conclusions and recommendations in this health consultation are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will review additional information when received. The review of additional data could change the conclusions and recommendations listed in this document.

BACKGROUND AND STATEMENT OF ISSUE

The Connecticut Department of Public Health (CT DPH) was asked by the Quinnipiack Valley Health District, the Town of Hamden and the CT Department of Environmental Protection (CT DEP) to evaluate the public health significance of soil data collected at the athletic field behind the Hamden Middle School. The Hamden Middle School is located at 560 Newhall Street in Hamden, Connecticut. The athletic field (the Field) is approximately four acres in size and is located on the west side of the middle school. It consists of paved tennis courts, soccer fields, baseball fields and a small paved track area. The Field was historically known as the Newhall Street Field and is bordered by private residences, an industrial park and by the buildings of the middle school. The Middle School itself has been the subject of an extensive environmental investigation which is covered in a separate public health assessment. Figure A is a site plan showing the school, the Field and selected sampling locations.

During the 1940s and 1950s the Field was allegedly used by local residents for disposal of domestic waste and by the Winchester Repeating Arms Division for the disposal of old batteries (NUS 1991). Hamden Middle School was built in 1955. According to some reports, the Field continued to be used for waste disposal for a period of time after the school was built.

Since the late 1970s, a number of soil sampling investigations have occurred at the Field. These investigations have documented the presence of numerous contaminants both at the surface and at depth. Visual observations made during sampling investigations noted the presence of "a black ash-like material with traces of brick/wood pulp or cinders" in sample locations at a minimum depth of 12 inches below grade (CDM 1994).

In August 1991, EPA's Removal Program completed a Preliminary Assessment/Site Investigation report for the Field in which they concluded that the amount and type of contamination present at the Field did not warrant a Federal response (Weston 1991).

ATSDR and CT DPH previously have been asked to make public health evaluations of data collected at the Hamden Middle School athletic field. In November 1991, at the request of EPA, ATSDR prepared a health consultation for the Field (ATSDR 1991). ATSDR concluded that based on limited data, lead contaminated soils at the Field posed a health threat to children playing in areas of exposed soils. They recommended that more sampling be done to better characterize lead contaminated soils and that the need for covering the Field be considered. At the time ATSDR prepared the health consultation, the Middle School was considering construction of a new athletic field at the same location. ATSDR further recommended that

precautions be taken during any excavation work to minimize soil dust and prevent exposures to children and construction workers.

In May 1992, at the request of the Quinnipiack Valley Health District, the CT DPH was asked to comment on potential health impacts associated with use of the Field (CT DPH 1992). CT DPH reviewed the most recent data available for the Field at that time and concluded that given the Field's grass-covered condition, it was safe to use. CT DPH's conclusion was based on EPA's lead exposure model which showed that at the maximum lead concentration detected in surface soil (1600 mg/kg), the Field would not contribute significantly to childrens' blood lead levels. CT DPH recommended that the grass cover on the field be maintained and that the potential for health impacts be reevaluated before any excavation activities were undertaken.

In 1993, HRP Associates Inc., under contract to the Town of Hamden, sampled the athletic field for the purpose of more fully characterizing the lead contamination and recommending an action plan to the Town. Sometime between 1994 and 1996, the Town capped the Field with clean fill and reconstructed the existing athletic facilities.

In late 2000, residents began to question whether the athletic Field was safe because of the extensive environmental investigations that were going on at the middle school. In February 2001, in response to residents' concerns about the safety of the field, CT DEP collected 26 surface soil samples (top 6 inches) in a grid pattern across the Field (samples shown in red in Figure A). They also collected core samples to a depth of four feet to visually confirm that a clean soil cap was present. DEP sample results confirm that surface soil at the Field is clean. Visual evidence confirms that the clean soil cap is present. Cap thickness ranges from a minimum of two feet to a maximum of four feet.

In April 2001, as part of an investigation EPA was conducting of contaminated landfill materials in the residential area adjacent to the Hamden Middle School, EPA discovered elevated levels of lead in surface soil (0-6 inches) in some of the residential yards along the southern side of the Field (Morse Street side). Further EPA sampling revealed that the elevated lead extends approximately 25 feet beyond the residential property lines toward the Field (samples shown in green in Figure A). Because that area is accessible to people walking between the Field and the Newhall Street School Parking lot, the Town of Hamden, at the direction of CT DEP and CT DPH, quickly installed snow fencing to restrict access to the area with elevated lead. In early May 2001, CT DEP collected 35 surface (0-3 inches) soil samples to better define the extent of elevated contaminants in the area (samples shown in blue in Figure A). Samples were analyzed for metals and semi-volatile organic compounds (SVOCs). CT DEP sample results indicated that the high lead levels found by EPA are limited to a narrow area along the residential property line. CT DEP sampling results also indicated some elevated levels of polycyclic aromatic hydrocarbons (PAHs) next to the Newhall Street School parking lot. As precaution against potential exposure, the Town immediately covered the entire area sampled by EPA and DEP (samples shown in green and blue) with wood chips. During the summer 2001, the Town will place an asphalt walkway through the area and will maintain the woodchips around the walkway area.

Demographics
The Hamden Middle School athletic field is used by middle school students, the Hamden Soccer Association, and nearby residents. There are approximately 1000 students (aged 11-14) in the middle school. Middle School students may use the Field an average of 1 to 4 hours per week during the nine month school year.

The Hamden Soccer Association uses the Field for soccer practices and games. There are approximately 600 children (aged 4 to 10 years) who have used the Field in past years for soccer practice and games. Currently, there are approximately 450 children (aged 6 to 10 years) who play soccer on the Field. In addition, there are approximately 15 junior referees (aged 12-15 years) and 55 adult coaches who use the Field as part of the youth soccer program. Usage of the Field for soccer games and practices is approximately 2 to 4 hours per week during the spring and fall soccer seasons. In addition to the children who play soccer at the Field, there are families with young children who regularly visit the Field to watch soccer practices and games.

There are approximately 639 children under the age of 18 who live within a one-block distance of the Field who could access to the Field for playing (1990 US Census).

Environmental Data and Exposure Pathways
To evaluate potential exposures at the Hamden Middle School Athletic Field, CT DEP considered the available environmental data for the site and how people might come into contact with contaminants. To evaluate past exposures, CT DEP considered soil data collected prior to the town of Hamden placing clean soil over contaminated areas. If there is no potential for exposure to contaminants, then it can be concluded that there is no possibility of adverse health effects from the contaminants. If there is potential exposure, contaminant concentrations are then compared with health-protective comparison values. Comparison values are screening levels, below which, there is little likelihood of adverse health effects from exposure. When contaminant concentrations exceed comparison values, exposures are evaluated further. For this site, comparison values were taken from two sources. One source is the Connecticut residential criteria for direct exposure to soil (CT RSRs). These values assume that contact with soil occurs every day over the long term (30 years). ATSDR-developed comparison values were also used for some contaminants. ATSDR comparison values also assume frequent contact with soil over the long term.

Since 1979, over 100 surface and subsurface soil samples have been collected at the Hamden Middle School Athletic Field. Prior to the Town installing the soil cap on the Field in the mid-1990s, both surface and subsurface soils were sampled on several occasions. Those sampling data show that metals including lead, arsenic, antimony, manganese and chromium are present at elevated levels in surface and subsurface soils.

Table 1 summarizes the soil sampling results from the Filed *prior to installation of the clean soil cap* in the mid-1990s. Maximum concentrations in surface and subsurface soils are included. Health protective comparison values are also shown. Contaminants detected below comparison values are not included in Table 1.

Table 1. Summary of soil data from Hamden Middle School Athletic Field, Hamden, CT
Data were collected **prior to** the town installing the clean soil cap over the Field.

Contaminant	Max. Conc. ANY DEPTH (mg/kg)	Sample Depth (inches)	Max. conc. in Surface Soil@	Comparison Value (mg/kg)	Comparison Value Source
Antimony	66	12	5.1	20	child RMEG
Arsenic	18.5	12	4.1	0.5 10	CREG CT RSR
Chromium (unspeciated)	300	4	300	3900 Cr III 100 Cr VI	CT RSR CT RSR
Lead	56,000*	12	4855	500	CT RSR
Manganese	5920	6	5920	3000	child RMEG

* This sample was significantly higher than any of the other 68 soil samples for lead. The next highest lead level measured at the Field was 4855 mg/kg.
@ Only samples taken within the top 6 inches were considered surface soil samples.
CT RSR = Connecticut residential criteria for direct exposure to soil; 365 days/year exposure for 30 years.
child RMEG = Reference Dose Media Evaluation Guide for children (noncancer effects).
chronic EMEG = Chronic (exposure $\geq$ 365 days) Environmental Media Evaluation Guide (noncancer effects).
CREG = Cancer Risk Evaluation Guide for 1 x 10-6 cancer risk based on lifetime exposure.

Soil samples collected by CT DEP in February 2001 show that the Field in its current condition has a clean soil cap that ranges from 2 feet to 4 feet in thickness. Soil samples were analyzed for metals and SVOCs and all results were well below CT DEP residential cleanup standards for direct exposure to soil (CT RSRs). CT RSRs are developed to be protective for direct exposure to soil, assuming exposure occurs 365 days per year for 30 years.

As mentioned above, elevated lead was found in surface soils along the southern side of the Field, near the fence separating Middle School property from residences along Morse Street. This area is not part of the athletic field per se, but is used as a walkway to and from the Field.

Table 2 provides a summary of surface soil results from the walkway area. Maximum concentrations are included. Health protective comparison values are also shown. Contaminants detected below comparison values are not included in Table 2.

Table 2. Summary of surface soil data from walkway area to Hamden Middle School Athletic Field, Hamden, CT Data were collected **prior to** the town installing fencing and placing woodchips over the area.

Contaminant	Maximum Concentration (mg/kg)	Comparison Value	Comparison Value Source	Number of samples exceeding Comparison Value
Lead	15,000	500	CT RSR	10 of 51
Arsenic	44	0.5 10	CREG CT RSR	37 of 39 2 of 39
Benzo(a)pyrene	4.7	0.1 1	CREG CT RSR	16 of 39 8 of 39
Benzo(a)anthracene	3.4	1	CT RSR	7 of 39
Benzo(b)fluoranthene	9	1	CT RSR	9 of 39
Indeno(1,2,3-cd)pyrene	3.1	1	CT RSR	3 of 39

CT RSR = Connecticut residential criteria for direct exposure to soil; 365 days/year exposure for 30 years.
CREG = Cancer Risk Evaluation Guide for 1 x 10-6 cancer risk based on lifetime exposure.

In order to be exposed to soil contaminants at the Hamden Middle School athletic field, one must come into direct contact with the soil by touching it (dermal contact), breathing in soil particles (inhalation) or eating soil adhered to fingers or food items (ingestion). Under current conditions, there are no pathways by which someone could be exposed to soil contaminants at the Field because the Field is grassed and has a two to four foot thick clean soil cap. Also, access to contaminated soil in the walkway area is restricted by fencing and a covering of wood chips.

Under past site conditions, prior to the mid-1990s when the town installed the soil cap, it is possible that exposure to soil contaminants at the Field could have occurred to children or adults by dermal contact, inhalation or ingestion. It is also possible that dermal, inhalation or ingestion exposure to lead and PAHs in soil in the walkway area could have occurred in the past, before the Town of Hamden fenced and covered the area with woodchips in the spring of 2001.

DISCUSSION

Evaluation of public health implications to adults and children

When determining the public health implications of exposure to hazardous contaminants, CT DPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective comparison values. When contaminant levels are below comparison values, we can say with relative certainty that health impacts from exposure to those levels are unlikely. When contaminant levels exceed comparison values, it does not mean that health impacts are likely. Rather, it means that exposures should be evaluated further.

Current Site Conditions - Field and Walkway Area
As stated above, there is no exposure to soil contaminants under current site conditions because the Field is grassed and is covered with a clean soil cap which provides a barrier between people and the soil contamination. Soil contaminants in the walkway area are currently covered with a layer of woodchips and access to the area of highest concentration is restricted by a fence. Without exposure to the contaminants, there is no potential for adverse health effects.

Past Site Conditions at the Athletic Field (prior to installation of cap in mid-1990s)
In the past, prior to the Town installing the soil cap, people using the Field could have come into contact with soil contaminants. As Table 1 shows, five contaminants were detected above comparison values. However, surface soils (top 6 inches) are generally much lower in concentration than deeper soils. Only four surface soil contaminants; arsenic, chromium, lead and manganese exceed comparison values. In the past, people would have been much more likely to come into contact with surface soils on a regular and continuing basis than they would have with deeper soils. Digging would have had to occur in order for deeper soils to be contacted. It is reasonable to assume that in the past, people would not have been exposed on a regular and continuing basis to soils at depth.

Arsenic
Arsenic is an element that is found naturally in soil at low levels. The arsenic that occurs naturally in soil is inorganic arsenic. Inorganic arsenic has been recognized as a human poison since ancient times. Eating very large doses of inorganic arsenic can produce death. At lower levels of exposure, over the long term, arsenic can produce a characteristic pattern of skin changes including darkening of the skin and lung and throat irritations. Arsenic is recognized as a known human carcinogen. Breathing inorganic arsenic increases the risk of lung cancer. Ingesting inorganic arsenic increases the risk of skin cancer and tumors of the bladder, kidney, liver and lung (ATSDR Toxicological Profile, 2000). These health impacts from arsenic exposure are provided for general information and not to imply that these effects would be expected from exposures at the site.

Prior to installation of the clean soil cap, only one surface soil sample at the Field was analyzed for arsenic. Arsenic was found at a concentration of 4.1 mg/kg. With only one surface soil sample, it is difficult to reach a conclusion about potential health effects. However, eleven depth samples showed arsenic ranging from 0.69 mg/kg to 18.5 mg/kg. The average concentration at depth is roughly the same as the level found at the surface. It seems reasonable to assume that the average arsenic concentration at the surface is similar to the average at depth. The arsenic concentration found at the surface does not exceed the CT RSR but it does exceed the ATSDR CREG value. The ATSDR value is based on assumed exposure 7 days per week, 365 days per year for 30 years. The frequency and duration of exposure to soils at the Field would have been significantly less than the ATSDR assumption. The ATSDR screening value also assumes that arsenic in soil is 100% bioavailable (that is, 100% of the arsenic in soil is absorbed by the body). It is widely agreed that arsenic bioavailability in soil is less than 100%. ATSDR uses a bioavailability of 60% when evaluating site-specific arsenic exposures (personal communication, David Mellard, April 24, 2001). Finally, background levels of arsenic in soil range from about 1 to 40 mg/kg, with an

average of about 5 mg/kg (ATSDR 2000). Given all of the above considerations, it is very unlikely that long-term exposure in the past to arsenic in surface soil at the Field would have resulted in adverse health impacts.

With regard to possible acute effects, 4.1 mg/kg arsenic is well below a level that would be expected to result in adverse health effects from a single exposure, based on the ATSDR acute Minimal Risk Level of 0.005 mg/kg/day.

Chromium

Chromium occurs in the environment in several different forms. The most common forms are chromium(0), chromium(III), and chromium(VI). Breathing high levels of chromium(VI) can cause irritation to the nose. Ingesting large amounts of chromium(VI) can cause stomach ulcers, convulsions, kidney and liver damage, and even death. Skin contact with certain chromium(VI) compounds can cause skin ulcers. Some people are extremely sensitive to chromium(VI) or chromium(III). Allergic reactions consisting of severe redness and swelling of the skin have been noted. Several studies have shown that inhaling chromium(VI) compounds can increase the risk of lung cancer (ATSDR Toxicological Profile, 2000). These health effects from exposure to chromium are provided for general information and not to imply that these effects would be expected from exposures at the site.

Chromium was found in surface soil of the Field (prior to installation of the clean soil cap) at a maximum concentration of 300 mg/kg. The average concentration in surface soil is much lower (35 mg/kg). The maximum concentration exceeds the CT RSR for Chromium VI but not the less toxic form, Chromium III. The average concentration does not exceed either comparison value. Sample results for chromium were not speciated but it is highly unlikely that all of the chromium at the Field is the more toxic form, Chromium VI. Additionally, CT RSRs are developed to be extremely health protective, with an assumed exposure to soil 365 days per year for 30 years. As stated previously, the frequency and duration of exposure to soils at the soccer field would be significantly less than what was assumed in developing the CT RSRs. Thus, CT DPH believes that past exposure to chromium in surface soil at the Field would not result in adverse health impacts.

Lead

Lead can affect almost every organ and system in the body. The most sensitive is the central nervous system, particularly in young children. High levels of lead exposure also damage kidneys and the reproductive system. The effects are the same whether it is breathed or swallowed. At high levels, lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Lead may cause anemia, a disorder of the blood. It can also damage the male reproductive system. The connection between these effects and exposure to low levels of lead is uncertain. Lead has not been shown to cause cancer (ATSDR Toxicological Profile, 1999). These health effects from exposure to lead are provided for general information and not to imply that these effects would be expected from exposures at the site.

Lead was found in surface soils of the Field (prior to installation of the clean soil cap) at a maximum concentration of 4855 mg/kg, a level higher than the CT RSR of 500 mg/kg. However, the average lead level in surface soil of the Field was only 378 mg/kg, which is well below the CT RSR of 500 mg/kg. CT DPH believes that 378 mg/kg provides a good estimate of the true average in the field because it is based on results of 61 soil samples for lead, which is a large number of samples given the size of the Field. The average concentration of lead in the Field (378 mg/kg) better represents what a person may have been exposed to over the long term than the maximum concentration. Given all of these considerations, CT DPH believes that past exposures to lead in surface soils at the Field are very unlikely to have resulted in adverse health impacts.

Manganese

Manganese is a naturally occurring metal that is found in many types of rocks. Manganese is an essential trace element and is necessary in small amounts for good health. Some individuals exposed to very high levels of manganese for long periods of time in their workplace developed mental and emotional disturbances, slow and clumsy body movements and respiratory problems. There is currently no evidence to suggest that manganese exposure causes cancer in humans (ATSDR Toxicological Profile, 2000). These health effects from exposure to manganese are provided for general information and not to imply that these effects would be expected from exposures at the site.

As Table 1 shows, manganese was found in surface soils at the Field (prior the installation of the clean soil cap) at a maximum concentration above the CT RSRs. However, all other surface soil samples showed no detectable levels of manganese. As stated previously, CT RSRs are developed to be extremely health protective, with an assumed exposure to soil 365 days per year for 30 years. Because the frequency and duration of exposure to soils at the Field would have been significantly less that what is assumed in developing the CT RSRs, CT DPH believes that past exposure to manganese in surface soil at the Field would not result in adverse health impacts.

Past Site Conditions in the Walkway Area (prior to the placement of fencing and woodchips in the spring 2001)

It is possible that prior to the spring of 2001, before the Town placed fencing and woodchips in the area, people may have been exposed to lead, arsenic and PAHs in surface soil while walking from the Newhall Street School parking lot to the Field or sitting in the western most part of the walkway area to watch activities on the Field.

Table 2 above summarizes surface soil data collected from the walkway area prior to the area being covered with woodchips. It is important to note that the highest lead concentrations were not found in the center, most accessible portion of the walkway area but rather, very close to the fence separating residential properties from school property. Lead concentrations decrease drastically as one moves away from the fence and into the center portion of the walkway area where people are more likely to walk or sit. For example, the samples collected by CT DEP (shown in blue in Figure A) were taken from areas where people are more likely to walk or sit than the area next to the fence. The maximum lead concentration detected in the CT DEP

samples is 1485 mg/kg and the average is 169 mg/kg; well below the CT RSR of 500 mg/kg for lead. Considering the low average concentration and the low frequency and intensity of potential past contact with soil, CT DPH believes that health impacts from exposure to lead under past site conditions (prior to the spring 2001) are unlikely to have occurred.

With regard to arsenic and PAH concentrations, the areas with exceedances of health-based comparison values are limited. In addition, as previously discussed, comparison values are developed to be protective for very frequent and intense soil contact, which is not likely to have occurred here. Thus, CT DPH concludes that potential past exposures to arsenic and PAHs in surface soils of the walkway are not likely to have resulted in adverse health impacts.

COMMUNITY HEALTH CONCERNS

Community health concerns were collected at a number of public meetings held between December 2000 and February 2001 as well as at a public availability session on March 26, 2001 organized by the Hamden Soccer Association. Specific community health concerns are identified and addressed here.

1. The community is concerned that inadequate documentation exists regarding the specifications of the soil cap on the Field. They question whether the soil cap is effective in eliminating exposure to contaminants and whether the Field is safe for children to use.

   In response to this community concern, CT DEP took 26 surface soil samples in a grid pattern across the Field in February 2001. In addition, CT DEP looked at core samples to a depth of 4 feet to observe whether a clean soil cap was present. Results from CT DEP's sampling showed that there are no contaminants present at levels above CT DEP's health protective cleanup standards (RSRs) for residential yards. Additionally, CT DEP's observations of core samples confirmed that a soil cap is present on the Field and it ranges from two to four feet in thickness. CT DPH believes that the soil cap on the Field effectively prevents contact with contaminants present in soil below the cap and that the Field is safe for all to use.

2. Several parents stated that young children (aged 1-3 years) often accompany families to the Field to watch soccer games and practices. The children often dig in the soil on the sidelines of the Field. Parents question whether the Field is safe for younger children.

   CT DEP's observations of core samples indicate that the minimum thickness of clean soil on the Field is two feet. Therefore, in order to come into contact with contaminated soil, a young child would have to dig more than two feet into the soil. It is highly unlikely, that a young child would dig more than two feet into the soil.

3. At least one parent asked whether the Field is safe for a child with a preexisting medical condition (such as a child receiving medical treatment for cancer or a child with asthma).

Yes, the Field is safe for anyone who wishes to use it. The clean soil cap on the Field will prevent any child, even one with a preexisting medical condition, from coming into contact with soil contamination beneath the cap.

4. A number of parents noted that the Field is often very wet, especially in the spring. They are concerned that groundwater beneath the Field may be moving contamination from deeper soils up to the surface.

   It is very unlikely that puddles on the Field are the result of groundwater rising to the surface. Rather, they are more likely to be from rain and melting snow. However, even if there was movement of contaminated groundwater to the ground surface, there would be only extremely small concentrations of contaminants in the groundwater (relative to concentrations in soil) because the contaminants present in soil at the Field (metals) do not dissolve well in water.

5. Many local residents believe that there are higher numbers of people with cancer in the Hamden Middle School area. They are concerned that contamination at the Field is causing cancer.

   In response to community concerns about cancer, the Quinnipiack Valley Health District conducted a house-to-house survey in the early spring 2001 in the residential area surrounding the Middle School. Questionnaires were used to collect information about cancer and other health concerns. Based on a preliminary evaluation of the information, there does not appear to be an unusually high number of people with cancer in the Hamden Middle School area. CT DPH is assisting the Quinnipiack Valley Health District in a more detailed evaluation of the data.

6. Parents expressed a concern about contamination that may have been in soils at depth that were dug up during utility work performed several years ago at the Middle School. The utility excavation work was apparently done on the west side of the school building, closest to the Field. Parents stated that soil from the excavation was left at the ground surface for a period of time and could have been moved about by people walking through it or by the wind blowing it around.

   CT DPH has no information to suggest that excavated soils containing hazardous contaminants were left on the ground after utility work was performed at the Middle School. If this did occur, it is possible that the contaminated soil was spread about. However, surface soil sampling has been conducted on the Field and in the area where the utility work was performed. Such sampling would have likely detected high levels of contaminants in the area if they were present.

CONCLUSIONS

Since the late 1970s, a number of soil sampling investigations have occurred at the Field. These investigations have documented the presence of numerous metals, including lead both at the surface and at depth. In the mid-1990s, the Town capped the Field with clean fill. Sampling performed by CT DEP in early 2001 confirmed that a clean soil cap is present across the field.

Recent sampling by EPA and CT DEP in a walkway area connecting the Newhall Street School parking lot with the Field showed some limited areas with elevated lead and PAHs in surface soil. This area has been covered with a layer of wood chips to restrict contact with the soil.

Under current conditions, the site presents no public health threat because there is no exposure to hazardous contaminants at the site. Under past site conditions, it is unlikely that exposures to contaminants at the Field or in the walkway area to the Field would have been great enough to result in adverse health impacts. Under future conditions, the site should pose no public health threat as long as the clean soil covering contaminated soils is not disturbed.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories. ATSDR conclusion categories are included as Attachment A to this report. CT DPH has concluded that soils at the site currently present "No Public Health Hazard." Under past conditions, the site presents "No Apparent Public Health Hazard."

RECOMMENDATIONS

1. CT DPH recommends that contaminated soils at the Field beneath the clean soil cap should not be disturbed unless appropriate measures are taken to protect people who could come into contact with the contamination.

2. CT DPH recommends that the Town of Hamden continue to maintain the cover of wood chips that it placed on the walkway area. This will ensure that contact with contaminated soil is prevented.

PUBLIC HEALTH ACTION PLAN

Actions Planned

1. CT DPH will continue to work with the Quinnipiack Valley Health District, CT DEP and EPA in responding to public health concerns and questions.

2. CT DPH will review additional data that may be collected in the future from the Field.

Actions Taken

1. CT DPH has assisted CT DEP in developing sampling plans for the Field and walkway area.

2. CT DPH has addressed health-related questions and concerns regarding the Hamden Middle School Athletic Field at six public meetings and two meetings for Middle School teachers and students.

3. CTDPH assisted the Quinnipiack Valley Health District in producing a Question and Answer Fact Sheet addressing questions and concerns regarding the safety of the athletic field.

REFERENCES

ATSDR 1991. ATSDR Record of Activity, Health Consultation. Newhall Street Field, Hamden, November 18, 1991.

ATSDR 1999. ATSDR Toxicological Profile for Lead, 1999.

ATSDR 2000. ATSDR Toxicological Profile for Chromium, 2000.

ATSDR 2000. ATSDR Toxicological Profile for Arsenic, 2000.

ATSDR 2000. ATSDR Toxicological Profile for Manganese, 2000.

CDM 1994. ARCS I Final Site Inspection Prioritization Report, Newhall Street Field. Prepared by CDM Federal Programs Corporation for US EPA, December 5, 1994.

CT DPH 1992. Letter from Jennifer Kertanis, CT DPH to Marianne Cherniak, Quinnipiak Valley Health District, May 7, 1992.

HRP 1993. Evaluation of Newhall Street Screening Study and Recommendations for Subsequent Sample Collection/Analysis, HRP Associates, Inc., May 1993.

NUS 1991. Final Screening Site Inspection, NUS Corporation, July 23, 1991

Weston 1991. Removal Program Preliminary Assessment/Site Investigation for Newhall Street Field. Prepared by Roy F. Weston, Inc. for the US EPA, August 1991.

1990 US Census Population Data, STF 1B.

CERTIFICATION

The Health Consultation for **Evaluation of Soil Data at the Athletic Playing Field Behind the Hamden Middle School, Hamden, Connecticut** was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Technical Project Officer, SPS,SSAB,DHAC

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

Chief, SSAB,DHAC,ATSDR

PREPARER OF HEALTH CONSULTATION

Margaret L. Harvey, MPH
Epidemiologist
Environmental Epidemiology and Occupational Health
Connecticut Department of Public Health

ATSDR Regional Representative:

William Sweet
EPA/New England

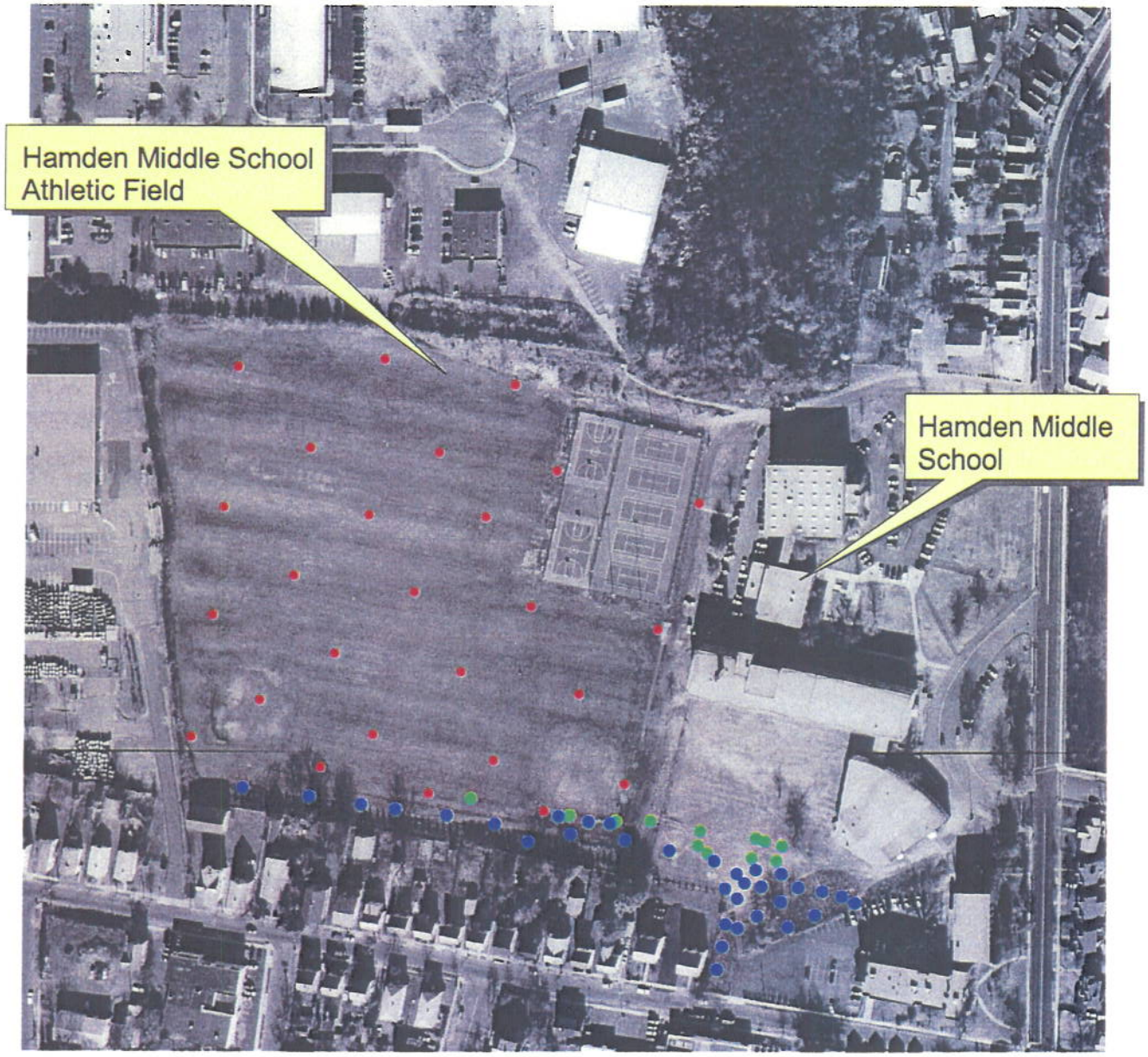
ATSDR Technical Project Officer:

Greg V. Ulirsch
Superfund Site Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

ATTACHMENT A: ATSDR Public Health Hazard Categories

Category	Definition	Criteria
A. Urgent public health hazard	This category is used for sites that pose an urgent public health hazard as the result of short-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon short-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires rapid intervention AND/OR physical hazards at the site pose an imminent risk of physical injury
B. Public health hazard	This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances.	evidence exists that exposures have occurred, are occurring, or are likely to occur in the future AND estimated exposures are to a substance(s) at concentrations in the environment that, upon long-term exposures, can cause adverse health effects to any segment of the receptor population AND/OR community-specific health outcome data indicate that the site has had an adverse impact on human health that requires intervention
C. Indeterminate public health hazard	This category is used for sites with incomplete information.	limited available data do not indicate that humans are being or have been exposed to levels of contamination that would be expected to cause adverse health effects; data or information are not available for all environmental media to which humans may be exposed AND there are insufficient or no community-specific health outcome data to indicate that the site has had an adverse impact on human health
D. No apparent public health hazard	This category is used for sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.	exposures do not exceed an ATSDR chronic MRL or other comparable value AND data are available for all environmental media to which humans are being exposed AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health
E. No public health hazard	This category is used for sites that do not pose a public health hazard.	no evidence of current or past human exposure to contaminated media AND future exposures to contaminated media are not likely to occur AND there are no community-specific health outcome data to indicate that the site has had an adverse impact on human health

Figure A
Hamden Middle School Athletic Field
Selected Sample Locations



0.05 0 0.05 0.1 0.15 Miles

N

Approximate Location of DEP Grid Samples [(n=26) Feb. 2001]

EPA Samples [(n=12) 4/26/2001]

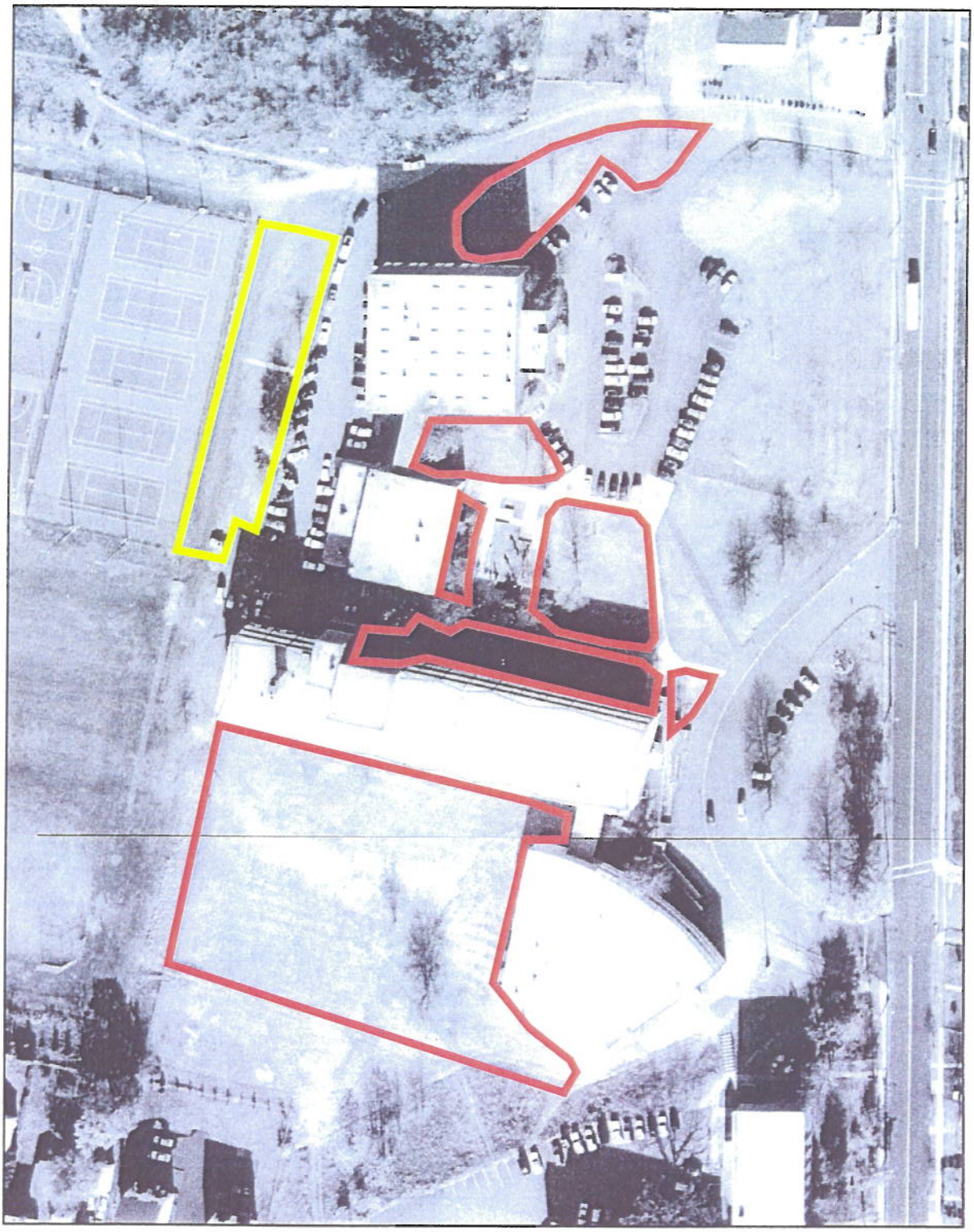
DEP Samples [(n=33) 5/10/2001]

August 2, 2001

ATTACHMENT B

FIGURE 1 HAMDEN MIDDLE SCHOOL

Figure 1 Hamden Middle School



Approximate Limits of Soil Area Capped in August 2001

Approximate Limits of Soil Area Capped in January 2001

ATTACHMENT C

FACT SHEETS

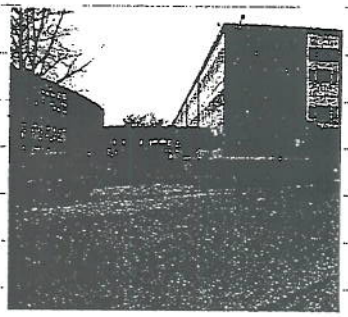
Environmental Hazards at Hamden Middle School:

Questions and Answers For Students

What's Going On?

March 2001
Vol. 1, No. 1

The Hamden Middle School site was used as a landfill. Industrial waste and garbage was placed there in the 1930s and 1940s. During the 1950s, the town bought the land and built the Middle School on the landfill site. Last year, the school system had soil samples taken as part of the planning for a school addition. These samples contained lead and other chemicals that were part of the landfill. More sampling was done, and other chemicals were found. The Connecticut Departments of Environmental Protection (CT DEP) and Public Health (CT DPH) and the Quinnipiack Valley Health District became involved to make sure people will not be exposed. Other testing has been done to make sure there are no other ways students and staff could be exposed to hazards outside and inside the school building. The building and grounds are safe for everyone to learn and work in.



Inside this issue:

What Hazards Were Found at the School?

- ✓ PAHs (Polycyclic Aromatic Hydrocarbons) in the soil outside
- ✓ Low levels of lead in some of the soil
- ✓ Methane gas under the boiler room
- ✓ Very low levels of PAHs in the air of the auditorium
- ✓ Dirty air ducts, some moisture

CT Department of Public Health

Joxel J. Garcia, MD, MBA, Commissioner
John G. Rowland, Governor

PUBLIC HEALTH
Keeping Connecticut Healthy

Quinnipiack Valley Health District

Some Background on Exposure:

Before you can have a good understanding about the environmental hazards at the school, you need to understand exposure. Exposure means that you have come in contact with a chemical. For exposures to chemicals to happen, there has to be a source, like a landfill or a factory. Chemicals then can get into air, water and soil. **The chemical has to move from the source to a point where you can come into direct contact with it.**

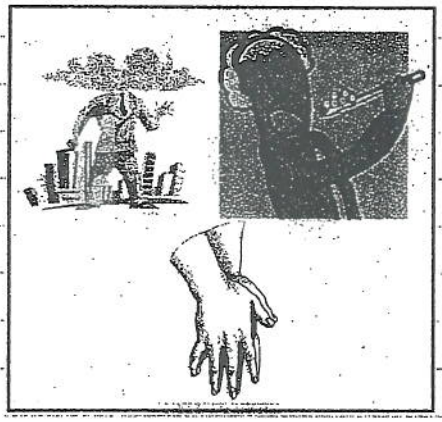
How Can You Be Exposed?

There are three ways a chemical could get into your body:

⇒ Breathing It in Air (inhalation)

⇒ Eating or Drinking (Ingestion)

⇒ Touching It (Dermal Exposure)



If You Are Exposed, Will You Get Sick?

This depends on several things about the exposure:

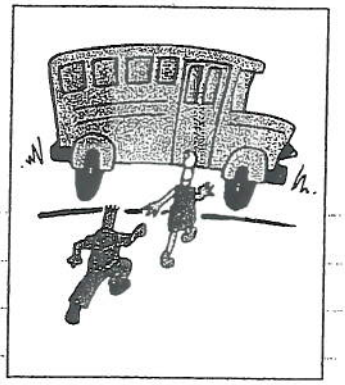
⇒ The **type** of chemical: how toxic?

⇒ The **amount**: how much were you exposed to?

⇒ The **duration**: how long were you exposed?

⇒ The **frequency**: how many times were you exposed?

What Are PAHs?



PAHs (Polycyclic Aromatic Hydrocarbons) are a group of chemicals formed when things like wood, trash, oil or food are burned. The PAHs at the school probably came from burning of garbage at the site. PAHs are found everywhere—in char grilled food, cigarette smoke, bus and car fumes. At very high levels, exposure to PAHs may cause health problems such as skin problems and certain kinds of cancer. Everyone should know that the levels found on the school grounds and the auditorium were not anywhere near high enough to cause health problems.

What Is Methane?

Methane is a flammable, colorless, tasteless and odorless gas. Decomposing (rotting) materials waste often produces methane . Methane is not toxic to the body. If methane is found at high levels inside a building, it is a concern because a spark or fire could cause it to explode. Methane was only found in the soil underneath the building. No methane has been found in the building. Therefore, the methane found does not mean there is an explosion risk at the school.

What Has Been Done To Protect The Students and Staff?

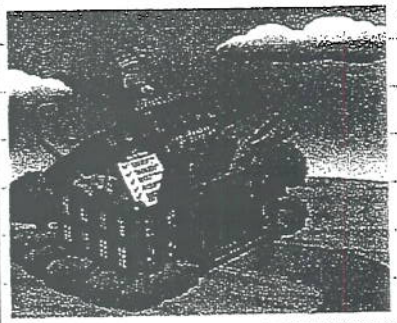
- A special liner and clean soil cover were placed over the school grounds, including the front lawn, side lawns, and the area behind the auditorium. This will prevent anyone from contacting PAHs in the soil.
- The inside of the school was thoroughly cleaned. This included:
  - All air ducts vacuumed
  - Everything wiped down, washed
  - New air filters to keep the air clean
- A methane alarm has been installed in the boiler room. The monitor has an alarm that will sound way before methane levels become dangerous. The Hamden Fire Department inspects the school for the presence of methane every Monday morning to make sure that no methane has seeped into the building over the weekend.
- Ventilation systems at the school have been improved.

What Else Will Be Done To Protect Our Health?

- ✓ The CT DEP will be checking regularly on the soil cover at the school.
- ✓ The methane monitor in the boiler room will be regularly checked by the Hamden Fire Department.
- ✓ The fire department will inspect the Middle School every Monday morning using a gas monitor to make sure the school is safe.
- ✓ A special "Tools for Schools" Indoor Air Committee has been formed and trained for the schools—see below.

What is "Tools for Schools"?

The Indoor Air Quality (IAQ) Tools for Schools Program was designed by the U.S. Environmental Protection Agency (EPA). The program helps schools fix indoor air problems in the school. A committee of administrators, teachers, maintenance staff, parents, (and maybe students!) works together to make sure there is good air quality in the school. You will be hearing more about the Tools for Schools Program in the Middle School soon.



If you have further questions about the Middle School situation, please ask your teacher or Ms. Norwood.

What Can I Do To Reduce My Exposure to Soil in my Yard?

What does it mean to be exposed?

In order to be exposed to chemicals in soil, you need to come into direct contact with soil that is contaminated and the chemicals need to get into your body. There are 2 main ways you could be exposed to chemicals in soil in your yard:

- ingestion; putting items into your mouth that have soil on them such as fingers, food, toys
- breathing in soil dust

Two more ways that exposure to soil could occur are through touching the soil or eating food grown in contaminated soil. However, these are **not** likely to be major ways of exposure for you because the chemicals we have found in the soil are not easily absorbed through the skin and do not accumulate a great deal in plants or vegetables.

If contamination has been found in the soil in your yard, there are some things you can do to reduce your contact with soil in your yard.

- Discourage children from playing in bare soil if possible, and make sure they wash their hands after playing outside, especially before eating.
- Bare soil areas underneath play equipment can be covered with mulch or clean topsoil.
- Wash toys before bringing them into the house, or leave them outside.
- Pets can bring dirt inside on their paws or fur. Try to keep pets clean.
- Clean up dirt that is tracked into the house. Use a wet mop whenever you can since sweeping or vacuuming can stir up dust into the air.
- Consider using raised beds for gardening.

For More Information

EPA
Call toll free at 888-372-7341
and ask for:
Gilberto "Tito" Irizarry
On-Scene Coordinator
(ext. 8-1255)
Angela Bonarrigo, Community Relations
(ext. 8-1034)

CT Department of Environmental Protection
Shannon Windisch, Project Manager
(860) 424-3546

CT Department of Public Health
Meg Harvey
Epidemiologist
(860) 509-7748

Quinnipiack Valley Health District
Leslie Balch, Health Director
(203) 248-4528

Town of Hamden
Mayor Carl Amento
or
Curt Leng
Director, Governmental Operations
(203) 287-2650

What are the chemicals that EPA sampled for?

EPA analyzed soil samples for a wide variety of chemicals. There are three main chemicals that EPA has found at elevated levels in some yards. These chemicals are Lead, Arsenic, and PAH's (Polycyclic Aromatic Hydrocarbons).

Lead:
Lead is a naturally occurring metal in the environment. However, most of the high levels of lead found in the environment come from human activities. Lead has many uses, most importantly in the production of batteries. Because of health concerns, lead in gasoline, paints and ceramic products among others, has been dramatically reduced in recent years.

Exposure to lead is more dangerous for young children or unborn children who can be exposed to lead through their mothers. The nervous system is the most sensitive to lead exposure, particularly in children. Lead can affect a child's mental and physical growth. Children exposed to lead in the womb may be born prematurely, have lower birth weights and have slower mental development. Exposure to high levels of lead can affect the brain and kidneys of adults and children. Lead has not been shown to cause cancer in people.

Arsenic:
Arsenic is found in nature at low levels. The major uses of arsenic are as wood preservatives and agricultural pesticides. Arsenic is very widely distributed in the environment and everyone is exposed to low levels. Long-term exposure to arsenic can increase the risk of skin, bladder, kidney, liver and lung cancer. Exposure to arsenic can also lead to skin effects such as irritation and skin darkening.

PAHs:
PAH's are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic materials like tobacco or charbroiled meat. Studies in animals have shown that PAHs can affect the skin, blood, immune system and the ability to reproduce. These affects have not been reported in people. Some people who had long-term exposures to high levels of PAHs developed skin and lung cancer. Studies have shown that some PAHs caused cancer in animals.

For more information on these chemicals, visit the website for the Agency for Toxic Substances and Disease Registry (ATSDR) website at http://atsdr1.cdc.gov

ATTACHMENT D

RISK CALCULATIONS

FACT SHEET - PAHs

Hamden Middle School-Risk Calculations for PAHs

A. Noncancer risks, student aged 11-13 years
1. Ingestion Dose
ADD_i = IR*[PAH]*EF*ED*CF*1/BW*1/AT

ADD_i = 50 mg/d * 14 mg/kg*200d/y*3 yr* 10^{-6} kg/mg*1/46 kg*1/1095 days
= 8.3E-6 mg/kg/day

2. Dermal Dose
ADD_d = [PAH]*CF*AF*ABS*EF*ED*EV*SA*1/BW*1/AT

ADD_d = 14 mg/kg *10^{-6} kg/mg* 0.2 mg/cm^2/-ev * 0.13*200 d/y*3 y*1 ev/d*4570 cm^2 *1/46 kg* 1/1095 d

ADD_d = 1.98E-5 mg/kg/ day

3. Noncancer Hazard Index

HI = (ADD_i + ADD_d)/RfD
HI= (8.3E-6 + 1.98E-5) /0.02mg/kg/day
HI= 0.001

A Hazard Index of 1 means that the estimated dose is equal to the safe dose. A Hazard Index less than 1 indicates that the estimated dose is below the safe dose and noncancer health impacts are unlikely. A Hazard Index greater than 1 indicates that the estimated dose is above the safe dose and noncancer health impacts cannot be ruled out. In this case, the Hazard Index for PAHs is well below 1. This indicates that noncancer health impacts from PAHs are unlikely.

B. Cancer Risks
1. Ingestion Dose

$LADD_i$ = 50 mg/d * 4.8 mg/kg * 1E-6 kg/mg * 200 d/y* 3 y*1/46 kg * 1/25550 d
= 1.2 E-7 mg/kg/day

2. Dermal Dose

$LADD_d$ = 4.8 mg/kg *1E-6 kg/mg* 0.2 mg/cm^2/-ev * 0.13*200 d/y*3 y*1 ev/d*4570 cm^2 *1/46 kg* 1/25550 days
= 2.9E-7 mg/kg/day

3. Cancer Risk-PAHs

ELCR = ($LADD_d$ + $LADD_i$)* CSF
ELCR= (1.2 E-7 + 2.9E-7)*7.3 $(mg/kg/day)^{-1}$
ELCR= 3E-6

The Estimated Lifetime Risk for PAHs is 3 E-6 (3 in 1,000,000). This means that if 1,000,000 people were exposed to PAHs in soil at the concentration, frequency and duration of exposure assumed in the calculations detailed above, there would be a theoretical increase of 3 cancers above the number of cancers that would normally be expected to occur in the population of 1,000,000. Background rates of cancer in the U.S. are one in 2 or 3 (American Cancer Society, 1996). This means that in a population of 1,000,000, background numbers of cancer cases would be approximately 330,000 to 550,000. Past PAH exposures at the Hamden Middle School could theoretically have resulted in an increase of 3 cancer cases above the background number of 330,000 to 500,000 cancer cases. This represents an insignificant increased cancer risk.

WHERE:

ADD_i = average daily dose from ingestion
ADD_d = average daily dose from dermal contact
$LADD_i$ = lifetime average daily dose from ingestion exposure
$LADD_d$ = lifetime average daily dose from dermal exposure
IR = soil ingestion rate; 50 mg/day (EPA 1997, ATSDR 2002)*
AF = skin-soil adherence factor (central tendency estimate for child, based on measurements made among older children); 0.2 mg/cm^2 (EPA 2001)
ABS = Soil dermal absorption fraction
PAHs: 0.13 (EPA 2001)
SA = Skin surface area, 50th percentile face, forearms, hands, lower legs, feet, child aged 11-13; 4570cm^2 (EPA 2001)
[PAH] = PAH concentration in soil
noncancer: 14 mg/kg (Total 95 percentile UCL for all PAHs)
cancer: 4.8 mg/kg (Total TEF-adjusted 95 percentile UCL for all PAHs)
EF = exposure frequency; 200 days/year (school year Sept. through mid-June; 5 d/w, 40 weeks/year)
EV = event frequency; 1 ev/d
ED = exposure duration; 3 years
CF = conversion factor; 10^{-6} kg/mg
BW = 50th %tile body weight for age 11-13, average for male and female 46 kg; (EPA 1997)
AT = averaging time
for noncancer risk; 3 years (1095 days)
for cancer risk; 70 years (25550 days)
RfD = EPA Reference Dose
PAHs: naphthalene used as a surrogate for PAHs; 0.02 mg/kg/day (IRIS)
CSF = Cancer Slope Factor
PAHs: benzo(a)pyrene; 7.3 (mg/kg/day)-1 (IRIS)
HI = Hazard Index
CSF = Cancer Slope Factor

* EPA (1997) recommends using soil ingestion rates of 100 mg/day for child < 6 years and 50 mg/day a child/adult≥6 years. EPA states that these values represent best estimates of average soil ingestion rates. EPA programs have used 200 mg/day and 100 mg/day as conservative estimates of average soil intake rates. CT DPH opted to use the best estimate average value 50 mg/day rather than the more conservative estimates for the sake of consistency with other parameters describing the receptor which are also central estimates (for example, body weight and skin surface area).

Values used to calculate PAH concentrations for cancer and noncancer risk calculations.

PAH	95 percentile UCL (mg/kg)	Toxic Equivalency Factor(TEF)*	TEF Adjusted Concentration (mg/kg)
Benzo(a)anthracene	3.5	0.1	0.35
Benzo(b)fluoranthene	5.1	0.1	0.51
Benzo(a)pyrene	3.35	1	3.35
Indeno(1,2,3-cd)pyrene	1.6	0.1	0.16
Dibenzo(a,h)anthracene	0.43	1	0.43
Total	**14**	**---**	**4.8**

* ATSDR 1995

ATTACHMENT E: ATSDR INTERIM PUBLIC HEALTH HAZARD CATEGORIES

CATEGORY / DEFINITION	*DATA SUFFICIENCY*	*CRITERIA*
A. Urgent Public Health Hazard *This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.*	*This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.*	*Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.*
B. Public Health Hazard *This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects.*	*This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.*	*Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.*
C. Indeterminate Public Health Hazard *This category is used for sites in which "critical" data are insufficient with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.*	*This determination represents a professional judgement that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision.*	*The health assessor must determine, using professional judgement, the "criticality" of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.*
D. No Apparent Public Health Hazard *This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.*	*This determination represents a professional judgement based on critical data which ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.*	*Evaluation of available relevant information* indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.*
E: No Public Health Hazard *This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.*	*Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future*	

**Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans*