ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

NEWHALL STREET NEIGHBORHOOD
(ALIASES: BRYDEN AND MORSE STREETS RESIDENTIAL PROPERTIES
AND ROSEM SITE RESIDENTIAL PROPERTIES)
HAMDEN, NEW HAVEN COUNTY, CONNECTICUT
SEPTEMBER 9, 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.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

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Newhall Street Neighborhood
(Aliases: Bryden and Morse Streets Residential Properties
and Rosem Site Residential Properties)

Final Release

Evaluation of Soil Data

NEWHALL STREET NEIGHBORHOOD
(ALIASES: BRYDEN AND MORSE STREETS RESIDENTIAL PROPERTIES AND ROSEM SITE RESIDENTIAL PROPERTIES)
HAMDEN, NEW HAVEN COUNTY, CONNECTICUT

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 Newhall Street neighborhood that is the focus of this Public Health Assessment is located in the southern portion of the town of Hamden, Connecticut. It is an approximately 11-block area that includes residences, nearby Hamden Middle School, and two town parks (Rochford Field and Mill Rock Park). The area was used for disposal of domestic and industrial waste during the 1930s, 1940s, and 1950s. Many of the homes in the Newhall Street neighborhood were built on top of landfill waste.

The purpose of this Public Health Assessment (PHA) is to evaluate environmental sampling data from residential yards in the Newhall Street neighborhood, in Hamden, Connecticut, to determine whether landfill waste materials present a public health hazard. This PHA builds upon results of several health consultations and a PHA previously prepared by the Connecticut Department of Public Health (CT DPH) (under a cooperative agreement with the Agency for Toxic Substances and Disease Registry [ATSDR]). These previously prepared documents address the public health significance of landfill waste materials at the Hamden Middle School, two town parks, and the Newhall Street School, all located in the Newhall Street neighborhood. This PHA builds upon information contained in the previous evaluations, but data analyzed in this document have not been evaluated previously.

Environmental investigations in the Newhall Street neighborhood have focused on surface and subsurface soils from residential yards. Investigations have found elevated levels of lead, polycyclic aromatic hydrocarbons (PAHs), and arsenic in both surface and subsurface soils. These results are consistent with sampling data from other areas in the neighborhood where landfill waste was disposed (for example, Hamden Middle School, Rochford Field, and Mill Rock Park). In 2001 and 2002, the U.S. Environmental Protection Agency (EPA) removed contaminated soils at 13 residential properties because surface soil contamination was so high that immediate action was needed to reduce exposure.

To evaluate public health implications from contaminants in soil in the Newhall Street neighborhood, 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 effects. When contaminant concentration exceeded comparison values, CT DPH further evaluated the exposures to determine the likelihood that such exposures would result in adverse health effects.

People could be exposed to landfill contaminants in the Newhall Street neighborhood through direct contact with contaminated soil (ingestion of soil, skin contact, inhaling soil particles). CT DPH evaluated exposures to lead in soil using a screening model that relates soil lead levels to blood lead levels. This model indicates that at properties with the highest concentrations of lead in surface soil, there is the potential for increases in blood lead levels in children above levels of concern for adverse health effects. Fortunately, these homes were cleaned up by EPA, so exposures are no longer occurring. However, many other homes still have elevated levels of lead in soil. If those are not cleaned up, future exposures could result in elevated levels of lead in children's blood. CT DPH reviewed blood test results to identify any children in the Newhall Street neighborhood who had elevated blood lead levels. No elevations were found that could be linked to lead exposure from landfill waste. CT DPH's evaluation of cancer and noncancer risks shows that adverse health effects from exposure to elevated levels of arsenic and PAHs in soil are unlikely.

ATSDR has a categorization system whereby the level of public health hazard at a site is assigned to one of five conclusion categories. From its review of the available environmental data, CT DPH has determined that the properties with the highest lead levels posed a "public health hazard" in the past (that is, before EPA performed soil cleanup activities). On the basis of current conditions and available data, "no apparent public health hazard" currently exists. However, this hazard category will be re-evaluated once the full nature and extent of landfill waste contamination of the Newhall Street neighborhood is determined.

This PHA also contains an evaluation of health outcome data. CT DPH evaluated the health survey information collected by the Quinnipiack Valley Health District (QVHD), which included reported cases of cancer. CT DPH verified reported cancer cases in Connecticut Tumor Registry records. CT DPH's qualitative review suggested that the number and types of cancer that were reported in the health survey conducted by QVHD do not exceed what would be expected to occur. For illnesses other than cancer, it was not possible to evaluate scientifically whether the reported illnesses are in excess of what would be expected to occur because there are no data on background rates of these illnesses. However, from the number of dwellings surveyed, CT DPH believes the number and type of reported illnesses are not unusual. CT DPH also evaluated the most recent published cancer incidence data for the town of Hamden and found no statistically meaningful elevations in cancer incidence among Hamden residents.

CT DPH received community health concerns during numerous public and private meetings with area residents. Their concerns have been identified and addressed in this PHA.

Based on its evaluation of the environmental data, CT DPH's recommended actions include the following:

- Residents should avoid digging or other activities that disturb soils beneath the ground surface in the neighborhood;
- the Connecticut Department of Environmental Protection (CT DEP) should continue to oversee further investigations of landfill waste in the neighborhood, which should proceed as quickly as possible;

- QVHD should offer free blood lead screening in the Newhall Street neighborhood;
- QVHD should expand the health concerns survey originally conducted in 2001 to areas known to have landfill waste that were not included in the previous survey; and
- QVHD, CT DEP or Olin Corporation should perform a follow-up inspection on each of the properties where CT DEP found lead above the trigger value of 1,200 mg/kg and cleanup has not yet occurred. The inspection should focus on whether actions taken to reduce exposure (e.g., mulching bare soil) still provide an effective barrier to direct contact with soil.

A draft version of this Public Health Assessment was made available for public comment from February 28, 2004, through May 3, 2004. CT DPH held a public availability session to answer questions and take comments on April 13, 2004. CT DPH also provided copies of the document to interested persons at two public meeting/open house events held by CT DEP on February 28, 2004, and April 27, 2004. CT DPH also prepared a fact sheet summarizing the results of this PHA. The fact sheet was made available at the public availability session and the public meetings mentioned above. The PHA and the fact sheet were also made available on the Newhall Remediation Project website (www.newhallinfo.org). CT DPH received comments from three parties. The comments and responses are listed in Attachment J. The fact sheet is provided in Attachment B.

In response to a comment received from the community during the public comment period, CT DPH, in conjunction with the QVHD, held a public health open house on Saturday, June 26, 2004. Free blood lead screening and blood pressure checks were offered. CT DPH made a presentation summarizing the results, conclusions, and recommendations of the PHA. An environmental medicine doctor from the University of Connecticut was available to answer residents' questions about potential health effects from living near contamination from landfill.

In June 2004, QVHD completed its evaluation of community health and environmental concerns based on an expanded community survey that was administered during the winter 2004.

Purpose

This Public Health Assessment (PHA) evaluates environmental sampling data from residential yards in the Newhall Street neighborhood, in Hamden, Connecticut, to determine whether landfill waste materials present a public health hazard. This PHA builds upon results of several health consultations and a PHA previously prepared by the Connecticut Department of Public Health (CT DPH) (under a cooperative agreement with the Agency for Toxic Substances and Disease Registry [ATSDR]). These previously prepared documents address the public health significance of landfill waste materials at the Hamden Middle School, two town parks, and the Newhall Street School, all located in the Newhall Street neighborhood (ATSDR 2003a, 2003b, 2001a, 2001b).

This PHA focuses on environmental investigations in residential yards. The document begins with a general summary of the history of the site and actions that have already been taken to protect people from exposure to contamination. This is followed by a presentation of the results of soil sampling in the neighborhood and an explanation of how people could be exposed to contamination in the soil. The public health implications section, which follows the exposure section, describes the likely health effects from exposure to residents of the neighborhood. Finally, community health questions and concerns are identified and answered, conclusions and recommendations are presented, and a public health action plan is proposed. In preparing this report, CT DPH relied on all currently available data. Additional environmental sampling is planned for the neighborhood. CT DPH will evaluate the new data as they become available. It is possible that the conclusions and recommendations presented in this PHA could change to reflect new sampling results.

Background

This PHA evaluates soil data from a residential area encompassing approximately 11 blocks in the Newhall Street neighborhood of southern Hamden, Connecticut. The data were collected by the U.S. Environmental Protection Agency (EPA), the Connecticut Department of Environmental Protection (CT DEP), and Olin Corporation. The area includes Bryden Terrace, Remington Street, Newbury Street, Edwards Street, St. Mary Street, and parts of Newhall Street, Morse Street, Marlboro Street, Winchester Avenue, Wadsworth Street, Shelton Avenue, Augur Street, and Butler Street. The land that is now occupied by residences, the nearby Hamden Middle School, and two town parks (Rochford Field and Mill Rock Park), was used for disposal of domestic and industrial waste during the 1930s, 1940s, and 1950s (Lockheed Martin 2001). Many of the homes in the Newhall Street neighborhood were built on top of landfill waste.

The portions of the neighborhood that are the focus of this PHA are delineated in an attached map (Figure 1, Attachment A). It is important to note that the lines on the map do not necessarily represent the limits of the landfill, but rather the lateral extent of soil sampling that has been conducted thus far. The landfill limits are still being investigated. Sampling in the residential neighborhood to determine the extent of landfill materials is ongoing.

In January 2001, CT DEP began investigating soils in the neighborhood to identify where landfill materials were present and whether there were elevated levels of contaminants. This investigation was initiated after environmental studies at the nearby Hamden Middle School, Rochford Field, and Mill Rock Park indicated the presence of elevated levels of metals and polycyclic aromatic hydrocarbons (PAHs) in soils. PAHs are chemicals that are formed during the incomplete burning of organic substances. In the Environmental Data Section, individual PAH compounds are identified and quantified. More about PAH toxicity is provided in Attachment F.

CT DEP's initial investigation in January 2001 focused on surface and subsurface soils from selected public right-of-way grass strips between the sidewalk and road. The selected areas may have been filled in the past, according to CT DEP's review of historical aerial photographs. CT DEP's investigation indicated the presence of elevated levels of contaminants including lead, arsenic, and PAHs in accessible surface soils and in soils at depth (up to 8 feet below ground surface) in many locations throughout the Newhall Street neighborhood. CT DEP observed non-native material, such as ash, cinders, slag, and other debris, in the soil samples they collected. The results of this sampling helped CT DEP identify initial boundaries of the landfill and areas on which to focus subsequent investigations.

Subsequent investigations in the neighborhood focused on defining the nature and extent of contamination in surface soils of residential yards. Surface soils are the most accessible soils. Children and adults could be exposed to contaminants on a daily basis in surface soils in their yards, especially if contaminants are present in areas that are not covered (i.e., bare earth not covered with grass, asphalt, or other barriers). For this portion of the investigation, CT DEP received assistance from EPA. In April 2001, EPA sampled surface soils (0–6 inches below ground surface) from approximately 76 residential properties. The purpose of EPA's investigation was to identify properties with surface soil contaminant levels so high that immediate action was needed to reduce potential exposure.

After EPA had completed its activities in the neighborhood, a number of residents whose properties had not been sampled by EPA asked to be included in the sampling. To respond to these requests, CT DEP initiated a supplemental soil sampling program. So far, CT DEP has sampled surficial soil at over 20 additional residences in the neighborhood. To qualify for sampling, a residence must have observed waste materials in the yard or there must be a reasonable suspicion of waste materials being present.

In August 2002, additional soil sampling in the neighborhood was performed by the Olin Corporation, one of the parties identified by CT DEP as being potentially responsible for the landfill waste material. Olin's primary focus was to better define the extent of fill material at depth in the neighborhood and to define the limits of landfill waste materials (Malcolm Pirnie 2002). Although their focus was soils at depth, they collected approximately 75 surface soil samples (0–3 inches below ground surface) in addition to the 139 depth samples. Depth samples were collected down to 20 feet below ground surface. Surface soils were analyzed only for lead and arsenic. Elevated levels of lead and/or arsenic were found in 23% of the surface soil samples taken by Olin.

In April 2003, CT DEP and the entities potentially responsible for placing contaminated landfill waste in the neighborhood and adjacent areas (Hamden Middle School, Rochford Field, and Mill Rock Park) finalized a consent order. The consent order allocates responsibility among the parties for investigation and remediation of the contamination. It also sets out a framework for further investigation and remediation of the site and provides a plan for public involvement.

Public Health Actions Taken

Contamination was discovered in the Newhall Street neighborhood in early 2001. Numerous activities have taken place since then to protect the public from exposure to contaminants, assess health concerns in the community, and communicate potential health risks to the public.

EPA "Time Critical" Soil Removal Action

EPA completed soil removal activities on 13 residential properties during the period October 2001 to January 2002 (Lockheed Martin 2001, Weston Solutions 2003). Contaminated soil was removed by EPA to a depth of approximately 18 inches. The soil removal action served to eliminate the potential for adults and children to contact very high levels of contaminants in accessible surface soils of these yards. The soil removal action by EPA is not a permanent remedy because in most cases, contaminants remain in soils deeper than 18 inches.

Properties were selected for soil removal based upon whether contaminant levels in surface soil exceeded immediate action trigger values[1] established by CT DPH in collaboration with EPA and others. At all 13 properties, lead levels exceeded the immediate action trigger level. At some of the 13 properties, arsenic and/or PAHs exceeded trigger levels as well.

Home Visits With Residents

During May and June 2001, CT DPH and EPA met with most of the residents of the approximately 76 properties that were sampled by EPA. Soil results were provided to each resident and next steps were discussed. CT DPH answered questions about exposure and health impacts. A fact sheet prepared jointly by EPA and CT DPH about ways to reduce exposure to soil was distributed to residents (the fact sheet is included in Attachment B). At properties where EPA removal actions were planned, EPA and CT DPH met with residents on multiple occasions.

Voluntary Blood Lead Screening

Because lead is a primary contaminant in the landfill waste, the Quinnipiack Valley Health District (QVHD) offered free blood lead screening to neighborhood residents on August 1, 2001. The screening was open to anyone interested, but residents were specifically targeted who had elevated lead in soil with children residing in the home. The purpose of the screening was to identify cases of lead poisoning among neighborhood residents so that further investigation could occur to identify possible sources of lead exposure. No individuals came to the screening.

[1] The immediate action trigger levels used in Hamden are 1,200 mg/kg for lead, 150 mg/kg for arsenic, and 10 mg/kg for benzo(a)pyrene. These levels are risk based and are intended to trigger action to reduce exposure within 6 months.

QVHD Lead Exposure Follow-Up Activities

CT DEP referred a number of homes to the QVHD for lead exposure follow-up activities. The homes referred for follow up were those homes with elevated lead in surface soil, where young children reside (or visit often), that were *not* scheduled to receive an EPA immediate soil removal action. In some cases, an EPA soil removal action was not possible because the elevated lead in soil was from lead paint, not landfill waste materials. In other cases, the lead elevation was not high enough to trigger immediate EPA action. Lastly, some homes were discovered through the CT DEP supplemental soil-sampling program after EPA had already completed its soil removal activities in Hamden.

QVHD follow-up actions for elevated lead in soil varied depending on the specifics of the situation. Activities they conducted included the following.

- Providing educational materials to residents about reducing exposure to lead paint in soil.
- Providing educational materials to residents about health impacts to adults and children from exposure to lead.
- Conducting home visits to observe the condition of the backyard and suggesting ways to reduce soil exposure (such as mulching bare soil).

QVHD Database Search for Elevated Blood Lead Levels in Children

To learn about potential elevated blood lead levels in children residing in the Newhall Street neighborhood, the QVHD performed a manual search of all QVHD files in the Newhall Street area for elevated blood lead levels. The QVHD found three children with elevated blood lead who resided in the Newhall Street neighborhood since 1978 (when record keeping began). Two of these children had been relocated from another town into the Newhall Street neighborhood because of elevated blood lead levels they had received while living in another town. These two children had continual decreases in their blood lead levels while in residence in the Newhall Street neighborhood. Peeling paint with toxic levels of lead was the known risk factor for the third child. CT DPH recognizes that this search would not identify a child with elevated blood lead who may frequently visit a grandparent or other relative but not reside in the neighborhood.

QVHD Community Health Concerns Survey

During May and June 2001, staff from the QVHD collected health information from the neighborhood using a community concerns interview form (see Attachment C). QVHD staff visited 125 homes in the Newhall Street neighborhood. In some homes, information was collected through a personal interview with the resident. In other cases, the resident completed the survey form themselves. Each of the 125 targeted homes were visited as many as three different occasions if an occupant was not found at home. After the third attempt, an interview form was left at the residence. The survey was intended to collect information (for qualitative evaluation) about health symptoms and health concerns among residents living in the area known to have landfill waste present. Completed survey forms were received from 55 of the 125 targeted homes.

Public Meetings and Public Availability Session

CT DPH staff participated in four public meetings and hosted one public availability session to present health and exposure information to residents and respond to residents' questions and concerns. In addition, CT DPH staff provided health and exposure information and answered questions at citizen advisory group meetings.

Methane Screening in Homes

Beginning in April 2001, the Town of Hamden Fire Marshall's office sponsored a methane screening program in the neighborhood. The program was initiated in response to residents' concerns about methane after elevated levels of methane were found beneath the boiler room floor in the adjacent Hamden Middle School. Although the source of the methane in the school was never definitively linked to the presence of landfill waste, residents wanted assurance that dangerous levels of methane were not present in their homes. The methane screening program was voluntary. Residents of 12 homes requested and received methane screening. Methane was not detected in any homes.

In addition to the methane screening conducted by the Hamden Fire Marshall's office, CT DEP collected and analyzed indoor air samples from approximately 20 residences built on known landfill areas at the site in 2001. CT DEP collected air samples from the basement or lowest level of the house, if there was not a basement. DEP's mobile laboratory analyzed the air samples for methane and volatile organic compounds (VOCs). Methane was not detected in any of the indoor air samples. No VOCs were identified that were attributable to landfill waste.

Residential Structural Evaluations

Many of the residents have concerns about settling problems in their homes and possible structural damage and safety issues. Beginning in late 2001, CT DEP hired structural and geotechnical engineering consultants to assess the issue of excessive settlement of foundations due to the loose fill over which many houses were built. Engineers identified 42 homes with possible settlement problems. At 34 of these homes, evidence of building cracks and settlement was observed during field visits. At four homes, crack gauges were installed across cracks in interior walls and exterior foundations to monitor any further movement. Detailed field visits were conducted at four homes with the most severe settlement. At all four homes, settlement has occurred to the extent that structural damage to beams and columns may have occurred. However, further investigation by structural engineers determined that none of the homes have damage so severe that occupants are in imminent danger. Engineering contractors made recommendations regarding repairs that could stabilize the homes. In 2004, CT DEP plans to further evaluate the structural condition of homes built on top of fill material. CT DEP intends to include structural repairs with remediation of the site, where warranted.

Demographics

The portions of the neighborhood that are the focus of this health consultation are delineated by the red lines in the map in Attachment A. Within this area, there are about 238 homes with approximately 600 residents.

Discussion

This section presents results from environmental sampling. Environmental data are presented and discussed along with relevant health-based comparison values. Comparison values are screening levels, below which, there is little likelihood of adverse health effects from exposure. When contaminant concentrations are below comparison values, no further evaluation for human health is necessary and it can be concluded that adverse health impacts are not likely. When contaminant concentrations exceed comparison values, it indicates that further evaluation of exposures and health impacts is needed. Comparison values used in this PHA are from the Connecticut Remediation Standard Regulations (CT RSRs) residential direct exposure criteria for soil (CT DEP 1996). Comparison values are presented in the data tables in the Environmental Data section.

Trigger concentrations were another set of values used to evaluate soil data from the Newhall Street neighborhood. These are not the same as comparison values. Trigger concentrations are levels that indicate the need for immediate action by EPA to reduce exposure. Trigger concentrations used for the Newhall Street neighborhood soil data were developed by CT DPH and EPA for this project. They are higher than CT RSRs because they indicate where contaminant levels are so high that immediate action is needed. As discussed in greater detail in the following section, EPA used the trigger concentrations to identify which properties needed immediate soil removal actions.

Exposure pathways (i.e., ways people could come into contact with contamination) and the public health significance of these exposures, along with an evaluation of available health outcome data, are also discussed in this Section.

Environmental Data

As mentioned in the Background Section, state and federal agencies have conducted soil sampling in the Newhall Street neighborhood on several occasions. CT DEP conducted the initial sampling effort in January 2001, focusing on public right-of-way grass strips between the sidewalk and road in locations believed to have received fill. This was followed by EPA sampling of surface soils to identify properties where immediate action was necessary. After EPA completed its surface soil sampling effort, CT DEP continued to sample soil at properties who requested soil sampling. The final dataset evaluated in this PHA consists of soil samples collected by the Olin Corporation in August 2002.

CT DEP Right-Of-Way Soil Sampling

Beginning in January 2001, CT DEP collected surface soil samples (0–6 inches below ground surface) from 65 locations in right-of-way grass strips. At eight of these locations, soils at depth were collected as well. Depth samples were collected as much as 12 feet below ground surface. Samples were analyzed for total metals, pesticides, semivolatile organic chemicals (SVOCs), volatile organic chemicals (VOCs), and extractable total petroleum hydrocarbons (ETPH).

In the right-of-way samples, polycyclic aromatic hydrocarbons (PAHs) were the contaminants found most often at levels exceeding health-based comparison values (15 out of 65 samples).

PAHs were more often elevated in surface soil than at soil at depth. Maximum concentrations of PAHs in surface soils are 2–5 times above comparison values. Lead, arsenic, ETPH, and pesticides were also found at levels exceeding comparison values. However, pesticides were elevated only in surface samples and were infrequently detected at elevated levels. Field observations during sampling noted the presence of non-native materials such as ash and cinders. The right-of-way sampling effort is significant because it was the first data to show that landfill waste extends into residential areas beyond the Hamden Middle School[2].

The right-of-way sample results for surface soils are summarized in Table 1. Table 1 includes maximum concentrations for those contaminants detected above health-based comparison values. Results from soils at depth (samples collected by both CT DEP and EPA) are summarized in Table 2.

EPA Residential Soil Sampling

The results of the CT DEP right-of-way sampling prompted CT DEP to ask EPA to conduct a residential soil sampling program to determine if contaminant levels were high enough that immediate action was needed to reduce exposure. In April 2001, EPA sampled surface soils (0–6 inches) at 76 properties. Sampling focused on accessible surface soils in yards where people work and play. In each yard, EPA targeted its sampling on children's play areas, bare soil areas, gardens and any other areas likely to receive high use. In addition, EPA sampled areas where homeowners had observed non-native soil material (e.g., ash, glass, cinders, slag, or other debris). Four or five locations on each property were sampled and field analyzed for lead, arsenic, and mercury using x-ray fluorescence (XRF). Approximately 40% of the XRF samples were sent to EPA's laboratory for confirmatory analysis. At the single location on each property with the highest lead level, a soil sample was laboratory analyzed for SVOCs, including PAHs.

EPA's sampling indicated that there were properties that had contaminant levels high enough that immediate action was needed to reduce exposure. The immediate action implemented by EPA was removal of contaminated soil to a depth of 18 inches below ground surface and disposal at an offsite location. Properties were considered for immediate action by EPA if contaminants in surface soil exceeded trigger levels[3] developed by CT DPH in collaboration with EPA, CT DEP, and the QVHD. At properties where surface soil concentrations exceeded trigger levels, EPA collected additional surface soil samples and at least one depth sample. The purpose of the additional sampling was to confirm the presence of contaminants above trigger levels and rule out lead paint as the source of elevated lead in surface soil. If, through additional sampling, a property was identified to receive an immediate action, EPA conducted a third round of sampling. This round of sampling provided a more complete characterization of the extent of

[2] The Hamden Middle School and the athletic field behind it are the primary areas where dumping of domestic and industrial waste occurred during the 1940s and 1950s.

[3] Trigger concentrations used to indicate further sampling and the possible need for immediate action by EPA were lead concentrations in surface soil exceeding 1,200 mg/kg, arsenic exceeding 150 mg/kg or benzo(a)pyrene exceeding 10 mg/kg. Immediate actions consisted of removal of soil to a depth of approximately 18 inches and replacement with clean soil.

contamination. It involved sampling surface soil at 10-foot grid intervals and field screening the samples for lead using XRF. This more detailed characterization allowed EPA to more precisely define the horizontal extent of contamination across the yard and develop work plans for where and how much soil removal would occur. Because sampling data indicated that high arsenic and PAHs almost always occurred with high lead levels, EPA made decisions about soil removal based only on lead results.

Table 1. Summary of Surface Soil Samples (0–6 inches) Collected by CT DEP from Right-Of-Way Areas, Newhall Street Neighborhood, Hamden, Connecticut, January 2001.

Chemical	Maximum Concentration (mg/kg)	# Samples above Comparison Value/Total # samples	Comparison Value[†] (mg/kg)
Lead	4,173	3/65	400[‡]
Arsenic	98	5/65	10
ETPH[*]	716	2/65	500
Chromium	104[§]	1/65	3,900/100[§]
PAHs			
Benzo(b)fluoranthene	5	15/81	1
Benzo(a)pyrene	2.5	5/65	1
Benzo(a)anthracene	2.6	6/65	1
Benzo(k)fluoranthene	2.3	0/65	8.4
Dibenzo(ah)anthracene	0.59	0/65	1
Indeno(1,2,3-cd)pyrene	2	3/65	1
Pesticides			
Chlordane (total)	17	3/65	0.49
Heptachlor	0.4	1/65	0.14
beta-BHC	1.6	1/65	0.34
Dieldrin	0.05	1/65	0.038

[*] ETPH = extractable total petroleum hydrocarbons

[†] The source for all comparison values used in this health assessment (unless otherwise noted) is the Connecticut Remediation Standard Regulations (CT RSR) residential direct exposure criteria for soil (CT DEP 1996). These soil standards are developed to be protective of a child who contacts soil on a daily basis for many years (30 years).

[‡] CT DEP site-specific cleanup criterion at the Hamden landfill sites. This criterion will eventually become part of the CT RSR and will be used statewide.

[§] The CT RSR residential criteria for trivalent chromium is 3,900 mg/kg, the CT RSR value for hexavalent chromium is 100 mg/kg. The sample was not speciated so it is unknown how much of the chromium is hexavalent.

Table 2. Summary of Subsurface Soil Samples Collected by CT DEP and EPA, Hamden, Connecticut, 2001–2002.

Chemical	Maximum Concentration (mg/kg)	Sample Depth (feet)	# Samples above Comp. Value/Total # Samples	Comparison Value[†] (mg/kg)
Lead	39,400	5.5–6	89/166	400[‡]
Arsenic	347	3–3.5	55/157	10
Mercury	70	1.5	1/145	20
Chromium[§]	114	2–7	1/145	3,900/100[§]
ETPH*	15,450	1–4	2/129	500
PAHs				
Benzo(b)fluoranthene	350	3–4.5	61 /142	1
Benzo(a)pyrene	240	3–4.5	60/142	1
Benzo(a)anthracene	230	3–4.5	56/142	1
Benzo(k)fluoranthene	250	3–4.5	50/142	8.4
Dibenzo(ah)anthracene	18	1–4	6/142	1
Indeno(1,2,3-cd)pyrene	52	3–4.5	17/142	1

* ETPH = Extractable total petroleum hydrocarbons.
† The source for all comparison values used in this health assessment (unless otherwise noted) is the Connecticut Remediation Standard Regulations (CT RSR) residential direct exposure criteria for soil (CT DEP 1996). These soil standards are developed to be protective of a child who contacts soil on a daily basis for many years (30 years).
‡ CT DEP site-specific cleanup criterion at the Hamden landfill sites. This criterion will eventually become part of the CT RSR and will be used statewide.
§ The CT RSR residential criteria for trivalent chromium is 3,900 mg/kg, the CT RSR value for hexavalent chromium is 100 mg/kg. The sample was not speciated so it is unknown how much of the chromium is hexavalent.

EPA conducted soil removal actions on 13 properties from October 2001 to January 2002. CT DPH reviewed and concurred with EPA's actions and assured that it was health protective (see letter in Attachment D). As mentioned previously, EPA removed soils to a depth of approximately 18 inches and then backfilled the excavation with clean fill. To gain a better understanding of contaminant concentrations at depth at the 13 properties, CT DEP collected soil samples at the base of the excavation before it was backfilled by EPA.

All of EPA's residential surface soil sampling results are summarized in Table 3. Depth samples collected by EPA and CT DEP are summarized in Table 2. Table 2 includes depth samples collected by EPA from residential yards, depth samples collected by CT DEP at the base of excavations, and depth samples from right-of-way areas.

Table 3. Summary of Surface Soil Samples (0–6 inches) Collected by EPA from Residential Yards in the Newhall Street Neighborhood, Hamden, Connecticut, April 2001.

Chemical	Maximum Concentration (mg/kg)	# Samples above Comp. Value/ Total # Samples	Comparison Value[†] (mg/kg)	# Samples above Trigger Concentration	Trigger Concentration[§] (mg/kg)
Lead	43,900	476/884	400[‡]	91/884	1,200
Arsenic[*]	155	15/85	10	1/85	150
PAHs					
Benzo(b)-fluoranthene	50	41/69	1	—	—
Benzo(a)-pyrene	54	41/69	1	2/69	10
Benzo(a)-anthracene	48	30/69	1	—	—
Benzo(k)-fluoranthene	46	3/69	8.4	—	—
Dibenzo(ah)-anthracene	12	6/69	1	—	—
Indeno(1,2,3-cd)pyrene	30	25/69	1	—	—

[*] Results presented for arsenic are laboratory results, not the field screening (XRF) results. Laboratory results are presented because the arsenic detection limit for XRF was 60 mg/kg, which is higher than the comparison value for arsenic of 10 mg/kg.

[†] The source for all comparison values used in this health assessment (unless otherwise noted) is the Connecticut Remediation Standard Regulations (CT RSR) residential direct exposure criteria for soil (CT DEP 1996). These soil standards are developed to be protective of a child who contacts soil on a daily basis for many years (30 years).

[‡] CT DEP site-specific cleanup criterion at the Hamden landfill sites. This criterion will eventually become part of the CT RSR and will be used statewide.

[§] The trigger concentrations were developed jointly by CT DEP, EPA, and CT DPH for this project. Trigger concentrations indicate the need for immediate soil removal actions.

Table 3 shows that lead was found in surface soil at extremely high levels (up to 43,900 milligrams per kilogram [mg/kg]). This is more than 100 times greater than the comparison value of 400 mg/kg. The comparison value of 400 is a screening level below which there is little likelihood of adverse health effects. Arsenic was found in surface soil at levels as high as 155 mg/kg (15 times greater than the comparison value). However, arsenic was not detected above the comparison value as frequently as lead. Virtually all of the samples with elevated arsenic also had elevated lead. With regard to PAHs, several properties in the neighborhood hade concentrations of PAHs above comparison values. In virtually all cases, properties with elevated

PAHs also had elevated lead. The highest levels of PAHs found on a property were as much as 50 times greater than comparison values.

During soil removal activities, EPA conducted perimeter air monitoring using two personal data real-time aerosol monitors (RAMs) which were placed upwind and down wind of the work area. The RAMs monitored dust levels in real time and ensured that dust suppression measures were performing within established guidelines. In addition, four low-flow air sampling pumps were placed along the perimeter of the work zone to verify that airborne lead in dust, if present, was not migrating beyond the work areas. Personal air monitoring for airborne lead was conducted during the first 3 days of excavation work. Personal monitoring was discontinued because analytical results indicated no elevated levels of lead in the air.

CT DEP Supplemental Soil Sampling

As mentioned previously, soil data were also collected by CT DEP as part of its supplemental soil-sampling program. CT DEP's supplemental soil sampling program included residences that were not included in EPA's sampling program, but there was reason to suspect that landfill waste materials were present in soil on those properties. Beginning in December 2001, CT DEP collected surface soil samples at approximately 46 residences not sampled by EPA. CT DEP followed essentially the same sampling procedure as EPA had followed for its April 2001 sampling effort. CT DEP's sampling identified the presence of lead in surface soil at levels up to 5,600 mg/kg (14 times greater than the comparison value). There were eight properties with lead levels greater than the immediate action trigger level of 1,200 mg/kg. At these properties, exposure reduction measures such as covering bare soil were performed. Arsenic was also found at levels greater than the comparison value of 10 mg/kg (maximum concentration 55 mg/kg). Several PAHs were found at levels as great as 40 times above comparison values in one surface soil location at one property. EPA did not conduct soil removal actions at these properties because they were discovered after EPA had already completed its activities in the neighborhood. These properties are being investigated further as part of Olin's workplan for additional soil sampling in the neighborhood. CT DEP's supplemental soil sampling results are not included in the summary data tables.

Olin Soil Sampling

The final soil data that exists for the Newhall Street neighborhood consists of samples collected and analyzed by Olin Corporation in August 2002. As mentioned earlier, the focus of Olin's sampling was to better define the extent of fill material at depth in the neighborhood and to define the limits of landfill waste materials. Although their focus was soils at depth, they collected approximately 75 surface soil samples (0–3 inches below ground surface) as part of their investigation. Some samples were collected from public right-of-way areas, other samples were collected from private yards. Surface soils were analyzed for lead and arsenic. The maximum lead concentration in surface soil was 738 mg/kg; the maximum arsenic concentration was 35 mg/kg. These concentrations are above comparison values, but do not exceed the immediate action trigger value. Regarding contaminant concentrations at depth, Olin's results were generally consistent with what previous subsurface investigations have found. That is, lead, arsenic, PAHs, and ETPHs were found at elevated levels. Maximum lead found in soils at depth was 10,100 mg/kg and maximum arsenic was 303 mg/kg. A new finding was that at one property, PAHs were found at depth (2–4 feet below ground surface) at levels much higher than any previous sampling had found. Several PAH compounds were found at 96 to 3,100 times greater than comparison values. Olin's dataset is not included in the summary data tables.

Exposure Pathways

To evaluate potential exposures in the Newhall Street neighborhood, CT DPH considered the available environmental data and how people might come into contact with contaminants. In order for exposure to occur, 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. It is important to emphasize that if there is no exposure to a hazardous contaminant, there is no risk of adverse health effects.

In the Newhall Street neighborhood, contaminants have been detected in surface soil and subsurface soil.

Surface soil

For surface soil, possible ways people could be exposed to contamination is by ingestion (eating soil particles adhered to fingers or food items), dermal contact (skin contact with soil during activities such as gardening or other yard work, children playing in the soil) and inhalation (inhaling soil particles). In yard areas that are grassed or have other barriers to direct soil contact, such as asphalt, exposure potential to surface soils will be greatly diminished. For this PHA, exposure to contaminants in surface soils is considered to be a *complete exposure pathway* and is evaluated in more detail in the Public Health Implications section.

Subsurface soil

Subsurface soils in the neighborhood were also found to have contaminants. As summarized in Table 2, contaminant levels in soils at depth are significantly elevated above health-based comparison values. In the past, it is possible that neighborhood residents could have come into contact with soils at depth during activities in their yards that penetrated into deep soils. Such activities could have included planting trees or shrubs and installing fence posts or footings for a deck. It is very difficult to quantitatively evaluate doses and health impacts to residents from past exposure to soils at depth.

Because contaminant levels in subsurface soils are high, CT DPH has conducted a number of public health intervention activities to inform residents about the contamination and recommend ways to avoid contact with subsurface soils. These interventions included home visits with residents, preparing and distributing fact sheets, and presenting information at numerous public meetings and availability sessions. CT DPH continues to distribute its fact sheets and continues to communicate its message about avoiding activities that penetrate into deep soils. Because of CT DPH's ongoing interventions, the current potential for exposure to soils at depth is very low. Therefore, CT DPH considers exposure to subsurface soils to be a potential exposure pathway and it is not evaluated quantitatively in this Public Health Assessment.

With regard to exposure pathways other than soil, air monitoring conducted during EPA's soil excavation work showed no airborne lead and the methane screening program found no evidence of methane in the basements of homes in the neighborhood that were tested. Therefore, exposure to landfill waste materials through the air pathway (indoor air and outdoor air) is not likely.

Contaminants have been detected in groundwater in the neighborhood. However, groundwater is *not* used for drinking water or other nonpotable uses, so there is no exposure to groundwater from drinking[5].

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. However, if there is an actual (completed) or potential exposure pathway, contaminant concentrations are compared to health-protective comparison values. As stated previously, comparison values are screening levels, below which, there is little likelihood of an adverse health effects from exposure. When contaminant concentrations exceed comparison values, exposures are evaluated further. In this Public Health Assessment, CT DPH used the Connecticut residential criteria for direct exposure to soil (CT RSRs) as comparison values. These values assume that contact with soil occurs every day over the long term (30 years).

Public Health Implications for Adults and Children

This section presents the likely health impacts to Newhall Street neighborhood residents from hazardous contaminants in landfill waste. Whether a person becomes sick from exposure to hazardous contamination depends on a number of factors including:

- the concentration of the chemical someone is exposed to (how much),
- the duration and frequency of exposure (how long, how many times),
- the route of exposure (breathing, eating/drinking, skin contact), and
- the person's individual characteristics (age, diet, lifestyle, genetics).

To evaluate public health implications to adults and children from contaminants in residential yards in the Newhall Street neighborhood, CT DPH first compared maximum concentrations of contaminants with comparison values. When concentrations exceeded comparison values, they were evaluated further to determine the likelihood that the exposures would be significant enough to cause health effects. For contaminants that exceeded comparison values (lead, arsenic, PAHs, pesticides, total petroleum hydrocarbons), CT DPH evaluated potential cancer and noncancer health effects. For lead, CT DPH evaluated the predicted increase in blood lead level.

See Attachment F for a summary of the general toxicological and epidemiological information for the three primary contaminants found in the Newhall Street neighborhood (lead, arsenic, and PAHs). The information in Attachment F is included as general background information. It is not intended to imply that these health effects would be expected or are likely to occur among

residents in the neighborhood. More toxicological information can also be found on the ATSDR website (www.atsdr.cdc.gov).

[5] Another way for exposure to occur from groundwater is through volatilization. If volatile chemicals are present in shallow groundwater at high enough levels, chemicals can move from the groundwater to soil through vapor, which can enter basements through cracks and other openings in the foundation. Limited groundwater sampling in the neighborhood does not show the presence of volatile chemicals. More groundwater sampling is planned that should provide information needed to rule out this exposure pathway as one of concern.

Public Health Implications of Lead in Surface Soil

Substantial amounts of environmental sampling have occurred in the Newhall Street neighborhood over the past 3 years. Surface soil samples collected from neighborhood yards (Table 3) indicate that lead was frequently found above its comparison value of 400 mg/kg. Lead is the contaminant found at the highest concentration in surface soil, relative to its comparison value. Lead was detected at one property at concentrations more than 100 times above its comparison value. The maximum lead level found in surface soil in a residential yard is 43,900 mg/kg. Lead was found at levels above 400 mg/kg in approximately 50% of samples.

Adults and children in the Newhall Street neighborhood could come into direct contact with contaminated surface soil while working or playing in their yards. Exposure could occur through direct skin contact (dermal), eating soil particles adhered to fingers or food items (ingestion) or breathing soil particles in the air (inhalation). Children have a greater potential for exposure to soil than do adults. Children have more opportunities for contact with soil because they play on the ground and in bare soil. Children also have greater hand-mouth activity, which leads to more soil ingestion than is common for adults. In addition, children have a greater sensitivity than do adults to the harmful health effects from lead exposure.

The high levels of lead found in the Newhall Street neighborhood were present in surface soils where children currently reside or resided in the past. As discussed previously, lead in soil can be an important route of exposure to lead.

ATSDR has developed a screening procedure for evaluating exposures to lead (ATSDR 1999). ATSDR's screening procedure uses a blood lead slope factor, which predicts the increase in blood lead per unit lead concentration in soil. The slope factor assumes continuous exposure. The screening procedure involves multiplying the lead level in soil by the percentage of outside time a person spends in their yard. This is then multiplied by the blood lead-to-soil lead slope factor. CT DPH used a blood lead slope factor for U.S. children of 0.0068, which is derived from a study of U.S. children from 1–18 years of age (Angle et al. 1984). For adults, CT DPH used a slope factor of 0.001, which is based results from a study of U.S. males aged 18–65 years (Stern 1996). For the percentage of outside time spent in the yard, CT DPH made two alternative assumptions, shown in Table 4.

The relationship between soil lead and blood lead depends on many factors, including the bioavailability[6] of lead in the soil, the chemical form of lead, the age of the exposed person, and the person's work or play habits. Using the ATSDR screening procedure, CT DPH estimated the incremental blood lead level for children and adults working and playing in soil in the yard with the highest *average* lead level (calculated to be 11,800 mg/kg). Lead levels were not averaged across multiple yards because exposure occurs mostly in one's own yard rather than in other yards in the neighborhood. The average lead concentration (11,800 mg/kg) was conservatively estimated as the 95% upper confidence limit (UCL) of the mean, using EPA's Pro UCL program (EPA 2001a). The results of the blood lead estimates are presented in Table 4.

[6] Bioavailability refers to the degree to which lead is available to the body. Bioavailability is influenced by how easily the lead is absorbed from the soil into the body.

For our calculations, we assumed that a child spends 100% of their playtime in their yard (as opposed to playtime spent elsewhere, such as at a park). That child might have an incremental blood lead level of 80 µg/dL (microgram per deciliter), estimated from the average (11,800 mg/kg) lead concentration in soil. If the children spend only 50% of their playtime in their yard, CT DPH then estimates a potential incremental blood lead level of 40 µg/dL for those children, using the average concentration in the most contaminated yard. CT DPH believes it is reasonable to assume that children would not spend less than 50% of their playtime in their yards.

These blood lead estimates are greater than the level of concern for potential adverse health impacts in children (greater than 10 µg/dL). It is important to note that 11,800 mg/kg is the average lead level in the *most contaminated yard.*[7] Estimated blood lead levels would be lower in yards with lower lead levels in soil. For example, using the ATSDR screening procedure, any yard with an average soil lead concentration exceeding 1,500 mg/kg has the potential to result in blood lead levels greater than the level of concern for children (>10 µg/dL). This assumes that the child spends 100% of his or her play time in their yard. Average lead levels in several yards exceeded 1,500 mg/kg, but they have already been cleaned up by EPA (as has the yard with an average lead level of 11,800 mg/kg). Therefore, under *current conditions*, there is no opportunity for exposure to lead at levels of public health concern.

Table 4. Estimated Blood Lead Increment from Exposure to Lead in Residential Soil, Newhall Street Neighborhood, Hamden, Connecticut (using ATSDR's Screening Procedure, July 1999).

Exposed Person	Soil Lead Concentration* (mg/kg)	Soil Slope Factor (µg/dL blood lead per mg/kg soil lead)	Fraction of play or work time spent in one's own yard	Estimated Incremental Blood Lead Burden (µg/dL)
Child	11,800	0.0068	1.0 (100%)	80
Child	11,800	0.0068	0.5 (50%)	40
Adult	11,800	0.001	0.5 (50%)	6

*The soil lead concentration of 11,800 mg/kg is the average concentration in the most contaminated yard. The average was conservatively estimated as the 95% upper confidence limit of the average. It is unlikely to underestimate the true average.

CT DPH's blood lead calculations show that estimates of incremental blood lead levels in children are above levels of concern for potential adverse health impacts (>10 µg/dL). However, there is no indication that children living in the neighborhood actually have these levels of lead in their blood. *The model used by CT DPH is a screening procedure that cannot predict the true blood lead levels in any given person because of the many uncertainties inherent in the relationship between soil lead and blood lead.*[8] At best, the model results indicate that at the most contaminated properties, there is the potential for increases in blood lead levels in children. At properties with lower lead levels in soil, the potential for exposure would be less. Fortunately, the homes with the highest levels of lead in surface soil that we know about, received immediate

[7] This yard (as well as other yards with very high lead levels) has already been cleaned up.

[8] If someone is concerned that they might have elevated lead levels in their blood, they should contact their physician to get a blood test for lead.

soil removal actions by EPA in 2001. Therefore, CT DPH believes that exposures at levels of public health concern are no longer occurring in the neighborhood. CT DPH has concluded that under current conditions in the neighborhood, lead does not pose a public health threat. However, past exposures to lead in soil could have caused elevations in children's' blood lead above levels of concern for possible adverse health effects. Elevations in children's blood lead could occur in the future if the remaining properties with elevated lead in soil are not cleaned up. As shown in Table 4, CT DPH also estimated incremental blood lead levels in adults and found the estimated increase to be small and not above a levels of concern for adults (>20 μg/dL).

Public Health Implications of Other Contaminants in Surface Soil

Arsenic and PAHs

As shown in Table 3, arsenic was found in surface soil at levels above comparison values. The maximum arsenic concentration was 155 mg/kg (15 times higher than the comparison value). Several PAHs were also found at elevated levels (as much as 54 times above comparison values). Only a single surface soil sample from each yard was analyzed for PAHs. For arsenic, most properties only have two or three laboratory confirmed samples[9]. The small number of samples is not enough to calculate averages on a property-by-property basis for arsenic and PAHs. Therefore, to estimate concentrations of arsenic and PAHs that residents could be exposed to, CT DPH calculated average concentrations of arsenic and PAHs using data from multiple properties. Properties in the neighborhood were separated into two groups according to the spatial distribution of landfill waste.

Morse Street Property Group

The first group of properties (Morse Street group), consists of six different properties. In this property group, six PAH samples and 13 arsenic samples were available to calculate average concentrations. The average concentration (95% UCL) for each PAH was below comparison values (CT RSRs). Therefore, PAH exposure in this group of properties is unlikely to present a cancer or noncancer health threat. The average concentration (95% UCL) of arsenic in the Morse Street group of properties was 54 mg/kg. This average concentration exceeds the comparison value for arsenic of 10 mg/kg, so exposures to arsenic in the Morse Street group of properties were evaluated further.

CT DPH calculated exposure doses and theoretical risks from exposure to arsenic in the Morse Street group of properties, assuming that soil exposure occurs 7 days per week for 9 months of the year, for 30 years. The calculations are based on 9 months rather than 12 months, on the assumption that contact with soil would not occur during the winter, when the ground is frozen and possibly snow-covered. CT DPH believes these are realistic, yet still health-protective assumptions, given the specifics of the site. Arsenic doses to children and adults were calculated. As previously stated, CT DPH assumed people would be exposed to 54 mg/kg arsenic in soil. This is the 95% UCL of the average. A 95% UCL accounts for variability in the data and ensures that the average is not underestimated. Given these assumptions, the average daily dose from

[9] There are many more field screening results for arsenic, but the detection limit is higher than the comparison value, so the results are not meaningful for evaluating public health impacts.

ingestion and dermal exposure to arsenic was estimated to be 0.00026 mg/kg/day. This dose is below the Agency for Toxic Substances and Disease Registry's (ATSDR's) minimum risk level (MRL) for chronic oral arsenic exposure of 0.00034 mg/kg/day. MRLs are estimates of daily exposure to humans that are likely to be without harmful noncancer effects. Because the dose from the site is less than the MRL, harmful noncancer effects from arsenic in soil are unlikely. See Attachment G for the detailed calculations.

Because arsenic can be an acute (short-term) toxin, CT DPH also calculated an acute ingestion dose for a 2-year-old child assuming a larger soil ingestion rate over a 7-day period. The acute calculation focused on a young child because younger children are more likely to ingest soil than are older children. The acute dose from the site is three times less than ATSDR's Acute MRL. Thus, adverse health effects from acute oral exposure to arsenic in the soil are unlikely. See Attachment G for the detailed calculations.

CT DPH also calculated theoretical cancer risks from long-term exposure to arsenic (assuming exposure from age one to age 30 years). The theoretical cancer risk from arsenic exposure of 5×10^{-5} (five excess cancer cases per 100,000 exposed people) represents a non-meaningful incremental cancer risk above the background cancer level of approximately one in three (NCI 2001). Another way to describe the background cancer rate of one in three is that in a population of 100,000 people, roughly 33,000 of them would be expected to get cancer at some point in their lifetime. If that same population of 100,000 people were exposed to arsenic in soil at 54 mg/kg (the average level in the Morse Street group of properties), five extra cancers (above the 33,000 cancer cases from all other causes) would be expected. This is not a meaningful increase in cancer risk. Readers should refer to the American Cancer Society (www.cancer.org) or the National Cancer Institute (www.nci.nih.gov) websites for more information about cancer and its risk factors.

Moreover, the estimated arsenic dose that people would receive over 30 years is lower than the cancer effect level (CEL). The CEL is the range of doses that have caused cancer in humans and animals. The estimated arsenic dose to residents in the Morse Street Property Group is 33 times lower than the CEL for lung cancer and 100,000 times lower than the CEL for bladder cancer (ATSDR 2000). Because the dose from the site is lower than the CELs, cancer effects are unlikely. See Attachment G for the detailed dose and risk calculations.

Bryden Terrace Property Group

The second set of properties (Bryden Terrace group) consists of 39 properties. The average arsenic concentration in this group of properties is below the comparison value of 10 mg/kg. That means arsenic exposure is unlikely to be a health threat at the Bryden Terrace group of properties. In the Bryden Terrace grouping, average concentrations of six individual PAH compounds—benzo(b) fluoranthene, benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, and dibenzo(ah)anthracene—exceed comparison values. Therefore, exposure to these PAHs was evaluated further.

CT DPH calculated doses and risks from PAH exposure at the Bryden Terrace group of properties using the same assumptions described above for arsenic. Estimated PAHs doses were

well below the EPA reference dose (RfD) for oral exposure to PAHs. The RfD is an estimate of the "safe dose," below which, adverse noncancer health effects are not likely. That means harmful noncancer health effects from PAH exposure are not likely. Refer to Attachment G for detailed risk calculations.

Because some PAHs are believed to cause cancer in humans, CT DPH also calculated theoretical cancer risks from exposure using the same exposure assumptions described for the arsenic cancer risk calculations. Detailed calculations are found in Attachment G. The theoretical cancer risk from PAH exposure of 8×10^{-5} (eight excess cancer cases per 100,000 exposed people) represents a non-meaningful incremental risk above the background cancer level of approximately one in three (NCI 2001). Additionally, the estimated PAH dose to residents in the Bryden Terrace Property Group is more than 200,000 times lower than PAH doses from the cancer effect levels (CELs) in the scientific literature that have been observed to cause cancer in humans and animals (ATSDR 1995). Because the dose from the site is much lower than the CELs for PAHs, cancer effects are considered very unlikely.

Pesticides and ETPH

Pesticides and extractable total petroleum hydrocarbons (ETPH) were the only other contaminants found at levels exceeding health-based comparison values in surface soil. These groups of contaminants were found at elevated levels in the samples collected from right-of-way areas adjacent to yards (see Table 1). Four pesticides (chlordane, heptachlor, beta-hexachloro-cyclohexane, and dieldrin) were detected very infrequently. When average levels are calculated for these pesticides, the averages are well below health-based comparison values. The same is true for ETPH. Therefore, CT DPH concludes that health impacts from exposure to pesticides and ETPH found in soil samples in the Newhall Street neighborhood do not pose a health threat.

Health Outcome Data

CT DPH evaluated the health survey information collected from local residents by QVHD. Reported cases of cancer were verified by CT DPH in the Connecticut Tumor Registry records[5] (see http://www.dph.state.ct.us/OPPE/hptumor.htm). Cancer cases occurred among individuals aged 22–85 years. Some of the cases were recently diagnosed, a few dated back to 1974. On the basis of CT DPH's review, the number and types of cancer that were reported in the health survey conducted by QVHD do not appear to be in excess of what would be expected to occur. CT DPH reached this conclusion because there was not a preponderance of cancers of the same type, or among the same age group. Different cancers are different diseases. Causes and risk factors for one type of cancer are different from another cancer. When cancer cases in a small geographic area (such as a neighborhood) are not the same type of cancer or are not within the same age group, there is little reason to believe the cancers may have a common environmental cause.

[5] According to Connecticut law, all tumors diagnosed to Connecticut residents must be reported to the CT DPH Tumor Registry. The Tumor Registry has been in existence since 1935. It collects data from reporting physicians and also has an active surveillance program which reviews hospital record to ensure complete reporting of tumors.

It should be emphasized that CT DPH's cancer evaluation did not include statistical analyses. Information collected in a health survey is typically not evaluated quantitatively (using statistics) because of limitations in the type of data such surveys can collect and limitations in epidemiological methods. One of the important limitations is that only about half of the targeted homes returned a completed survey form. It is not known whether there are more illnesses among the people who did not return a survey as compared with the people who did return a survey form. This limitation makes it impossible to draw any conclusions about the neighborhood as a whole. We can only say that among the Newhall Street neighborhood residents who returned a health survey form, the number and types of cancers reported do not appear to be unusual. CT DPH's cancer evaluation is contained in Attachment E.

With regard to illnesses other than cancer, from the number of dwellings surveyed (55), CT DPH believes the number and type of reported illnesses do not look unusual. Again, this evaluation was qualitative, not quantitative. Limitations in the data that can be collected using a health survey (such as the lack of background rates of illnesses) make it impossible to conclude whether the reported illnesses exceed what would be expected to occur.

CT DPH also looked at the published cancer incidence for the town of Hamden for the period 1995–1999 (CT DPH 2002). This is the period for which cancer statistics compiled by town are readily available. There were no statistically meaningful elevations in cancer incidence for Hamden during 1995–1999. It should be emphasized however, that an evaluation of townwide cancer rates is very unlikely to reveal an elevation in cancer in a particular neighborhood, unless the numbers of cancers in the neighborhood are extremely high.

Evaluation of Community Health Concerns

Community health questions and concerns were collected by CT DPH during numerous public meetings and home visits in the neighborhood and from the QVHD. This section summarizes community health concerns. A response is provided following each concern.

1. *Many residents are concerned about cancer. They wonder whether cancers in their family members could be related to living around landfill waste for so many years. They also wonder whether there are more cases of cancer in the Newhall Street neighborhood than would be expected.*

Soil samples taken in areas where landfill waste is present indicate that lead is the primary contaminant. The main target for lead toxicity is the nervous system, both in adults and children. We have no evidence that lead causes cancer in people. Therefore, it is extremely unlikely that the cause of cancer among Newhall Street residents is exposure to lead in their soil. Arsenic and PAHs have also been found at elevated levels in local soil. Arsenic is known to cause cancer in humans. Some PAHs probably cause cancer in humans, also. However, for both arsenic and PAHs, CT DPH's dose and risk calculations indicate that exposure to these contaminants is very unlikely to result in adverse health effects. In most homes tested, levels of PAHs and arsenic

were consistent with natural background levels. Background means levels that would be present even if the landfill was not present.

Unfortunately, cancer is relatively common. According to the National Cancer Institute (part of the National Institutes of Health), one of every three persons will be diagnosed with cancer at some point in their lifetime. To put this cancer rate into perspective for the Newhall Street neighborhood, of approximately 600 residents, 200 of the 600 residents would be expected to receive a diagnosis of cancer at some point in their lifetime. These 200 cancers would be the expected background rate, even if the landfill were not present. It is also important to keep in mind that cancer is not a single disease but rather, 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. When there are cancers of many different types clustered in one geographic area, it is less likely that environmental causes are to blame and more likely that other causes are to blame, such as family history, diet, and age.

2. *Residents asked many questions about gardening and other yard work. They were concerned about whether it is safe to do yard work, such as mowing the lawn, and whether it is safe to do gardening activities, including growing and eating vegetables and fruits.*

Yes, it is safe to do yard work and gardening in your yard, provided that you take several simple precautions. Following these precautions will help ensure that your exposure to contaminants that may be in soil in your yard will be reduced as much as possible. When working in your garden, you should limit direct contact with soil as much as possible by wearing gloves and washing your hands after gardening. If you must dig into the soil (for instance, when planting a tree or putting in a fence post), soil that you dig up from below the ground should not be left on the surface where it is accessible, especially to children. Soil that is dug up should be covered or moved to a location in the yard where it is not accessible. Avoid mowing your lawn when it is excessively dry and dusty to reduce your exposure to soil dust in the air.

For vegetable gardening, it is advisable to use a raised bed in which new topsoil is brought in. If you cannot use a raised bed, consider adding compost or new topsoil to your garden soil. This will dilute contaminant concentrations in the soil and reduce your chance of exposure. In addition, plants tend to absorb lesser amounts of chemical contaminants if the soil has neutral pH and the correct level of nutrients. The type of crops you select to grow will also influence how much chemicals are absorbed into the crops. For more details on reducing exposure to soil contaminants during gardening and other yard work, you should refer to the fact sheets "What Can I Do To Reduce My Exposure to Soil in my Yard?" and "Growing and Eating Fruits and Vegetables in the Newhall Neighborhood of Hamden." These fact sheets were prepared by the CT DPH and are included in Attachment B.

3. *Many residents in the Newhall Street neighborhood are grandparents. They asked whether it is safe to let their grandchildren play in their yards.*

Yes, on the basis of data we have at this time, it is safe for your grandchildren to play in your yard. Children will not be exposed and will not be in any danger from contaminants that may be

in the soil if they do not touch the soil on a regular and continuing basis. You can do several things to ensure that children playing in your yard do not come into contact with contaminants that may be present in soil. First, children should be discouraged from playing in bare soil. Grass, mulch, pavement, and other coverings over the soil provide a good barrier to direct contact with the soil. Maintain good grass covering on your lawn. Bare soil areas, especially beneath play equipment, should be covered with mulch, sand, clean topsoil, or any other covering. Other things you can do to limit contact with soil are to wash toys before bringing them inside the home and make sure children wash their hands after playing in the yard, especially before eating.

4. *Several residents indicated that grass would not grow in certain areas of their yards. They questioned whether this was an indication that contaminants were present in the soil and whether these bare areas should be avoided.*

It is possible that the presence of very high levels of contaminants in soil could influence whether grass grows there. However, other things can affect whether grass grows (such as heavy shade) that are not related to the presence of landfill waste. It is a good idea to avoid direct contact with bare soil areas in your yard if you are not sure whether contamination is present. This is especially important for children. Encourage grass to grow in bare areas. As alternatives, bare soil areas can be covered with mulch or clean topsoil to minimize opportunities for exposure.

5. *Many residents are very concerned about cracks in their walls from severe settling that has occurred in their homes. They expressed concerns for their safety and the structural stability of their homes. They also were concerned about contaminants moving up from the ground into their homes through the cracks.*

The presence of landfill waste materials beneath homes in the Newhall Street neighborhood has caused settling and subsidence problems in some homes. In those homes most severely affected, CT DEP had a structural engineer inspect the home and identify structural safety problems. Any structural safety problems that were identified have been addressed.

The primary contaminants that have been found in soil are lead, arsenic, and PAHs. These chemicals do not readily evaporate out of the soil. They remain bound to the soil and will not move through the soil into homes. Volatile chemicals that could evaporate out of the soil into homes have **not** been found in the soil in the Newhall Street neighborhood. Methane was found beneath the boiler room floor of the nearby Hamden Middle School, raising concerns about the possibility that methane was present in the landfill. Methane gas, if it were present, could move into indoor air in a home through cracks in a home's foundation. As discussed earlier in this health assessment, a methane screening program was conducted in the neighborhood and no methane or volatile chemicals attributable to waste were found.

6. *Several residents asked whether there is a test to determine if their children had been exposed to lead.*

The amount of lead in the blood can be measured to determine if exposure to lead has occurred. This test can tell if you have been **recently** exposed to lead. However, a blood test for lead will

not tell you the source of the lead exposure. Children can be exposed to lead in various ways, including through food, drinking water, soil, and lead paint in the home. Blood tests are routinely used by pediatricians to screen young children for potential lead poisoning. It is a good idea to get a blood lead test for all children younger than 2 years (regardless of whether they live (or spend time) in the Newhall Street neighborhood). For children, blood lead levels greater than 10 µg/dL are cause for concern for possible adverse health effects. If you are concerned that your child or grandchild might have elevated levels of lead in their blood, you should contact their pediatrician or the QVHD and ask about a blood test.

7. *Some residents asked whether their drinking water was contaminated by the landfill waste material.*

Drinking water for Newhall Street neighborhood residents comes from a public water supply provided by the South Central Connecticut Regional Water Authority. Drinking water comes from surface water reservoirs located in either North Branford or Woodbridge. These drinking water sources are safe and are not affected by the landfill.

8. *Residents asked whether there were lasting health effects from exposure to lead as a child.*

One of the effects that has been seen in children exposed to lead in the womb, in infancy, or in early childhood is delayed mental development and lower intelligence later in childhood. There is evidence that some of these effects may persist beyond childhood.

9. *Many residences had elevated levels of contaminants in soil, but none were high enough to warrant immediate soil removal by EPA. Some residents are concerned that their yards are not being cleaned up right away and whether it is safe to continue living in their homes.*

Yes, it is safe to continue living in your home, even if contaminants were found in the soil, but no cleanup has yet occurred. The EPA clean-up action included only those homes with levels of contaminants so high that immediate action was determined to be necessary to protect public health. If you have contamination present in soil in your yard that has not yet been cleaned up, there are things you can do to help reduce your contact with soil until cleanup does occur. The Fact Sheet included in Attachment B provides a number of suggestions about ways to reduce soil exposure. The presence of some lead and PAHs in surface soil is common, especially near older homes that have or had lead paint or are near roadways with significant car and truck traffic.

Conclusions

Environmental samples collected from residential yards in the Newhall Street neighborhood indicate that lead, arsenic, and PAHs are present in surface and subsurface soils at elevated concentrations in some yards. Adults and children living in the neighborhood could be exposed to contamination while working or playing in their yards. Exposure could occur through dermal contact (direct skin contact), ingestion (eating soil particles adhered to fingers or food), or inhalation (breathing soil particles in the air). Children have a greater potential for exposure to soil than adults do because they play on the ground and have greater hand-to-mouth activity than

adults. In addition, children have a greater sensitivity than adults to the harmful effects from lead exposure. Lead can affect many organs in the body. The most sensitive is the central nervous system, especially in children. Lead can cause decreased mental abilities in infants and learning difficulties and reduced growth in young children.

CT DPH used a screening procedure developed by ATSDR for estimating the incremental blood lead level for children and adults working or playing in lead-contaminated soil in their yards. CT DPH's calculations indicate that for homes with the highest concentrations of lead in surface soil (greater than 1,500 mg/kg), there is the potential for increases in blood lead levels in children above levels of concern for potential adverse health impacts. *Fortunately, the homes with the highest lead levels have been already cleaned up by EPA, so exposures, at levels of public health concern, are no longer occurring.* However, past exposures could have caused elevations in blood lead among children. Future exposures could cause elevations in blood lead levels if the remaining homes with high lead levels are left uncorrected.

With regard to arsenic and PAHs in soil, CT DPH calculated cancer and noncancer risks from exposure and has concluded that adverse health effects are unlikely. 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 H to this report. CT DPH has concluded that, on the basis of the existing environmental data, exposure to lead in the yards with the highest levels, posed a "public health hazard" in the past (that is, *before* EPA performed its soil cleanup activities). On the basis of current conditions and available data, a "no apparent public health hazard" currently exists. However, this hazard category will be re-evaluated once the full nature and extent of landfill waste contamination of the Newhall Street neighborhood is determined. For example, Olin has presented a workplan for further soil and groundwater sampling in the neighborhood. When these (or other) data are available, CT DPH will evaluate the data and will modify conclusions and recommendations contained in this PHA, if necessary.

Recommendations

1. CT DPH recommends that residents follow the suggestions contained in this Public Health Assessment and the attached fact sheets regarding ways to reduce exposure to soil in their yards. This advice includes avoiding digging or other activities that disturb soils beneath the ground surface.

2. CT DPH recommends that CT DEP continue its role overseeing the process of further investigation of the nature and extent of landfill waste contaminants in the Newhall Street neighborhood and that this investigation proceed as quickly as possible so that a permanent remedy will be in place as soon as possible.

3. CT DPH recommends that QVHD offer free blood lead screening in the Newhall Street neighborhood again.

4. CT DPH recommends that QVHD expand the community health concerns survey originally conducted in 2001, to areas known to have landfill waste that were not included in the previous

survey. CT DPH also recommends that QVHD conduct a community needs assessment focusing on information such as identifying stakeholders, collecting health education needs, and identifying health concerns.

5. CT DPH recommends that QVHD, CT DEP, or Olin Corporation perform a follow-up inspection on each of the properties where CT DEP found lead above the trigger value of 1,200 mg/kg and where cleanup has not yet occurred. The inspection should focus on whether actions taken to reduce exposure (e.g., mulching bare soil) still provide an effective barrier to direct contact with soil.

Public Health Action Plan

Actions Taken

Since contamination was first discovered in the Newhall Street neighborhood in early 2001, CT DPH, in conjunction with QVHD, has conducted many activities to assess health concerns in the community, provided health education to the community, and communicated potential health risks to the public.

1. During May and June 2001, CT DPH and EPA met with most of the residents of the approximately 76 properties that were sampled by EPA. Soil results were provided to each resident and next steps were discussed. CT DPH answered questions about exposure and health effects. A fact sheet prepared jointly by EPA and CT DPH about ways to reduce exposure to soil was distributed to residents (see Attachment B).

2. In August 2001, the QVHD offered free blood lead screening to neighborhood residents. The screening was open to anyone interested. Residents were specifically targeted who had elevated lead in soil and children residing in the home. The purpose of the screening was to identify cases of lead poisoning among neighborhood residents so that further investigation could occur to identify possible sources of lead exposure. No individuals came to the screening.

3. CT DEP referred a number of homes to the QVHD for lead exposure follow-up activities. The homes referred for follow up were those homes with elevated lead in surface soil, where young children reside (or visit often), that were *not* scheduled to receive an EPA immediate soil removal action. QVHD follow-up actions for elevated lead in soil varied depending on the specifics of the situation. Activities they conducted included the following:

- Providing educational materials to residents about reducing exposure to lead paint in soil.
- Providing educational materials to residents about health impacts to adults and children from exposure to lead.
- Conducting home visits to observe the condition of the backyard and suggest ways to reduce soil exposure (such as mulching bare soil).

4. To learn about potential elevated blood lead levels in children residing in the Newhall Street neighborhood, the QVHD performed a manual search of all QVHD files in the Newhall Street area for elevated blood lead levels.

5. During May and June 2001, staff from the QVHD collected health information from the neighborhood using a community concerns interview form (see Attachment C). QVHD staff visited 125 homes in the area where EPA sampling had occurred in April 2001. In some homes, information was collected through a personal interview with the resident. In other cases, the resident completed the survey form themselves.

6. CT DPH staff participated in numerous public meetings and hosted one public availability session in April 2004 on this draft Public Health Assessment. At each of these events, CT DPH staff presented health and exposure information to residents and responded to residents' questions and concerns. In addition, CT DPH staff have provided health and exposure information and answered questions at citizen advisory group meetings.

7. In January 2004, CT DPH prepared a fact sheet on how to safely grow and eat fruits and vegetables.

8. In February 2004, CT DPH prepared a fact sheet summarizing the information contained in the draft release of this Public Health Assessment and distributed the fact sheet at the April 2004 public availability session as well as other open house and public meetings.

9. In June 2004, CT DPH, along with the QVHD, hosted a public health open house. Free blood lead screening and blood pressure checks were offered. CT DPH presented a summary of this Public Health Assessment. An environmental medicine doctor from the University of Connecticut Division of Occupational and Environmental Medicine was present to speak with residents about their health concerns. CT DEP staff were present to answer questions about environmental sampling. This open house event was organized in response to a request from the community that was received during the public comment period for this Public Health Assessment.

10. During the spring 2004, CT DPH began to actively distribute the fact sheet entitled "Growing and Eating Fruits and Vegetables in the Newhall Street Neighborhood," dated January 2004, to residents in the Newhall Street neighborhood and any other stakeholders and interested persons or organizations.

11. In June 2004, QVHD completed its evaluation of community health and environmental concerns based on an expanded community survey that was administered during the winter 2004.

Actions Planned

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

2. CT DPH will evaluate new sampling data from the neighborhood as it becomes available and will update the conclusions and recommendations contained in this Public Health Assessment, if necessary. As part of this evaluation, CT DPH will report on results of blood lead screening and the QVHD Community Concerns Survey. CT DPH will also review and update the Public Health Action Plan as needed to reflect the status of activities.

3. CT DPH will evaluate new sampling data from the neighborhood as it becomes available and will update conclusions and recommendations contained in this Public Health Assessment, if needed.

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

5. CT DPH will work with the QVHD, 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 time frame.

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CERTIFICATION

The Public Health Assessment for the Evaluation of Residential Soils in the Newhall Street Neighborhood of Hamden 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 assessment was initiated.

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

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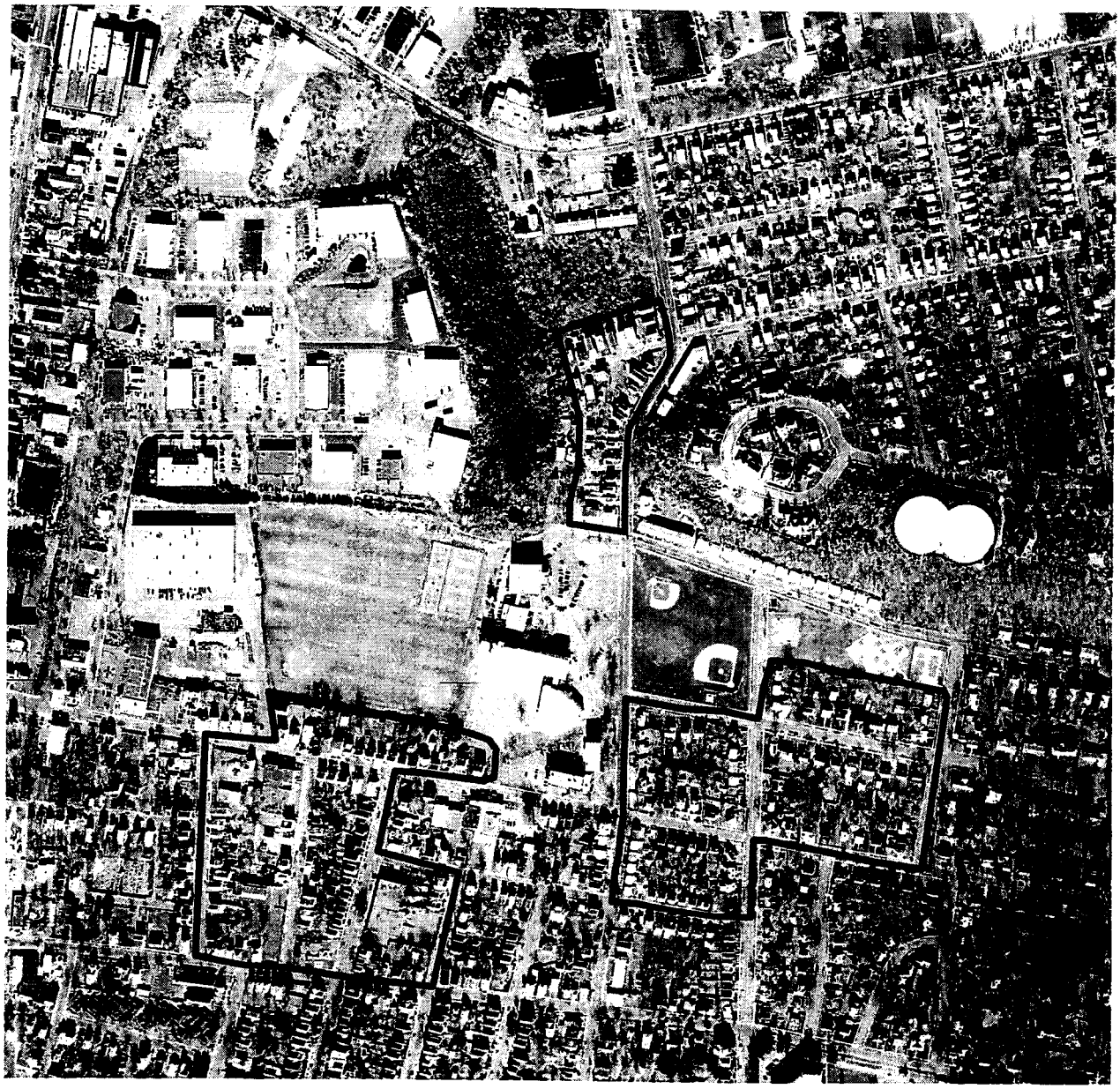
ATTACHMENT A

Figure 1

Figure 1
Extent of Soil Sampling in the Newhallville Neighborhood
Hamden Connecticut
November 2002



June 20, 2003

ATTACHMENT B

Fact Sheets

Ways to Reduce Your Exposure to Soil

Safe Gardening

Summary of the Public Health Assessment for Soils in the Newhall St. Neighborhood

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 several 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, or toys.
  - ⇒ Eating food grown in contaminated soil that has not been completely washed or that has absorbed chemicals from the soil.
- Inhalation: breathing in soil dust
- Dermal: skin contact with soil

What Things Can I do to Reduce My Contact With Soil in my 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 beneath play equipment can be covered with mulch or clean topsoil.
- 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.
- Pets can bring dirt inside on their paws or fur. Try to keep pets clean.
- Consider using raised beds for gardening. Follow other gardening advice provided in CTDPH's fact sheet entitled "Growing and Eating Fruits and Vegetables in the Newhall Neighborhood of Hamden."
- Wash toys before bringing them into the house, or leave them outside.

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What Contaminants Have Been Found in Soil in the Newhall Neighborhood?

There are three main contaminants that have been found at elevated (higher than normal) levels in soil in some yards. These contaminants are **lead, arsenic and polycyclic aromatic hydrocarbons (PAHs).**

Some **general** information about health effects from exposure to these chemicals is provided below. This information is not meant to imply that the health effects mentioned would be expected to occur among Newhall neighborhood residents.

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

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 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 effects 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) http://www.atsdr.cdc.gov

This fact sheet is funded, in part, by funds from the Comprehensive Environmental Response, Compensation, and Liability Act trust fund through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U. S. Public Health Service.

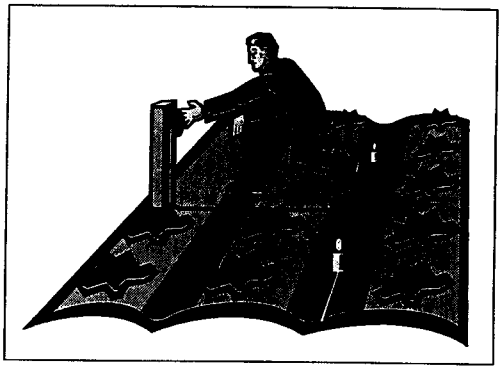
CT Department of Public Health

January 2004

Growing and Eating Fruits and Vegetables in the Newhall Neighborhood of Hamden

TABLE OF CONTENTS:

Many people have asked whether it is safe to grow and eat fruits and vegetables from gardens in their yards. This fact sheet will provide information so you can enjoy growing and eating your fruits and vegetables safely. By taking a few simple precautions, you can reduce your chances of being exposed to contaminants in the soil and you can still enjoy your homegrown produce.



Many of the homes in the Newhall neighborhood in Hamden were built on top of a landfill that was used for disposal of domestic and industrial waste during the 1930s, 1940s and 1950s. Three chemicals have been found at elevated levels in surface soil in some yards in the neighborhood. They are arsenic, lead and polycyclic aromatic hydrocarbons (PAHs). There is some background information about each of these three chemicals at the end of this fact sheet.

We believe it is likely that the most contaminated yards in the neighborhood have been identified and cleaned. If you have questions about sampling and cleanup activities in the neighborhood, you should call CT DEP at the phone number listed on page 4 of this fact sheet.

What does it mean to be exposed?

To be exposed to chemicals in soil, you need to come into contact with soil that is contaminated and the chemicals need to get into your body. Exposure to chemicals in soil can occur in the following ways.

- **Eating**: You can be exposed by eating in two ways:
  - ⇒ putting fingers in your mouth that have soil on them, or
  - ⇒ eating food grown in contaminated soil that has not been completely washed or that has absorbed chemicals from the soil.
- **Breathing** soil dust
- **Skin contact**: Some chemicals can be absorbed through the skin. This is an unlikely type of exposure because the chemicals found in the Newhall neighborhood are poorly absorbed through the skin.

Preparing Your Garden

Growing fruits and vegetables in raised beds with new topsoil is the best way to prevent exposure to chemicals in the soil. If you cannot use raised beds, adding organic material such as compost or new topsoil to your garden will enrich your soil. This will also dilute the amount of contaminants in the soil and will reduce your chances of exposure. Also, plants tend to absorb less chemicals if the soil is close to neutral pH (6.5-7.0) and has adequate levels of nutrients.

⇒ Adding a balanced commercial fertilizer to your garden soil can help maintain correct levels of nutrients.

⇒ If your soil is too acidic (low pH), adding lime will bring the pH up to the neutral range.

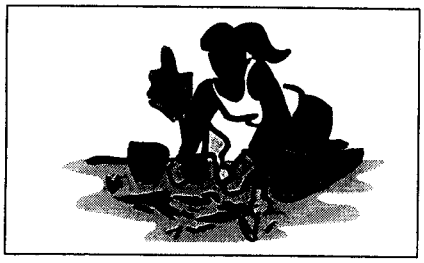
How do I know if my soil has the correct level of nutrients and pH?

The Connecticut Agricultural Experiment Station will do fertility and pH tests on your garden soil for free. Based on your test results, they will recommend what to add to your soil. For more information, contact the CT Agricultural Experiment Station, 123 Huntington Street, New Haven, 203-974-8521.

Can I have the soil in my garden or my homegrown produce tested for contaminants?

Additional soil sampling in the neighborhood will take place in the near future. If you are interested in having testing done sooner, there are private labs that will test soils or homegrown produce for a charge. These labs can be found in your local yellow pages under "environmental laboratories." You may also call the Quinnipiack Valley Health District at 203-248-4528 to learn how you can have your garden soil tested for free.

Selecting Which Crops to Grow



The best crops to plant are *fruiting* crops such as tomatoes, squash, peppers, okra, cucumbers, peas, beans and corn. These plants take up (accumulate into parts of the plant) very little, if any, contaminants in the parts we eat.

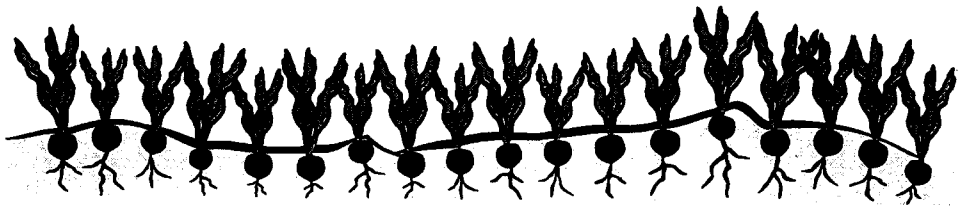
Root crops (such as carrots, beets and potatoes) can take up arsenic and lead from the soil. Most of the contamination can be removed by peeling the skin off root vegetables before eating. Even after peeling, a small amount of the chemicals will remain in the flesh of the root vegetable. If you peel these vegetables - and grow and eat less of these type of vegetables - you will have less chance of being exposed to lead and arsenic in the soil.

Leafy greens (such as lettuce, spinach, beet greens and herbs) can take up lead from the dust or soil that settles on leaf surfaces. If you grow less leafy greens crops, you will have less chance of being exposed to lead in the soil.

Key Tip: It is better to grow more fruiting crops such as tomatoes, squash and beans; and fewer root (potatoes, beets, etc.) and leafy green (lettuce, spinach, etc.) crops.

Working in Your Garden

- Avoid eating and drinking while working in your garden because you could swallow soil and dust that gets on your hands and food.
- Wash your hands and work clothes to remove dust and dirt after gardening.
- Take off your shoes at the door to avoid tracking a lot of soil into your home.



Preparing Fruits and Vegetables

Contaminated dust or soil can settle on to the surfaces of the plant. Following these guidelines will prevent or reduce your exposure to contaminants.

- Wash all homegrown produce before eating it. Use a 1% vinegar solution, soapy water or a commercial vegetable-cleaning product. Washing produce is a good idea whether it is homegrown or comes from a market.
- Soak leafy greens in cool water and rinse thoroughly before cooking. This is especially important for greens that grow low to the ground, such as collard greens, spinach or lettuce.
- Scrub root vegetables with a clean brush to remove dirt. Peel root vegetables such as carrots, turnips or potatoes before eating. The skin of root vegetables often contains more contaminants than the flesh.
- Wash the edible portion of fruiting crops such as tomatoes, squash or peppers before eating to remove any soil adhered to the outside skin or peel.

Contaminant Summary Chart

Chemical	Health Concerns	Effect on Vegetables
Lead	Lead can affect a child's mental and physical growth. Lead is not believed to cause cancer in people.	Lead in soil can be absorbed into root crops and leafy greens. Lead in dust or soil can settle on surfaces of the plant.
Arsenic	Long-term exposure to high levels of arsenic can irritate and darken the skin, and increase the risk of skin, bladder, kidney, liver and lung cancer.	Arsenic in soil can be absorbed into root crops. Arsenic in dust or soil can settle on surfaces of the plant.
PAHs	Some people who had long-term exposures to high levels of certain PAHs developed skin and lung cancer.	PAHs are not easily absorbed into plants. PAHs in dust or soil can settle on leaf surfaces.

I already ate produce from my garden without following this advice. Will I get sick?

If you have already eaten homegrown produce and did not follow the advice in this fact sheet, the health risks are still very low. You would need to have many years of exposure to high levels of lead, arsenic and PAHs before heath effects would become more likely. In addition, the levels of lead, arsenic and PAHs in the soil in your neighborhood are not high enough to present any immediate health concerns.

For More Information, Please Contact:

Meg Harvey
CT Department of Public Health
860-509-7742

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

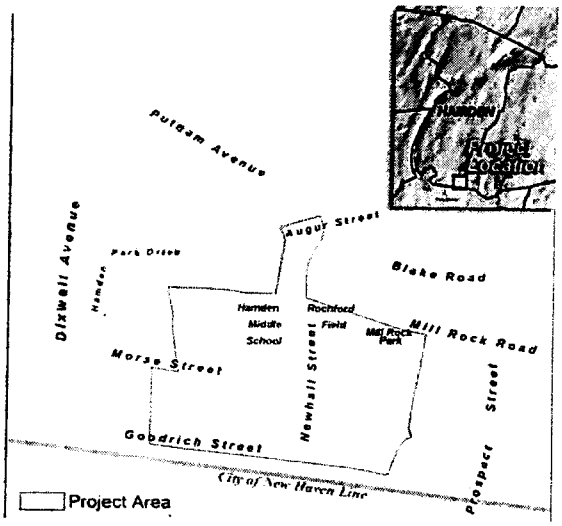
Shannon Windisch Pociu
CT Department of Environmental Protection
860-424-3546

(This fact sheet is funded in part by funds from the Comprehensive Environmental Response, Compensation, and Liability Act trust fund through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, Public Health Service, U.S. Department of Health and Human Services.)

February 2004 CT Department of Public Health

Residential Soils in the Hamden Newhall Street Neighborhood

BACKGROUND



The Connecticut Department of Public Health (CTDPH) has reviewed environmental data for contaminated soils in the Newhall neighborhood to determine whether landfill waste in residential soils is a public health hazard. Based on this data, CTDPH has written a Public Health Assessment (PHA). A PHA looks at environmental sampling data, the concerns of the neighborhood, and readily available health information about the community. The purpose of this fact sheet is to summarize the findings of the **public comment version** of the PHA. This PHA builds on the results of three other documents that looked at landfill waste and health concerns at the Hamden Middle School, two town parks and the Newhall Street School. For more information about the PHA process, contact CTDPH at the number on the back of this fact sheet, or go to www.newhallinfo.org. We are accepting comments and questions about the PHA until May 3, 2004. If you would like a copy of the PHA, please call (860) 509-7742, or go to the web site provided above.

ABOUT THE SITE

The Newhall neighborhood is an 11-block area located in the southern portion of Hamden, Connecticut. During the 1930s, 1940s and 1950s, domestic and industrial waste was disposed in wetlands and other low spots throughout the area. Many of the homes in the neighborhood were built on top of landfill waste. The area has about 238 homes with around 600 residents. The map above shows the boundaries of the known or suspected landfill waste. Not all homes in the mapped area necessarily have landfill waste. The landfill boundaries may change in the future, as the environmental investigations continue.

WHAT CONTAMINANTS WERE FOUND?

The environmental investigations in the Newhall neighborhood have focused on residential soil, both on and below the surface. CTDPH looked at results of over 1000 soil samples from the neighborhood that were collected by the Environmental Protection Agency (EPA), the CT Department of Environmental Protection (CTDEP) and Olin Corp. These included soil samples taken from about 100 different yards. The main contaminants found at elevated (higher than normal) levels are lead, polycyclic aromatic hydrocarbons (PAHs), and arsenic. Lead was the contaminant found most often at levels exceeding CT's cleanup standard for lead in soil. However, not every home that was tested had high levels of contaminants. About one-half of the surface soil samples were above the lead standard. Less than a quarter of the samples had high levels of arsenic or PAHs. Thirteen homes had very high levels of lead. These yards were cleaned up 2 years ago by EPA.

How Do We Evaluate Health Risks?

It is important to understand how CTDPH evaluates exposures and how we make **decisions about health risks** for hazardous waste sites. The first step is to find out if there has been exposure to contaminants. Then we try to find out how long people were exposed and to how much contamination. Then we estimate cancer and other health risks. Finally, we come to a conclusion about whether the exposure is likely to cause illness. If we conclude that exposures may have caused disease, we may recommend further studies. Here are some concepts important in evaluating health risks to contaminants:

- **"Exposure"** means that you have come into contact with a chemical (breathing, eating, touching), and it has gotten into your body.
- If you are **not exposed** to a chemical, **it won't make you sick**.
- CTDPH is required to use accepted science-based methods when we evaluate health risks. When CTDPH analyzes environmental data, we use conservative (most protective of health) health guidelines and approaches to reach our conclusions and make our recommendations.
- It is very difficult to determine if people have gotten sick from a site, even though it may be shown that people were likely exposed. This is because of many complicated factors:
  - ⇒ Were people exposed long enough and to enough of the contaminant?
  - ⇒ What are other exposures?
  - ⇒ What are some lifestyle issues such as diet, smoking, etc?

Just because we may not be able to say that people have gotten sick from contaminants, this does not mean the community should not be concerned or work to clean up the site. Preventing exposures is very important!

Were People Exposed? Are Health Effects Likely?

Neighborhood residents could be exposed to landfill contaminants through contact with contaminated soil while working or playing in their yards (eating soil, skin contact, breathing in soil particles). Children may have a greater opportunity for exposure than adults because they play on the ground and have more hand-to-mouth activity. Residents will not be exposed to landfill contaminants buried below the ground surface unless they dig into the soil. CTDPH evaluated the soil data and how people could be exposed and reached the following conclusions about health effects:

- The yards with the highest levels of lead in surface soil may have caused increases in blood lead levels in children in the past. **Fortunately, these homes have been already cleaned up by EPA so exposures are no longer occurring.**
- Based on a review of files on blood lead levels in children in the Newhall neighborhood, no high levels were found that could be related to lead exposure from landfill waste.
- There are still some homes with elevated lead in surface soil. If exposure is not stopped through cleanup of soil or other means, there could be future exposures that might result in increases in blood lead among children.
- Other contaminants in soil such as arsenic and PAHs are unlikely to cause health problems such as cancer or other non-cancer diseases.

PUBLIC HEALTH ACTIONS ALREADY TAKEN

Since the time contamination was first discovered in the Newhall neighborhood in early 2001, a number of activities have taken place to protect neighborhood residents:

- **Soil Removal**: EPA removed contaminated soil from 13 residential properties in late 2001 and early 2002. This soil removal is not a permanent remedy because some contaminants still remain in soils deeper than 18 inches.
- **Home Visits:** In May and June 2001, CTDPH and EPA met with residents of about 76 properties that were sampled by EPA. Results of the soil tests were provided to each resident and next steps were discussed. CTDPH answered questions about exposure and health impacts.
- **Blood Lead Screening:** The Quinnipiack Valley Health District (QVHD) offered free blood lead screening to neighborhood residents on August 1, 2001.
- **QVHD Lead Exposure Follow Up Activities:** CT DEP referred a number of homes to the QVHD for lead exposure follow-up activities. The homes referred for follow-up had elevated lead in surface soil, where young children reside (or visit often), that were *not* scheduled to receive soil removal by EPA. At some of these homes, the source of the lead in soil was lead paint, not landfill waste. Follow-up activities included providing educational materials about lead exposure and observing yards and suggesting ways to reduce soil exposure.

- **Community Health Concerns Survey:** During May and June 2001, staff from the QVHD collected health information from 125 local residents in the neighborhood. CTDPH evaluated the information and concluded that the numbers and types of cancers and other illnesses that were reported did not look unusual. QVHD is currently doing an expanded community health concerns survey in the neighborhood.
- **Methane Screening in Homes:** Beginning in April 2001, the Hamden fire marshal sponsored a voluntary **methane** screening program in the neighborhood. Methane is an explosive gas that can come from some landfills. 12 homes asked for and received methane screening. CTDEP consultants also tested for methane in about 30 homes. *Methane was not detected in any homes.*
- **Residential Structural Evaluations:** Many of the residents have settling problems with their homes. CTDEP hired engineering consultants to investigate this problem. They have identified 42 homes with real or possible settlement problems. This investigation is still going on. During the site cleanup process, CTDEP will repair the homes where needed.
- **Gardening Fact Sheet:** CT DPH has prepared and distributed a fact sheet on how to safely grow and eat fruits and vegetables.

WHAT DOES CTDPH RECOMMEND?

- Residents should follow the advice in CTDPH's fact sheets regarding how to reduce your exposure to soil and how to grow fruits and vegetables safely.
- Further investigation of landfill waste in the Newhall neighborhood should proceed as quickly as possible so that a permanent remedy will be in place as soon as possible.
- QVHD should offer free blood lead screening again in the Newhall neighborhood.

FUTURE ACTIVITIES IN THE NEWHALL NEIGHBORHOOD

- CTDPH will continue to work with the QVHD and CTDEP to provide technical assistance regarding developing sampling plans and evaluating data.
- CTDPH will evaluate new sampling data from the neighborhood as it becomes available and will update the Public Health Assessment, if needed.
- CTDPH will continue to participate in public meetings, availability sessions and other ways to help the neighborhood understand the site health issues.
- CTDPH will work with QVHD to evaluate data from the community health concerns survey.
- CTDPH will work with the QVHD, the Town of Hamden and CTDEP as necessary to ensure that recommendations made in this Public Health Assessment are carried out in a reasonable time frame.
- CTDPH will hold an "open house" for residents to provide comments and have questions answered about the Public Health Assessment.

FOR MORE INFORMATION:

Meg Harvey
CT Dept. of Public Health
Telephone: (860) 509-7742
FAX: (860) 509-7785
margaret.harvey@po.state.ct.us

Leslie Balch, Director of Health
Quinnipiack Valley Health District
Telephone: (203)-248-4528
FAX: (203)248-6671
LAB@qvhd.org

Shannon Windisch Pociu
Remediation Section
CT Dept. of Environmental Protection
Telephone: (860) 424-3546
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Shannon.pociu@po.state.ct.us

This fact sheet is funded, in part, by funds from the Comprehensive Environmental Response, Compensation, and Liability Act trust fund through a cooperative agreement with the Agency for Toxic Substances and Disease Registry, U. S. Public Health Service.

Department of Public Health
Environmental & Occupational Health
Assessment Program
Division of Environmental Health
410 Capitol Avenue
P.O. Box 340308, MS#11-CHA
Hartford, CT 06134-0308

ATTACHMENT C

Community Concerns Interview Form

Confidential Illness Report

Quinnipiack Valley Health District (QVHD) is interested in hearing from you about illness concerns related to Hamden Middle School. Of particular interest is information which will help answer community questions regarding cancer incidence among people that work/have worked or attend/have attended the Hamden Middle School (formerly Michael J. Whelan Junior High). If you or a family member have been diagnosed with cancer, please complete this form. If you know of another person who has been diagnosed with cancer you may wish to give a copy of this form to a member of his/her family to complete. All information reported will be held in the strictest confidence, covered by the confidentiality laws of the State of Connecticut, and will be shared only with the CT State Department of Public Health for use in determining cancer incidence in the identified population.

Please complete all sections of the form for which you have information. QVHD will try to supplement information for any incomplete areas so the information can be used in the survey. You may also submit information online at: www.qvhd.org/HMS.

Name: Date of Birth:
Address:
Health Provider Diagnosis: Dates of attendance/employment at Hamden Middle School: FROM:_____ TO:_____
Date of Diagnosis:
Other Comments:
Please give/mail this form to: Leslie Balch, Health Director Quinnipiack Valley Health District 1151 Hartford Turnpike North Haven CT 06473 (203) 248-4528

ATTACHMENT D

Letter from CT DPH to EPA

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

July 25, 2001

Gilberto Irizarry
On-Scene Coordinator
US Environmental Protection Agency, Region 1 New England
Office of Site Remediation and Restoration
One Congress Street, Suite 1100 (HBR)
Boston, MA 02114-2023

Dear Mr. Irizarry;

This letter is in response to your verbal request that the Connecticut Department of Public Health (CT DPH) provide a public health evaluation regarding the need to address hazardous soil contamination at properties in the Newhall Street residential neighborhood in Hamden, Connecticut.

EPA has conducted surface soil sampling (top six inches) at numerous properties in a residential neighborhood in Hamden (Newhall Street residential neighborhood) to investigate the nature and extent of surface soil contamination from landfill waste present in the neighborhood. In April 2001, before EPA began sampling soil in the residential area, CT DPH worked with EPA to develop health-based "action levels" for the contaminants of potential concern in Hamden; lead, arsenic and benzo(a)pyrene. The "action levels" were developed considering factors such as existing state and federal regulatory levels, potential exposures to adults and children, published toxicity values and health effects reported in the scientific literature. The "action levels" were developed with the understanding that EPA would address soil contamination through time-critical removal actions at properties with exceedances of an "action level" (provided that the contamination is landfill-related).

For lead in surface soil, CT DPH selected 1200 mg/kg as the "action level" or level that indicates that action should be taken to address the contamination in the short term. EPA's soil sample results indicate that there are a number of properties with lead in soil greater than 1200 mg/kg. Based on EPA's sampling, lead appears to be the primary contaminant of concern.

As mentioned above, the following factors were considered by CT DPH in selecting 1200 mg/kg as a level above which, action should be taken to reduce exposure to lead in surface soil.

Phone:
Telephone Device for the Deaf (860) 509-7191
410 Capitol Avenue - MS # _____
P.O. Box 340308 Hartford, CT 06134

- EPA has recently released new standards to protect children from hazards posed by lead (January 5, 2001 Federal Register, pp. 1206-1240). Under the new standards, EPA considers lead to be a hazard if there is greater than an average of 1200 mg/kg in bare soil in a yard. In addition, 1200 mg/kg lead in residential soil is a CT DPH guideline used by local health departments to indicate when lead abatement should be pursued.

- CT DEP has a residential cleanup standard (CT RSR) for lead in soil of 500 mg/kg. The "action level" of 1200 mg/kg used in Hamden is approximately two times higher than the CT RSR. The CT RSR was developed to be protective for young children with frequent and intense contact with soil over the long-term. Modeling done to develop the CT RSR for lead indicates that virtually any child exposed in a residential situation to lead in soil at 500 mg/kg would not have elevated blood lead levels because of the soil exposure. At a lead level of roughly twice the CT RSR in a residential setting, with frequent and intense soil contact, there is a possibility that some children could have elevated blood lead levels from the soil exposure. This possibility supports the need for action to be taken to reduce exposure in the short-term at lead levels greater than 1200 mg/kg.

- Many of the properties sampled in Hamden have young children who either reside in the home or visit often. The elevated lead is present in the top six inches of soil, which is more readily accessible for contact than deeper soils. In addition, many of the yards have one or more areas of bare soil, which increases the potential for exposure to occur. At all the properties, adult residents engage in yard work of one kind or another such as mowing the lawn and vegetable/flower gardening. These factors indicate that a real potential for young children and adults to be exposed to lead in soil in their yards exists at these homes.

- Exposure to lead can be harmful to both adults and children. The main target for lead toxicity is the nervous system, both in adults and in children. Long-term exposure of adults to lead in the workplace has resulted in decreased performance in some tests that measure functions of the nervous system. Lead exposure may also cause weakness in fingers, wrists, or ankles and anemia. Some studies in humans have suggested that lead exposure may increase blood pressure, but the evidence is inconclusive. At high levels of exposure, lead can severely damage the brain and kidneys in adults or children.

  It is easier for children to receive greater exposure to lead than adults. Children have more hand-to-mouth contact than adults, which can result in greater exposure. Unlike adults, children can be exposed to lead in the womb if their mothers have lead in their bodies. Finally, compared to adults, a larger proportion of the amount of lead a child swallows will enter the blood. In addition to greater exposures, childrens' developing bodies are more sensitive than adults to the health effects from lead exposure. A child exposed to high levels of lead can develop blood anemia, kidney damage, muscle weakness, and brain damage. Lower levels of exposure can result in adverse effects on mental and physical development and intelligence.

EPA sampling results indicate that there are a number of residential properties with lead in excess of 1200 mg/kg in surface soil. CT DPH believes that the potential exists for adults and

children to be exposed to lead in surface soil in their yards. Because of the potential health effects associated with exposure to lead, CT DPH believes that action should be taken in the short term to reduce exposures at the properties with lead in surface soil at levels exceeding the "action level" of 1200 mg/kg. CT DPH supports EPA's plan to conduct time-critical removal actions this summer (2001) on properties with site-related lead levels greater than 1200 mg/kg.

Please contact me at 860-509-7748 if you have questions about the information contained in this letter.

Sincerely,

Margaret L. Harvey, MPH
Epidemiologist

ATTACHMENT E

CT DPH Cancer Evaluation

STATE OF CONNECTICUT

DEPARTMENT OF PUBLIC HEALTH

August 29, 2001

Leslie Balch, MPH, RN
Director of Health
Quinnipiack Valley Health District
1151 Hartford Turnpike
North Haven, CT 06473

Dear Ms. Balch,

We have reviewed the information you provided regarding the incidence of cancer among the residents who participated in the neighborhood survey in Hamden. Most of the cases of cancer were verified in the Tumor Registry records. These cases occurred among individuals age 22 to 85. Some of the cases were recently diagnosed and a few of the cases dated back to 1974. Any diagnosis of cancer is a serious issue for the person and their family, however, the number and types of cancer that were reported do not appear to be in excess of what would be expected to occur.

The Department of Public Health is often asked to review information regarding incidence of cancer. People can become concerned when it appears that there may be an unusual occurrence of cancer in their neighborhood, work environment, or if there are other concerns about environmental contamination in their neighborhood. Cancer, however, is a relatively common disease. One of every three persons will be diagnosed with cancer at some point in their lifetime. Fortunately, many persons now survive a diagnosis of cancer and live long lives. Cancer is actually many diseases. Cancer such as breast, lung, and colon cancer are all specific, individual types of cancer. What causes lung cancer might be very different than what causes brain cancer. Additionally, the risk factors associated with the development of specific cancers, such as breast cancer, are not the same as what is associated with lung or colon cancer. Unless the types of cancer are the same, there is even less of a reason to think that cases may have a common cause.

The information that you provided does not indicate that there is an excess of cases of cancer in that neighborhood. If you have further questions please contact me at (860) 509-7756. The following Internet resources have additional information on cancer that may be helpful.

National Cancer Institute:
http://cancernet.nci.nih.gov/clinpdq/risk/Cancer_Clusters.html

Centers for Disease Control:
http://www.cdc.gov/cancer/npcr/new.htm#cluster

American Cancer Society:
http://www.cancer.org/statistics/cff2000/data/probability.html

Sincerely,

Diane Aye

Diane D. Aye, MPH, PhD
Epidemiologist

Phone:
Telephone Device for the Deaf (860) 509-7191
410 Capitol Avenue - MS # _____
P.O. Box 340308 Hartford, CT 06134
An Equal Opportunity Employer

Attachment F

General toxicological and epidemiological information for lead, arsenic, and polycyclic aromatic hydrocarbons (PAHs)

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. Background levels of lead in soil collected from various locations in Hamden (outside the Newhall Street neighborhood) ranged from 35 mg/kg to 360 mg/kg. These levels are consistent with background levels reported in other urban residential areas (ATSDR 1999).

Lead has many uses, most importantly in the production of batteries. Because of health concerns, lead in gasoline, paints, and ceramic products has been dramatically reduced in recent years. However, lead is still present in the environment. People can be exposed to lead from breathing workplace air or dust, eating contaminated foods and drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in lead-contaminated soil. Lead can affect many organs and systems in the body. The most sensitive is the central nervous system, particularly in children. Lead can cause decreased mental abilities in infants and learning difficulties and reduced growth in young children. Pregnant women exposed to lead can experience premature births and smaller babies (ATSDR 1999). Premature and low birth weight children are more susceptible to various neurological, developmental, learning, behavioral and other chronic health problems such as cerebral palsy, blindness, deafness, slower growth, lower IQ, epilepsy, chronic lung disease, and attention-deficit hyperactivity disorder (Paneth 1995).

In adults, lead exposure (from breathing or swallowing lead) can decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory. Breathing or swallowing lead may cause anemia (a low number of blood cells), may increase blood pressure in middle-aged men, and may affect sperm or damage other parts of the male reproductive system (ATSDR 1999).

With regard to the cancer causing potential of lead, animals that were given very large amounts of lead developed kidney tumors. However, there is not adequate evidence to demonstrate that lead causes cancer in humans (ATSDR 1999).

A blood test is available to measure the amount of lead in a person's blood and to estimate the amount of exposure to lead. Blood tests are routinely used to screen children for potential lead poisoning. The Centers for Disease Control and Prevention (CDC) considers 10 micrograms per deciliter (10 μg/dL) of lead in children's blood to be a level of concern for possible adverse health effects. CT DPH considers 20 μg/dL to be a level of concern for adults.

Arsenic

Arsenic is found in nature at low levels. National background levels of arsenic in soil range from about 1–40 mg/kg, with an average of about 5 mg/kg (ATSDR 2000). Background samples collected in Hamden (outside the Newhall Street neighborhood) ranged from 3–8 mg/kg. People may be exposed to arsenic by eating food, drinking water, breathing air, or through skin contact with soil or water. Children may be exposed to arsenic by playing in soil.

The most characteristic effect of ingesting arsenic for a long period is a pattern of skin changes. These include a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso. These skin growths may ultimately develop into skin cancer. Long-term ingestion of arsenic can also lead to damage of the heart and blood vessels and increases the risk of skin, bladder, kidney, liver, and lung cancer. Breathing large amounts of arsenic for a long time increases the risk of lung cancer and can also cause respiratory irritation, nausea and characteristic skin changes. (ATSDR 2000).

The most reliable test for arsenic exposure is a urine test. Since arsenic stays in the body a short time, the test must be done soon after exposure occurs. Tests on hair and fingernails can measure exposure to high levels of arsenic over the past 6–12 months. However, these tests are not very useful for low levels exposures (ATSDR 2000).

PAHs

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

People are most likely to be exposed to PAHs that are attached to dust or other particles in the air. Sources include cigarette smoke, vehicle exhaust, asphalt roads, and smoke from wood fires. Cooking meat or other food at high temperatures, which happens during grilling or charring, increases the amount of PAHs in the food. National background levels of PAHs found in soil range from less than 1 mg/kg to 60 mg/kg (ATSDR 1995). Background samples in Hamden (outside the Newhall Street neighborhood) for individual PAHs ranged from 0.5 to 4.2 mg/kg. Total PAHs were as high as 12 mg/kg.

PAHs can be harmful to health under some circumstances. Studies on animals have shown that PAHs can cause harmful effects on the skin, and immune and reproductive systems. These effects have not been seen in people. Some PAHs caused cancer in animals when the PAHs were breathed in air (lung cancer), ingested in food (stomach cancer) or applied to the skin (skin cancer). Some people who breathed or touched mixtures of large amounts of PAHs for long periods of time developed cancer (ATSDR 1995).

In the body, PAHs are changed into other chemicals (called metabolites) that can attach to

substances within the body. The presence of PAHs attached to these substances can then be measured in body tissues or blood after exposure to PAHs occurs. PAHs or their metabolites can also be measured in urine, blood, or body tissues. Although these tests can show that you have been exposed to PAHs, the tests cannot be used to predict whether any health effects will occur or to determine the extent or source of your exposure to PAHs (ATSDR 1995). Because PAHs are so common in the environment, everyone has some PAHs in their body.

Attachment G
Risk Calculations

Arsenic—Morse Street Group of Properties

A. Noncancer risks, child aged 1–6 years

1. Ingestion Dose—Arsenic

This calculation estimates the average daily dose of arsenic to a child, age 1–6 years from incidental soil ingestion.

$ADD_{ingestion} = Ir_c * [Soil] * EF * ED * C1 * C2 * 1/BW_c * 1/AT_{nc}$

$ADD_{ingestion}$ = 100 mg/day * 54 mg/kg * (7 days/week * 39 weeks/year) * 6 years * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/6 years = 2.5 E-4 mg/kg/day

2. Dermal Dose—Arsenic

This calculation estimates the average daily dose of arsenic to a child, age 1-6 years from dermal contact.

$ADD_{dermal} = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * 1/BW_c * 1/AT_{nc}$
= 54 mg/kg * 0.04 mg/cm^2/ev * 0.03 * 3,307 cm^2 * (7 days/week * 39 weeks/year) * 6 years * 10^{-6} kg/mg * year/365 days * 1 ev/day * 1/16 kg * 1/6 year

ADD_{dermal} = 1E-5 mg/kg/day

3. Noncancer Hazard Index—Arsenic

$HI = ADD_{ingestion} + ADD_{dermal}/RfD$
HI = 2.5 E-4 mg/kg/day + 1 E-5 mg/kg/day = 2.6 E-4 mg/kg/day
2.6 E-4 mg/kg/day/3.4 E-4 mg/kg/day

HI= 0.76

A hazard index (HI) 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 effects are unlikely. A hazard index greater than 1 indicates that the estimated dose exceeds the safe dose and noncancer health effects cannot be ruled out. In this case, the hazard index for arsenic isles than 1. This indicates that noncancer health effects from arsenic are unlikely.

4. Acute Ingestion dose for a child, aged 2 years

This calculation estimates the average daily dose of arsenic to a child, aged 2 years, from incidental ingestion of soil, assuming a large ingestion rate over a short period (7 days).

$ADD_{ac} = IR_{ac} * [Soil] * EF * ED * 1/BW_{ac} * 1/AT_{ac}$
$= 400$ mg/day * 54 mg/kg * 10^{-6} kg/mg * 7 days/week * 1 week * 1/13 kg * 1/7 days
$= 0.0016$ mg/kg/day

The acute ingestion dose for arsenic exposure for a child is 0.0016 mg/kg/day. ATSDR's acute oral maximum risk level for arsenic is 0.005 mg/kg/day, which is more than the than acute ingestion dose. Therefore, these acute doses are within safe levels and do not pose a significant health threat.

B. Cancer Risks, Child/Adult Age 1–30 Years

1. Ingestion Dose—Arsenic

This calculation estimates the lifetime average daily dose of arsenic to a child/adult (age 1–30 years) from ingestion of soil.

$LADD_{child\ ingestion} = IR_c * [Soil] * EF * ED * C1 * C2 * 1/BW * 1/AT_c$

$LADD_{child\ ingestion}$ = 100 mg/day * 54 mg/kg * (7 days/week * 39 weeks/year) * 6 years * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/70 years = 2.16 E-5 mg/kg/day

$LADD_{adult\ ingestion}$ = 50 mg/day * 54 mg/kg * 7 days/week * 39 weeks/year * 24 years * 10^{-6} kg/mg * year/365 days * 1/70 kg * 1/70 years = 9.89 E-6 mg/kg/day

2. Dermal Dose—Arsenic

This calculation estimates the lifetime average daily dose of arsenic to a child/adult (age 1–30 years) from dermal contact.

$LADDD_{child\ dermal} = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * 1/BW * 1/AT_c$ = 54 mg/kg * 0.04 mg/cm^2/ev * 0.03 * 3,307 cm^2 * (7 days/week * 39 weeks/year) * 6 years * 1 event/day * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/70 years = 8.5 E-7 mg/kg/day

$LADDD_{adult\ dermal} = [Soil] * AF * ABS_d * SA_c * EF * ED * F * C1 * C2 * 1/BW * 1/AT_c$
= 54 mg/kg * 0.01 mg/cm^2/ev * 0.03 * 5,672 cm^2 * (7 days/week * 39 weeks/year) * 24 years * 1 event/day * 10^{-6} kg/mg * year/365 days * 1/70 kg * 1/70 years = 3.36 E-7 mg/kg/day

3. Cancer Risk—Arsenic

$ELCR = (LADD_{child\ ingestion} + LADD_{adult\ ingestion} + LADDD_{child\ dermal} + LADDD_{adult\ dermal}) * CSF$
ELCR = (2.16 E-5 + 9.89 E-6 + 8.5 E-7 + 3.36 E-7) * CSF
ELCR = 3.3 E-5 mg/kg/day * 1.5 (mg/kg/day)$^{-1}$
ELCR = 5 E-5

The estimated lifetime cancer risk (ELCR) for arsenic is 5 E-5 (5 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 five 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 United States are one in two or three (National Cancer Institute, SEER Program 2001). 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 five cancer cases above the background number of 33,000 to 50,000 cancer cases. This represents a relatively low increased cancer risk.

Polycyclic Aromatic Hydrocarbons (PAHs)—Bryden Terrace Group of Properties

A. Noncancer risks, child aged 1–6 years

1. Ingestion Dose—PAHS

This calculation estimates the average daily dose of PAHs to a child, age 1-6 years from soil ingestion.

$ADD_{ingestion}$ = 100 mg/day * 30.2 mg/kg * (7 days/week * 39 weeks/year) * 6 years * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/6 years = 1.4 E-4 mg/kg/day

2. Dermal Dose—PAHs

This calculation estimates the average daily dose of PAHs to a child, age 1–6 years from dermal contact with soil.

ADD_{dermal} = 30.2 mg/kg * 0.04 mg/cm^2/ev * 0.13 * 3,307 cm^2 * (7 days/week * 39 weeks/year) * 6 years * 1 event/day * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/6 years
ADD_{dermal} = 2.4 E-5 mg/kg/day

3. Noncancer Hazard Index—PAHs

HI= 1.4 E-4 + 2.4 E-5 /0.02 mg/kg/day
HI= 1.64 E-4/.02 mg/kg/day
HI= 0.008

A hazard index (HI) 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 less than the safe dose and noncancer health impacts are unlikely. A hazard index greater than 1 indicates that the estimated dose exceeds the safe dose and noncancer health effects cannot be ruled out. In this case, the hazard index for PAHs is well below 1. This indicates that noncancer health effects from PAHs are unlikely.

B. Cancer Risks, Child/Adult Age 1–30 Years

1. *Ingestion Dose—PAHs*

This calculation estimates the lifetime average daily dose of PAHs to a child/adult (age 1–30 years) from soil ingestion.

$LADD_{child\ ingestion}$ = 100 mg/day * 16.04 mg/kg * 7 days/week * 39 weeks/year * 6 years * 10^{-6} kg/mg * year/365 days* 1/16 kg * 1/70 years = 6.4 E-6 mg/kg/day

$LADD_{adult\ ingestion}$ = 50 mg/day * 16.04 mg/kg * 7 days/week *39 weeks/year * 24 years * 10^{-6} kg/mg * year/365 days * 1/70 kg * 1/70 year = 2.9 E-6 mg/kg/day

2. Dermal Dose—PAHs

This calculation estimates the lifetime average daily dose of PAHs to a child/adult (age 1–30 years) from dermal contact with soil.

$LADDD_{child\ dermal}$ = 16.04 mg/kg * 0.04 mg/cm^2/ev * 0.13 * 3,307 cm^2 * (7 days/week * 39 weeks/year) * 6 years * 1 event/day * 10^{-6} kg/mg * year/365 days * 1/16 kg * 1/70 year = 1.1 E-6 mg/kg/day

$LADDD_{adult\ dermal}$ = 16.04 mg/kg * 0.01 mg/cm^2/ev * 0.13 * 5,672 cm^2 * (7 days/week * 39 weeks/year) * 24 years * 1 event/day * 10^{-6} kg/mg * year/365 days * 1/70 kg * 1/70 year = 4.3 E-7 mg/kg/day

3. Cancer Risk—PAHs

ELCR = $LADD_{child\ ingestion}$ + $LADD_{adult\ ingestion}$ + $LADDD_{child\ dermal}$ + $LADDD_{adult\ dermal}$ * CSF
ELCR = 6.4 E-6 + 2.9 E-6 + 1.1 E-6 + 4.3 E-7 = 1.08 E-5 mg/kg/day * 7.3 (mg/kg/day)$^{-1}$
ELCR = 8 E-5

The estimated lifetime cancer risk (ELCR) for PAHs is 8 E-5 (8 in 100,000). This means that if 100,000 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 eight 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 United States are one in two or three (National Cancer Institute, SEER Program 2001). This means that in a population of 100,000, background numbers of cancer cases would be approximately 33,000 to 50,000. PAH exposures could result in a theoretical increase of 7 cancer cases above the background number of 33,000 to 50,000 cancer cases. This represents a small incremental increased cancer risk.

Definitions for terms used in risk equations:

ABS_d = Soil dermal absorption fraction
Arsenic: 0.03, PAHs: 0.13 (EPA 2001)
$ADD_{ingestion}$ = average daily dose from ingestion
ADD_{dermal} = average daily dose from dermal contact
ADD_{ac} = average daily dose from acute ingestion
AF = skin-soil adherence factor for central tendency residential child; 0.04 mg/cm^2/ev (EPA 2001)
skin-soil adherence factor for central tendency residential adult; 0.01 mg/cm^2/ev (EPA 2001)
AT_{nc} = averaging time for noncancer risk; 6 years
AT_c = averaging time for cancer risk; 70 years
AT_{ac} = average time for acute noncancer risk; 7 days
BW = child 50th percentile body weight for age 1–6 years (EPA 1997); 16 kg
BW_a = adult 50th percentile body weight (EPA 1997); 70 kg
BW_{ac} = body weight, 2-year-old child (EPA 1997); 13 kg
C1 = conversion factor; 10^{-6} kg/mg
C2 = conversion factor; 1 year/365 days
CSF = cancer slope factor
Arsenic: 1.5 (mg/kg/day)$^{-1}$ (IRIS)
PAHs: benzo(a)pyrene; 7.3 (mg/kg/day)$^{-1}$ (IRIS)
ED = exposure duration; 6 years for child, 24 years for adult
EF = exposure frequency; 7 days/week, 39 weeks/year (non-winter weeks)
ELCR = estimated lifetime cancer risk
F = event frequency, 1 event/day
HI = hazard index
IR_c = soil ingestion rate for a child; 100 mg/day (EPA 1997)*
IR_a = soil ingestion rate for an adult; 50 mg/day (EPA 1997)*

Ir_{ac} = acute soil ingestion rate for a child (upper percentile) (EPA 1997)
kg = kilograms
$LADD_{child\ ingestion}$ = lifetime average daily dose from ingestion for child, aged 1–6 years
$LADD_{adult\ ingestion}$ = lifetime average daily dose from ingestion for adult, aged 7–18 years
$LADDD_{adult\ dermal}$ = lifetime average dermal daily dose for child, aged 1–6 years
$LADDD_{child\ dermal}$ = lifetime average dermal daily dose for child, aged 7–30 years
mg = milligrams
RfD = EPA reference dose
Arsenic; 3 E-4 mg/kg/day (IRIS)
PAHs: naphthalene used as a surrogate for PAHs; 0.02 mg/kg/day (IRIS)
SA_c = Skin surface area, 50th percentile legs, feet, hands, and arms, child aged 1–6 years; 3,307 cm^2 (EPA 1997)
SA_d = skin surface area, 50th percentile legs, feet, hands, and arms, adult; 5,672 cm^2 (EPA 1997)
[Soil] = soil concentration;
Arsenic: 54 mg/kg (95% upper confidence limit of the arithmetic mean)†
PAHs (noncancer calculation): 24.4 mg/kg (total of 95% UCLs for PAHs)
PAHs (cancer calculation): 15.46 mg/kg (total TEF-adjusted 95% UCL for PAHs)

** 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 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).*

† ATSDR (2002) advises using the 95% upper confidence limit of the arithmetic mean. This was performed using Pro UCL (EPA 2001a). A 95% UCL accounts for the variability in the data and ensures that the mean is not underestimated.

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

PAH	95% UCL (mg/kg)	Toxic Equivalency Factor (TEF)	TEF Adjusted Concentration (mg/kg)
Benzo(a)anthracene	5.2	0.1	0.52
Benzo(b)fluoranthene	5.7	0.1	0.57
Benzo(k)fluoranthene	5.8	0.1	0.58
Benzo(a)pyrene	6.3	1	6.3
Indeno(1,2,3-cd)pyrene	5.7	0.1	0.57
Dibenzo(ah)anthracene	1.5	5	7.5
Total of 95% UCLs	**30.2**	—	**16.04**

ATTACHMENT H

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 year) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.	This determination represents a professional judgment 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 year) to hazardous substance or conditions that could result in adverse health effects.	This determination represents a professional judgment 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 judgment 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 judgment, 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 judgment 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*

ATTACHMENT I

ATSDR Glossary of Environmental Health Terms

ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with **chronic**].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with **intermediate duration exposure** and **chronic exposure**].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect**].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems.

Aerobic
Requiring oxygen [compare with **anaerobic**].

Ambient
Surrounding (for example, *ambient* air).

Anaerobic
Requiring the absence of oxygen [compare with **aerobic**].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP
See **Community Assistance Panel.**

Cancer
Any one of a group of diseases that occurs when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic
Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with **acute exposure** and **intermediate duration exposure**].

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as **Superfund**, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, **biota** (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and **biota** (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The **environmental media and transport mechanism** is the second part of an **exposure pathway**.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [**acute exposure**], of intermediate duration, or long-term [**chronic exposure**].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a **source of contamination** (such as an abandoned business); an **environmental media and transport mechanism** (such as movement through groundwater); a **point of exposure** (such as a private well); a **route of exposure** (eating, drinking, breathing, or touching); and a **receptor population** (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a **completed exposure pathway**.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with **surface water**].

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **public health assessment**].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with **prevalence**].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see **route of exposure**].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with **acute exposure** and **chronic exposure**].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of **metabolism**.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see **reference dose**].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, condition, or injury) is stated.

Mutagen
A substance that causes **mutations** (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or **NPL)**
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see **exposure pathway**].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **health consultation**].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or **radionuclides** that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are **no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard**, and **urgent public health hazard**.

Public health statement
The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see **Resource Conservation and Recovery Act (1976, 1984)**]

Receptor population
People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD
See **reference dose**.

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [**inhalation**], eating or drinking [**ingestion**], or contact with the skin [**dermal contact**].

Safety factor [see **uncertainty factor**]

SARA [see **Superfund Amendments and Reauthorization Act**]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see **population**]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an **exposure pathway**.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with **groundwater**].

Surveillance [see **epidemiologic surveillance**]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a **safety factor**].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other Glossaries and Dictionaries

Environmental Protection Agency	http://www.epa.gov/OCEPAterms/
National Center for Environmental Health (CDC)	http://www.cdc.gov/nceh/dls/report/glossary.htm
National Library of Medicine (NIH)	http://www.nlm.nih.gov/medlineplus/dictionaries.html

ATTACHMENT J

Response to Comments Submitted to CT DPH on the draft Public Health Assessment for Residential Soils in the Newhall Street Neighborhood, Hamden, Connecticut

Comment 1: Upon determining that soil has contaminants at levels greater than soil cleanup standards, residents want soil removed, if small children are living in the household. What plan does the DPH have to prevent children and pregnant women with PICA from ingesting chemical contaminants in their yards? Asking residents with small children not to dig in their yards below 4 inches of the top soil is unrealistic.

Response 1: Ultimately, residents who have landfill-related contamination in their yards at levels above cleanup standards will have that contamination addressed by CT DEP or Olin so that the soil meets state cleanup standards. Until that happens, CT DPH has provided residents with practical advice about how to reduce their exposure to soil. CT DPH recognizes that asking residents not to dig in their yards is not a practical permanent solution. CT DPH's recommendations about reducing soil exposure are only intended to be in place until a final cleanup action occurs in the neighborhood.

Comment 2: The residents want to be tested for the toxic effects of the known contaminants, understanding that chemicals may have opposing or even synergistic effects. For example, smoking coupled with asbestos exposure increases the risk of lung cancer by 25 fold.

Response 2: CT DPH has recommended blood lead screening for Newhall neighborhood residents because lead is the only contaminant found in soil at levels high enough that harmful health impacts could occur.

Comment 3: The community would like lead screening, for adults and children, to be offered at CT DEP's next quarterly meeting in July, not at QVHD. The community would also like CT DPH to develop a health program, to be held on a Saturday, to help residents better understand the adverse health effects of living on or near a hazardous waste landfill.

Response 3: In response to the community's request, CTDPH held an open house for addressing health concerns on Saturday, June 26, 2004. Blood lead screening was offered. An environmental medicine physician from the University of Connecticut Division of Occupational and Environmental Medicine was also present to answer residents' health questions.

Comment 4: The community would like radon testing for residential homes in the Newhall Street neighborhood. Radon is known to cause lung cancer.

Response 4: Testing for radon in your home is always a good idea. Radon tests are easy and inexpensive and are the only way to know for sure whether you and your family are at risk from radon exposure. The CT DPH is not able to provide radon test kits to the neighborhood but residents can purchase a radon test kit at any local hardware or home improvement store.

Comment 5: Why did CT DPH segment the community with two public health assessments, one for the Hamden Middle School and one for the residential neighborhood. Why not conduct a comprehensive evaluation? What is the difference between the contaminants at the Middle School versus contaminants found in residential areas? Poison is poison!

Response 5: CT DPH's intent was not to "segment" the community, or to imply that the effects of contaminants are different in different areas of the landfill. CT DPH prepared separate health consultation/health assessment documents for the Middle School, the Newhall Street School, Rochford Field, and the Residential Neighborhood. For each of these areas, CT DPH prepared a document at the time that sufficient environmental data was available for that area. CT DPH believes that this is more responsive than waiting for all environmental data from all the areas to be available.

Comment 6: New text was submitted to describe the methane screening performed by DEP in 2002.

Response 6: The suggested text was added to page 6 of the Public Health Assessment.

Comment 7: New text was suggested to state that in the CT DEP Right-of-Way soil sampling, depth samples were also analyzed for extractable total petroleum hydrocarbons (ETPH).

Response 7: The suggested text was added to page 8 of the Public Health Assessment.

Comment 8: New text was suggested to clarify that results summarized in Table 2 include samples collected by both DEP and EPA.

Response 8: The suggested text has been added to the Public Health Assessment.

Comment 9: New text was suggested to clarify footnote 5.

Response 9: The suggested changes were made to footnote 5.

Comment 10: The acronym CEL should be explained on the top of page 20.

Response 10: An explanation for CEL has been added.

Comment 11: In the Health Outcome Data section, the same two cancer incidence time periods are listed. This should be corrected.

Response 11: The correction has been made.

Comment 12: Recommendation 6 should be deleted because it is included in general recommendation 2.

Response 12: CT DPH agrees. Recommendation 6 has been deleted.

Comment 13: It would be helpful to see a map showing the rough distribution of chemical contaminants throughout the neighborhood. GIS methods allow the map to be created in ways that protect privacy of information.

Response 13: A significant level of effort would be needed to create a GIS map using all the soil data that have been collected thus far. CT DPH does not have the resources needed to create such a map. It is possible that a contaminant distribution map for the neighborhood may be created as part of the investigation work CT DEP, Olin, the Town of Hamden, and the Regional Water Authority are doing on the site.

Comment 14: The Newhall Street neighborhood is not the same as the study area. The neighborhood includes at least 25 blocks. Confusing the two may leave the impression that the current study area encompasses all the potentially contaminated areas. It should be made clear that large parts of Newhall and Newhallville (in New Haven) have not been tested.

Response 14: The text on page 1 now specifies that the focus of the Public Health Assessment is the "Newhall Street Neighborhood," as it is defined in the Public Health Assessment.

Comment 15: On page 1, there is no mention of ETPHs which have somewhat consistently been found at levels that exceed the RDEC (see Olin's proposed sampling plan). This omission is consistent throughout the document.

Response 15: The text referred to on page 1 is a summary statement which includes contaminants found at elevated levels in both surface and subsurface soils. ETPH was found at somewhat consistently elevated levels in subsurface soils, not surface soils. The Environmental Data section of the Public Health Statement already mentions exceedances of ETPHs.

Comment 16: Stating that the screening step excludes exposures for which there is no meaningful health effect (because they are below the RDEC) may not be true. For example, such screening methods exclude the potential health impacts of exposure to multiple chemicals at once. Indeed, the co-occurrence of lead and arsenic alone is so frequent in the US, a separate Toxicological Profile to consider the interaction effects was performed by the ATSDR. Frameworks for assessing risks of multiple exposures have been proposed by many, including ATSDR.

Response 16: The CT Residential Criteria for Direct Exposure (RDEC) that were used for screening are derived to be very conservative (health protective). Criteria for individual chemicals are set at very low risk levels to account for cumulative exposures from multiple contaminants at a site.

Comment 17: To say that any homes with the highest lead-related risk have been cleaned may be premature given (a) the ongoing and currently incomplete nature of soil testing and (b) the fact that some homes tested during the EPA's cleanup were over 400 mg/kg but less than 1200 mg/kg, meaning they were still hazardous but not cleaned up. It may also be misleading given that over half of all samples contained over 400 mg/kg of lead.

Response 17: CT DPH has stated in many places throughout the Public Health Assessment that its evaluations, conclusions and recommendations are based on the sampling results from 2001 and 2002. Therefore, based upon those results, homes with the highest lead levels have been cleaned up. CT DPH acknowledges that there are still many homes in the neighborhood with lead levels in surface soil that exceed cleanup standards and will be addressed as part of the neighborhood-wide cleanup plans. Likewise, there may be homes that have not yet been tested that have elevated lead in soil.

Comment 18: Discussion of QVHD's health survey should be accompanied by full disclosure of the weaknesses of the study, especially the low response rate which precludes the definitive statements about cancer rates and noncancer illnesses that are mentioned. With a response rate of less than 50% in a non-randomized sample, no statement about cancer rates can be made with confidence. In addition, the low response rate for noncancer effects renders the results unusable from an epidemiological standpoint. This should be made clear.

Response 18: In Section C4 of the Public Health Assessment (Health Outcome Data), additional language has been added to more clearly describe the weaknesses of the QVHD survey.

Comment 19: Cancer rates in the entire Town of Hamden cannot be expected to show any elevated rates of cancer in Newhall because the results will be diluted. Hamden cancer rates tell us only that the cancer rates in Newhall are not so profoundly astronomical that they would cause the rates of the entire town to increase. But they do not substantively contribute to a body of evidence which collectively says Newhall cancer rates are normal, as is implied here.

Response 19: In Section C4 of the Public Health Assessment (Health Outcome Data), additional language has been added to clarify this limitation.

Comment 20: The data in Tables 1 and 2 do not agree with the tables in Olin's revised work plan which, I believe summarizes the same bodies of data. If the data summarized is different, perhaps both data sets should be matched to include as much data as is currently available.

Response 20: The Tables in Olin's revised work plan do not include EPA surface soil data collected in 2001. Data Tables in the Public Health Assessment include the EPA data.

Comment 21: Though the EPA cleaned soil down to a depth of 18 inches, it is my understanding that a depth of 4 feet is the standard. Is that in a regulation somewhere and, if so, what are the risks posed to residents and how will those risks be managed? Will there be frequent soil retesting to track pollutant mobility? A possible recommendation would be to finish the cleanup job and/or to conduct permanent periodic testing to ensure there is no recontamination.

Response 21: CT Remediation Standard Regulations specify that the direct exposure soil cleanup standards must be met in soils as deep as 15 feet unless an environmental land use restriction is placed on the area so that contaminated soils less than 15 feet deep will not be exposed as a result of digging or other excavation activities.

Comment 22: My understanding is that somewhere in the process of testing for lead, a number of soil samples were composited which obscures any local hotspots and may even preclude some areas from protective action. If so, that should be disclosed. Also, there should be a discussion about the potential weaknesses of using one contaminant as a proxy for several others. In fact, the text acknowledges that high arsenic and PAH levels *almost* always occurred with high lead levels. How often was that not the case? Are residents therefore being fully warned that they will *almost* always be encountering safe soil in their yards? How many cases exist in which there were elevated levels of PAHs but not lead? How can the people in whose yards this is the case be informed?

Response 22: EPA performed extent-of-contamination surveys on properties identified for a removal action. For the extent-of-contamination surveys, a 10-foot grid was established at each property and EPA collected a composite sample consisting of soil from 5 points within each grid. If the composite sample exceeded 500 ppm lead (i.e., the average of the results of each 5 points), the grid was marked for excavation. It is possible that this procedure of using composite samples could have missed a moderately elevated lead result. However, if there was one point within the grid that was extremely elevated, the average within the grid would exceed 500 ppm and the grid would have been excavated.

Regarding the co-location of contaminants, lead was used as a proxy for arsenic and PAHs *only* during EPA's extent-of-contamination surveys on properties that had already been identified for cleanup.

Comment 23: I thought the XRF only looked at lead and arsenic in this case, not PAHs. Is that correct? Was a proxy for PAH used here? Also, I recall going through the QA/QC data and noticing that some of the soil samples tested for arsenic using the XRF and later confirmed by laboratory testing showed large discrepancies between the results from different methods. In other words, XRF results did not agree with lab results. If that is true, it could invalidate any conclusions that arsenic levels are safe according to the EPA-related testing. Furthermore, in footnote #1, the XRF limit is only 60 mg/kg , which is higher than the RDEC. So if the XRF results are invalid, and lab tests are

infrequent for arsenic, with what amount of confidence can we say that arsenic levels are not as high as they are for lead?

Response 23: As stated in the Environmental Data section of the Public Health Assessment, soil samples were field analyzed (using XRF) for lead, arsenic and mercury. Roughly 40% of the samples received confirmatory laboratory analysis. One sample from each property was analyzed for PAHs (as well as other semi-volatile chemicals). EPA investigated the correlation between XRF field results and laboratory results and concluded that XRF results for lead are in excellent agreement with laboratory results for lead concentrations less than 6000 ppm. At concentrations greater than 6000 ppm, XRF results do not agree as closely with laboratory results.

For arsenic, EPA concluded that XRF results are useable when lead levels are low (500 ppm or less). When lead levels are above 500 ppm but below 3000 ppm, arsenic XRF results are useable with a correction factor (which EPA applied to the data). When lead levels are greater than 3000 ppm, arsenic XRF results are not reliable.

The issue of XRF reliability is only a problem at high lead levels, well above the 1200 ppm concentration that would trigger EPA cleanup.

Comment 24: A disclosure about the limitations of the methods used to identify properties suitable for testing is needed. If the DEP only tested soil on properties where someone BOTH called and their yard contained bare spots or visual landfill clues, many potentially contaminated homes are unfairly excluded from analysis. Disclosure should include acknowledgement of populations whose properties will be excluded from this methodology. For example, renters and other short term residents are less likely to be informed or concerned about the contamination in the neighborhood and therefore are less likely to call in to request soil testing. Furthermore, they may be unwilling to risk alienating their landlords by calling to request soil testing which could drive the housing value down. It is also worth mentioning that children can be exposed to contaminated soil even when there are no bare spots.

Response 24: Only the supplemental soil testing done by CT DEP required that a property owner request sampling and have visual evidence of fill on the property. The soil testing done by EPA in 2001 identified properties for testing based on historical aerial photographs showing where fill was likely to be present. In addition, more extensive soil sampling was begun in the spring of 2004 by Olin and will continue until the summer of 2004.

Comment 25: Please specify how deep contamination must be in order to be excluded as a potential exposure pathway. If the critical depth is less than 4 feet, please explain how exposure can be managed among residents and contractors doing home improvements, how children can be warned to never dig that deeply, how kids with Pica will be identified and their risks managed, and how other incidental exposures can be managed. These are not unusual occurrences based on my experience in the area.

Response 25: When preparing a public health assessment, CT DPH and ATSDR typically consider accessible surface soils to be within the top 0-6 or 0-3 inches to be a complete exposure pathway (ongoing exposures). Deeper soils (no depth limit) are typically considered to be a potential exposure pathway. As stated in the response to a previous comment, Connecticut's soil cleanup standards apply to soils as deep as 15 feet unless an environmental land use restriction is placed on the area to warn against digging or other excavation activities.

Comment 26: The list of exposure factors on page 15 should include all exposure factors such as stage in development/pregnancy as well as other co-exposures such as other chemical contaminants or pharmaceuticals.

Response 26: The list was not intended to be a complete list of all factors that can affect whether a person becomes sick from exposure to environmental contamination. The text in Section C3 - Public Health Implications has been changed to clarify that it is not a comprehensive list of all factors.

Comment 27: All assumptions in the blood lead screening model and risk calculations for arsenic and PAHs should be listed.

Response 27: CT DPH believes that the Public Health Assessment does provide the relevant assumptions used in the blood lead screening model and the risk calculations for arsenic and PAHs. Some assumptions are provided in the text and some are provided in Attachment G.

Comment 28: It is impossible to say that "exposures at levels of public health concern are no longer occurring in the neighborhood" for many reasons, not the least of which is that lead exists in the soils at unsafe levels in over half the samples taken so far. Other reasons have already been articulated.

Response 28: CT DPH believes that its evaluation of the currently available data supports the conclusion that under current conditions, exposures at levels of public health concern are not occurring. The fact that lead is present in soils at elevated levels in over half the samples is not relevant because many, if not most, of those samples are from properties that EPA cleaned up in 2001.

Comment 29: I am not confident in the methodology to assess health risks associated with arsenic and PAHs (i.e., calculating an average concentration across properties rather than a property-specific average). Randomly selected lead data, which is more extensive, should be applied using this methodology and the results should be compared to lead findings as a whole. If spatial heterogeneity is on a small enough scale that local variation renders a one-sample-per-property methodology worthless, more samples would need to be gathered to get a true estimate of the distribution of arsenic and PAHs.

Response 29: CT DPH agrees that more arsenic and PAH data are needed on each property in order to get a more accurate estimate of the distribution of these contaminants. However, in this Public Health Assessment, CT DPH worked with the data it had available. Given the small number of arsenic and PAH samples on each property, CT DPH decided that an area-wide average was a reasonable way to evaluate the data.

Comment 30: A risk estimate of 5 in 10,000 is said to be "non-meaningful" when the EPA's standard is 1 in 1 million. Using that well known risk standard, the public is actually at significant risk. Comparing the risk from living in Newhall to the "background" cancer rate is inappropriate. First, all cancers cannot be considered as the same disease. Secondly, there is no way to know what portion of these "background" rates are actually attributable to the contamination. Thirdly, it assumes a single baseline cancer rate for the entire population which we know is not true. The cancer rate for Newhall is probably significantly higher for most cancers than in Connecticut or the US because of demographics alone (with some exceptions like breast cancer). But it will be very difficult to detect with a relatively small sample size even if the entire neighborhood was included. Fourth, the assertion that the small increase in risk is negligible relative to the background risk assumes that all relatively low level risks are not worth addressing.

Response 30: EPA does not have a "standard" of one in one million risk. EPA uses a cancer risk range (one in ten thousand to one in one million) as a guide for making cleanup decisions. EPA almost never takes a cleanup action when risks are less than the "de minimus" risk of one in one million. EPA almost always takes a cleanup action when risks are greater than one in ten thousand. When cancer risks from a site fall within the risk range of one in ten thousand to one in one million, EPA makes cleanup decisions based on a variety of factors, including risk.

CT DPH estimated a cancer risk of five in one hundred thousand (5×10^{-5}) from exposure to arsenic in soil in the Morse Street group of properties (**not** five in ten thousand, as the commenter states). This is not considered by CT DPH to be a significant excess cancer risk, in terms of the likelihood of exposure causing disease. However, from a regulatory point of view, a risk of five in one hundred thousand falls within the risk range where EPA may take cleanup action but also may decide not to cleanup. From a health perspective, it represents a tiny increase above background cancer risks and such a tiny increase could never be observed among the small population of the Newhall neighborhood.

CT DPH argues that it is both appropriate and helpful to compare the theoretical excess cancer risks from the site with background rates. Background cancer rates provide some perspective on how many residents in the Newhall neighborhood might be expected to be diagnosed with cancer *even if there is no exposure to landfill contaminants*. With an understanding of background cancer rates, residents can better understand the magnitude of the theoretical increase that exposure to landfill contaminants could cause.

Comment 31: In the response to community concerns question #3, the expectations that a child will not touch the soil on a regular and continuing basis or that residents will vigilantly eliminate bare spots, wash toys and feet after every excursion into the backyard are unrealistic. Indeed the incidence of Pica in the US is highest among children (10-32%) (http://www.nlm.nih.gov/medlineplus/ency/article/001538.htm) and in people of color. There appears to be no statistical accommodation for that behavior in the model. Again, the burden of protection and behavior modification is on the residents. They need to know what they can do to protect themselves but this cannot be a long term strategy to deal with the contamination in this neighborhood.

Response 31: CT DPH agrees that residents need to be aware of actions they can take to reduce their contact with soil. CT DPH also agrees that placing the burden on residents to minimize their soil contact is not an acceptable long term solution. CT DEP will ensure that any permanent solution protects residents who use their yards to the fullest extent.

Comment 32: The response to community concerns question #8 should be more expansive and inclusive regarding lead exposure health effects that may persist beyond childhood. Is ADD/ADHD an expected outcome? What about research by Needleman and others that epidemiologically linked violent crime to blood lead levels in childhood?

Response 32: There are very limited data regarding attention deficit hyperactivity disorder and lead exposure. One study found a strong association between hair lead levels and the diagnosis of attention deficit hyperactivity disorder. However, this study has been criticized because hair is not considered a valid marker of lead exposure due to the extensive contamination possibilities (for example, hair care products) and the extent to which it relates to other usual markers of lead is not clear (ATSDR 1999).

With regard to links between lead exposure and violent crime, studies by Needleman et al. have suggested that lead levels in bone are related to various antisocial behaviors among children aged 7 to 11 years. However, there are questions regarding how confounding factors such as parental antisocial behavior were controlled for (ATSDR 1999). A recent study published in 2001 (Dietrich et al. 2001) reports that exposure to lead very early in life was associated with a small, but statistically significant increased frequency of self-reported and parent-reported delinquent and antisocial behaviors among 15-17 year olds. The authors conclude that while the effect of lead appears to be small, lead exposure may be one of many important variables in the development of antisocial behavior.

Comment 33: The final sentence in the answer to community concerns question #9 should be deleted. It is misleading and creates a false sense of security. Because a chemical is common does not mean it is harmless which is the implication here.

Response 33: CT DPH disagrees that the final sentence creates a false sense of security. It is important for residents to understand that there are sources of contaminants in soil other than the landfill.

Comment 34: In the conclusions section, ETPH has not been considered enough. In addition, the italicized statement regarding homes with the highest lead levels have been already cleaned up is misleading. First, even though the homes with the highest lead levels in the area have been remediated by the EPA, many more remain with unsafe lead levels as compared to the RDEC. Second, we cannot definitively say that exposure at levels of public health concern are not happening. We can say that the analysis, though limited in its application to individual circumstances, tells us that the average person will probably not be exposed at levels of concern according to the statistical model which requires certain assumptions. However we should also qualify the scientific guesses with statements about behaviors such as "playing in some yards or digging in the yards, could cause more exposure and put you at risk." Another reason we cannot be definitive about the lack of risk is that testing is not yet complete inside the study area, let alone the properties outside the study area, where most indications point to a wider area of contamination.

Response 34: ETPH are discussed in the Public Health Implications Section (C3) but are not included in the Conclusions section for the following reasons. Average ETPH levels in surface soils were below health comparison values so they were not evaluated in detail. In deeper soils, ETPH were present at very elevated levels. However, contaminants in deep soils are considered a potential exposure pathway (because of the recommendation that digging not occur at the site) and therefore were not evaluated in this Public Health Assessment.

Comment 35: If the recommendations found in the fact sheets about gardening and digging in the soil are to be taken seriously, they must be accompanied by person-to-person outreach. Otherwise warnings will go largely unheeded and not respected. This might be a good opportunity to collaborate with Elizabeth Hayes on an outreach plan since she is working on the neighborhood issues full time.

Response 35: CT DPH agrees that its recommendations in the fact sheets are most effective when communicated on a one-on-one basis. CT DPH has spoken individually with many residents in the neighborhood at a variety of public meetings and Saturday open house events. CT DPH has also worked with the University of Connecticut Cooperative Extension Service Urban Gardening Program to provide practical information to the community regarding safe gardening. The suggestion to collaborate with Elizabeth Hayes, who is currently the Community Advocate, hired by CT DEP is a good one. CT DPH will work with the Community Advocate to improve outreach on CT DPH's fact sheets.

Comment 36: Biomonitoring should be offered for other contaminants of concern such as arsenic, PAHs, ETPHs and other frequently detected contaminants where biomarkers are available.

Response 36: Based on the environmental data currently available, levels of contaminants (other than lead) and resulting exposures are not high enough to warrant biomonitoring.

Comment 37: Attachment F should be more clear about the health implications of exposure to lead and smaller babies and premature births. For example, both are linked to higher rates of birth defects.

Response 37: Additional text has been added to Attachment F.