# Health Consultation

Public Health Evaluation of Soil Data

EAST MAIN STREET DISPOSAL AREA
(a/k/a EAST SHORE TRAILER PARK AND SHORELINE TRAILER PARK)

BRANFORD, NEW HAVEN COUNTY, CONNECTICUT

EPA FACILITY: CTSFN0103051

OCTOBER 8, 2004

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

**Health Consultation: A Note of Explanation**

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

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

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

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

## BACKGROUND AND STATEMENT OF ISSUE

The Connecticut Department of Public Health (CTDPH) was asked by the Connecticut Department of Environmental Protection (CTDEP) and the East Shore Health Department (ESHD) to evaluate the public health significance of soil contamination in the area known as East Main Street Disposal Area in Branford, Connecticut. The site is also known as East Shore Trailer Park.

The East Shore Trailer Park site is bounded by E. Main Street to the north and Buisiness Park Drive to the south (Appendix A). The site consists of the Shoreline Trailer Court property (509-545 E. Main Street), two residential properties (483 and 497 E. Main Street) and a portion of a commercial property (6-12 Business Park Drive, also known as the Klutch Property). The 483 E. Main Street property contains a residence (adjacent to E. Main Street) and a rear building (that is used as an art studio). A large, grassed yard extends from the rear building south to a heavily vegetated drainage swale that runs through the 6-12 Business Park Drive property. The 483 E. Main Street property is bounded on the east and west by commercial properties, including a gas station. The 497 E. Main Street Property is a narrow parcel bounded by the 483 E. Main Street property and the Shoreline Trailer Court property. Shoreline Trailer Court is bounded to the east by a small, vegetated ridge. The 6-12 Business Park parcel is approximately 3.93 acres and is located along the north side of Business Park Drive. Until August 2003, this parcel was undeveloped. Beginning in August 2003, trees and brush were cleared in preparation for a proposed office building and paved parking lots. Construction of the office building and parking lots is ongoing. As part of the proposed construction, the drainage swale will be backfilled and surface water drainage for the parcel will be provided through underground pipes to a catch basin.

On June 23, 1989, CTDEP received a complaint from a resident at 483 East Main Street that an unknown industrial waste was seeping out of the ground in her yard. CTDEP respondents noted tar, industrial slag, and blue and orange stained areas spanning approximately 2 acres and affecting 3 or 4 additional property owners. Residents reported that the owner of Shoreline Trailer Park dumped mounds of unknown materials in the area from the mid 1960s until approximately 1984 and that some of the material came from a former coal/coke factory in New Haven, CT. As a result of the complaint, in 1989 CTDEP collected soil and standing water samples from the 483 E. Main Street property and neighboring properties. These samples indicated that metals, cyanide, and volatile organic compounds (VOCs) were present in waste materials, soil, and standing water.

As a result, the 483 E. Main Street property and the surrounding area were added to the CTDEP's inventory of Hazardous Waste Disposal Sites in March 1993. Because the residents are on a public water supply, no potential for exposure through drinking water exists. The site was therefore given a low priority for further investigation at that time.

As of November 1999, the site had not been assessed, nor had remedial actions been taken at the site. Therefore, CTDEP requested on January 7, 2000, that the U.S. Environmental Protection Agency (EPA) add the E. Main Street Disposal Area (aka 483 E. Main Street and surrounding area) to the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) to provide funding for an environmental assessment.

CTDEP sampled soil in the Trailer Court, 483 and 497 E. Main Street, and the 6-12 Business Park properties in July 2003 and found elevated levels of TPHs, PAHs and arsenic in surface and subsurface soils (Appendix B). Following this discovery, CTDEP met with CTDPH in late September 2003 to discuss the sampling results and subsequent health concerns. CTDPH and CTDEP also met with the health director from the East Shore Health District (ESHD) and town leaders to discuss the discovery and a plan of action. CTDEP, ESHD, and CTDPH then met with town leaders, property owners, and the property manager from the trailer court to discuss a plan of action to disseminate the contamination information. CTDEP, CTDPH, and ESHD, went door-to-door in the Trailer Court and surrounding properties to hand out fact sheets containing information about soil contamination, health concerns, and ways to reduce exposure. CTDPH, CTDEP, and ESHD held an open house on October 7, 2003 to provide information about the contamination and answer any questions about the site..

CTDEP performed additional subsurface soil sampling in October 2003 to further characterize the soil contamination on the site. In October and November of 2003, a consultant working for the owner of the 6-12 Business Park Drive property collected subsurface soil samples from various locations on the 6-12 Business Park property and surface water samples from the drainage swale.

In late 2003, the United States Environmental Protection Agency (EPA) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) Region I office perform a preliminary evaluation of CTDEP's soil sampling data of the site. ATSDR's evaluation of the data indicated that the elevated contaminant levels at the site would warrant remediation (ATSDR 2003).

*Site Visit*

CTDPH conducted site visits with EPA, CTDEP, and ESHD in October 2003 to observe the conditions of 4 properties that make up the site. Visitors observed several areas in the Shoreline Trailer Court property that were bare and not covered with grass. The local health director responded to this problem by providing free mulch for the residents of the Shoreline Trailer Court to cover areas of a field located on the southern portion of the property that is used frequently by children who live in the trailer court.

CTDPH, CTDEP, and EPA also visited the 483 and 497 E. Main Street properties and observed a hard black substance across a 1.5 foot berm in the back of the 483 E. Main Street property. A small amount of grass was growing on top of it, but CTDPH did not observe any presence of black tar oozing out of the ground as in the 1989 CTDEP visit to the site. Most areas on these properties were covered by grass; however, a black substance covered the ground on the southern end of the property, and very little grass was able to grow.

*Demographics*

The Shoreline Trailer Court property contains 84 trailers with approximately 210 residents. The 483 E. Main Street property has one residence with four residents and the 497 E. Main Street property has one residence with one resident. Many children live in the Shoreline Trailer Court Property, but no known children live in the 483 or 497 E. Main Street properties. The 6-12 Business Park Drive property was previously an undeveloped parcel. It is now being developed for office space and parking.

*Environmental Contamination and Health Comparison Values*

1. Shoreline Trailer Court Property

In July 2003, CTDEP sampled soil from six locations on the Shoreline Trailer Court property. At all six locations, samples were taken from 0-3 inches below ground surface (bgs) and from subsurface soils at various depth intervals (Tables 1 and 2). The six sample locations were in the southern end of the trailer court property, mostly in the open field area used by children living on the property and in the back row of trailers. This area was believed to be wetlands that were filled with coal tar pitch.

Several of the surface soil samples taken in July 2003 contain polycyclic aromatic hydrocarbons (PAHs) at levels that greatly exceeded Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs soil standards were developed to protect children and adults who have contact with soils on a daily basis for many years (30 years). The PAHs detected

that exceeded CT RSRs are benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. The PAH found in surface soil at the greatest concentration relative to the CT RSRs is benzo(a)anthracene at 58.7 parts per million or milligrams per kilogram (ppm or mg/kg). Approximately 50-66% of the samples had PAH levels that exceeded CT RSRs (Table 1).

Total Petroleum Hydrocarbons (TPHs) were found in surface soil samples in the Shoreline Trailer Court property in July 2003. Roughly half of the surface soil samples exceeded the CT RSRs for TPHs. Maximum TPH concentrations were 2360 ppm, about four times the CT RSR for residential soils. Generally, TPHs and PAHs were co-located on this property. Arsenic was tested for in surface soils but was not detected above the CT RSR of 10 mg/kg.

**Table 1. Summary of Surface[#] Soil Sample Results from Shoreline Trailer Court Property, July 2003**

| Contaminant | Concentration Range (ppm or mg/kg) | Number of Exceedances of Comparison Value | Comparison Value (ppm) | Comparison Value Source |
|---|---|---|---|---|
| Benzo(a)anthracene | 0.35 - 58.70 | 4/7 | 1 | CT RSR[^] |
| Benzo(a)pyrene | 0.25 - 31 | 4/7 | 1 | CT RSR |
| Benzo(b)fluoranthene | BDL - 31 | 4/7 | 1 | CT RSR |
| Benzo(k)fluoranthene | BDL - 20.50 | 1/7 | 8.40 | CT RSR |
| Dibenzo(a,h)anthacene | BDL - 4.70 | 3/7 | 1 | CT RSR |
| Indeno(1,2,3-cd)pyrene | BDL - 19.70 | 3/7 | 1 | CT RSR |
| **Total Petroleum Hydrocarbons** | 0.09 - 2360 | 3/7 | 500 | CT RSR |

* Below Detection Limit

[^]Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).

ppm=parts per million

[#] Six samples were collected from 0-3" bgs and one sample was collected from 0-6" bgs.

**Table 2. Summary[#] of Subsurface Soil Sample Results from Shoreline Trailer Court Property, July and October 2003**

| Contaminant | Sample Depth | Sample Date | Concentration Range (ppm) | Number of Exceedances of Comparison Value | Comparison Value (ppm) | Comparison Value Source |
|---|---|---|---|---|---|---|
| **PAHs** | | | | | | |
| Benzo(a)anthracene | 0-2' | 10/2003 | 2.26 - 25.2 | 2/2 | 1 | CT RSR[^] |
| | 1-3' | 10/2003 | BDL - 40.30 | 1/2 | | |
| | 2-3' | 7/2003 | 2.76 | 1/1 | | |
| | 2-4' | 10/2003 | BDL - 2.12 | 1/4 | | |
| | 4-6' | 7/2003 | 4.0 | 1/1 | | |
| | 6-8' | 10/2003 | BDL - 3.93 | 1/5 | | |
| | 10-12' | 10/2003 | BDL - 6.03 | 1/2 | | |
| Benzo(a)pyrene | 0-2' | 10/2003 | 2.37 - 24.0 | 2/2 | 1 | CT RSR |
| | 1-3' | 10/2003 | BDL - 33.5 | 1/2 | | |
| | 2-3' | 7/2003 | 1.56 | 1/1 | | |
| | 2-4' | 10/2003 | BDL - 2.28 | 1/4 | | |
| | 4-6' | 7/2003 | 2.0 | 1/1 | | |
| | 6-8' | 10/2003 | BDL - 4.24 | 1/5 | | |
| | 10-12' | 10/2003 | BDL-6.18 | 1/2 | | |
| Benzo(b)fluoranthene | 0-2' | 10/2003 | 2.63 - 27.0 | 2/2 | 1 | CT RSR |
| | 1-3' | 10/2003 | BDL - 35.10 | 1/2 | | |
| | 2-3' | 7/2003 | 1.57 | 1/1 | | |
| | 2-4' | 10/2003 | BDL - 2.48 | 1/4 | | |
| | 4-6' | 7/2003 | 1.92 | 1/1 | | |
| | 6-8' | 10/2003 | BDL - 4.28 | 1/5 | | |
| | 10-12' | 10/2003 | BDL - 6.51 | 1/2 | | |
| Benzo(k)fluoranthene | 0-2' | 10/2003 | 1.60 - 14.9 | 1/2 | 8.40 | CT RSR |
| | 1-3' | 10/2003 | BDL - 22.40 | 1/2 | | |
| Dibenzo(a,h)anthacene | 0-2' | 10/2003 | 0.20 - 1.9 | 1/2 | 1 | CT RSR |
| | 1-3' | 10/2003 | BDL - 3.02 | 1/2 | | |
| Indeno(1,2,3-cd)pyrene | 0-2' | 10/2003 | 1.35 - 13.1 | 2/2 | 1 | CT RSR |
| | 1-3' | 10/2003 | BDL-19.40 | 1/2 | | |
| | 2-3' | 7/2003 | 1.086 | 1/1 | | |
| | 2-4' | 10/2003 | BDL-1.03 | 1/4 | | |
| | 4-6' | 7/2003 | 1.11 | 1/1 | | |
| | 6-8' | 10/2003 | BDL-2.61 | 1/5 | | |
| | 10-12' | 10/2003 | BDL-3.19 | 1/2 | | |
| **Total Petroleum Hydrocarbons** | 4-6' | 7/2003 | 555 | 1/1 | 500 | CT RSR |

[#]Sample results for a depth interval are included in the Table only if there was a CT RSR exceedance.
* Below Detection Limit
[^]Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs) are soil standards developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).
ppm=parts per million

Results of subsurface soil samples collected in July 2003 (summarized in Table 2) indicate that TPH and PAHs were also present at elevated levels in subsurface soils in the southern portion of the Trailer Court property. The highest PAH concentration from the July 2003 sampling was in

the 4-6' depth interval: benzo(a)anthracene at 4 ppm, which is 4 times above the CT RSR of 1 ppm.

In October 2003, CT DEP conducted additional subsurface soil sampling at seven locations in the Shoreline Trailer Court property. Samples were collected from various depths (as great as 10-12' bgs), primarily in the open field area in the southern end of the property where the contamination was expected to be at its highest concentration. One surface soil sample (0-6 inches bgs) was also taken in October 2003 by CT DEP in the northern part of the property in response to a request from a resident, but the sample was not contaminated.

Results of the depth soil samples (summarized in Table 2) show that in October 2003, the maximum PAH contamination in the trailer court property (relative to CT RSRs) was 40.3 ppm (benzo(a)anthracene) at 1-3 feet bgs. As expected, contaminant concentrations were highest in the southern most end of the trailer court. In depth intervals greater than 2-4 feet, only one sample location contained PAH levels greater than CT RSRs.

2. 483 and 497 E. Main Street Properties

In July 2003, surface soil samples (0-3 inches) and subsurface soil samples were collected from 16 locations on the 483 and 497 E. Main Street properties (Tables 3 and 4).

**Table 3. Summary of Surface Soil Results from 483 and 497 E. Main Street Properties, July 2003**

| Contaminant | Sample Depth | Concentration Range (ppm) | Number of Exceedances of Comparison Value | Comparison Value (ppm) | Comparison Value Source |
|---|---|---|---|---|---|
| Benzo(a)anthracene | 0-3" | BDL*-73.70 | 8/16 | 1 | CT RSR |
| Benzo(a)pyrene | 0-3" | BDL-39 | 7/16 | 1 | CT RSR |
| Benzo(b)fluoranthene | 0-3" | BDL-49.8 | 7/16 | 1 | CT RSR |
| Benzo(k)fluoranthene | 0-3" | BDL-22.60 | 3/16 | 8.40 | CT RSR |
| Dibenzo(a,h)anthracene | 0-3" | BDL-5.45 | 5/16 | 1 | CT RSR |
| Indeno(1,2,3-cd)pyrene | 0-3" | BDL-27.30 | 7/16 | 1 | CT RSR |
| **Total Petroleum Hydrocarbons** | 0-3" | BDL-2740 | 5/16 | 500 | CT RSR |
| Arsenic | 0-3" | BDL-22.90 | 5/16 | 10 | CT RSR |

* Below Detection Limit
^Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).
ppm=parts per million

**Table 4. Summary[#] of Subsurface Soil Sample Results from 483 and 497 E. Main Street Properties, July 2003**

| Contaminant | Sample Depth | Maximum Concentration (ppm) | Number of Exceedances of Comparison Value | Comparison Value (ppm) | Comparison Value Source |
|---|---|---|---|---|---|
| Benzo(a)anthracene | NR | 3.7 | 1/1 | 1 | CT RSR[^] |
| | 2-3' | 4.38 | 1/1 | | |
| | 3-4' | 28.3 | 1/1 | | |
| | 5-6' | 35.6 | 1/1 | | |
| Benzo(a)pyrene | NR | 2.04 | 1/1 | 1 | CT RSR |
| | 2-3' | 2.24 | 1/1 | | |
| | 3-4' | 16.0 | 1/1 | | |
| | 5-6' | 18.0 | 1/1 | | |
| Benzo(b)fluoranthene | NR | 2.03 | 1/1 | 1 | CT RSR |
| | 2-3' | 2.24 | 1/1 | | |
| | 3-4' | 14.4 | 1/1 | | |
| | 5-6' | 18.3 | 1/1 | | |
| Benzo(k)fluoranthene | 3-4' | 8.8 | 1/1 | 8.40 | CT RSR |
| | 5-6' | 10.9 | 1/1 | | |
| Dibenzo(a,h)anthacene | 3-4' | 1.99 | 1/1 | 1 | CT RSR |
| Indeno(1,2,3-cd)pyrene | NR | 1.3 | 1/1 | 1 | CT RSR |
| | 2-3' | 1.58 | 1/1 | | |
| | 3-4' | 8.6 | 1/1 | | |
| | 5-6' | 11.3 | 1/1 | | |
| **Total Petroleum Hydrocarbons** | 3-4' | 2750 | 1/1 | 500 | CT RSR |
| | 5-6" | 4580 | 1/1 | | |
| Arsenic | 3-4' | 21.6 | 1/1 | 10 | CT RSR |
| | 5-6' | 24.3 | 1/1 | | |

[#]Sample results for a depth interval are included in the Table only if there was a CT RSR exceedance.
NR = Not Reported
* Below Detection Limit
[^]Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).
ppm=parts per million

In surface soils at the 483 and 497 E. Main Street properties, PAHs, TPHs, and arsenic were found at levels above the CT RSRs in one-third to one-half of the samples. Surface soil contamination levels are greater in the 483 and 497 E. Main Street properties than in the trailer court. The PAHs detected that exceeded CT RSRs are benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. The maximum PAH level (relative to CT RSRs) was 73.7 ppm of benzo(a)anthracene, which is almost 75 times above the CT RSR. Maximum TPHs found in surface soil samples were approximately five times above the CT RSR. Arsenic surface soil contamination levels were much lower, at only twice the CT RSR.

A different depth interval was analyzed at each of the 16 locations. Depths that were sampled ranged from 1-3' to 6-7' bgs. Just as in the surface soil results, PAHs, TPH and arsenic were found at levels exceeding the CT RSRs. The maximum PAH concentration (relative to CT RSRs) was 35.6 ppm (benzo(a)anthracene at 5-6' bgs). TPH was found at levels as high as 4,580 ppm in the 5-6' depth interval. Arsenic was found at a maximum concentration of 24.3 ppm (Table 4).

3. 6-12 Business Park Drive Property

Soil investigations have been conducted at the 6-12 Business Park Drive property by both CTDEP and by consultants working for the owner of the property (Table 5). Investigations at 6-12 Business Park Drive took place in October and November 2003. Consultants for the property owner collected subsurface soil samples from 22 test pits on the property. Results indicate the presence of extremely high levels of PAHs and TPHs. At a depth of 4 feet bgs, individual PAHs were found at levels as high as 8,900 times above the CT RSR of one ppm. TPHs were found in test pit samples at a maximum concentration of 217,000 ppm. Contaminant levels were substantially lower in shallower soils. For example, the maximum PAH concentration in a sample from 0-2' deep was 71.6 mg/kg. Observations of soils in the test pit noted that soils were dark brown to black in color and had a shiny, tar-like appearance.

In another investigation of the 6-12 Business Park Drive property, CT DEP collected soil samples from 10 locations and analyzed a different depth interval at each location. CTDEP also collected sediment and surface water samples from the drainage swale on the property. Results show no exceedances of drinking water standards or CT RSRs for direct contact with soil. Overall, results indicate that soils are most heavily contaminated with PAHs across the northern portion of 6-12 Business Park Drive parcel at depths between 2 and 5 feet bgs.

Although some of the soil samples at 6-12 Business Park Drive were collected from 0-2' bgs and some samples were collected from one foot bgs, CTDPH considers all the data to be representative of subsurface soils (Table 5). Typically, only data from the 0-3" or 0-6" depth intervals are considered representative of surface soils.

**Table 5. Summary of Subsurface Soil Sample Results from 6-12 Business Park Drive Property, October and November 2003.**

| Contaminant | Maximum Concentration (ppm) | Maximum Concentration Sample Depth (feet) | Number of Exceedances of Comparison Value | Comparison Value (ppm) | Comparison Value Source |
|---|---|---|---|---|---|
| **PAHs** | | | | | |
| Benzo(a)anthracene | 8,910 | 4 | 28/47 | 1 | CT RSR^ |
| Benzo(a)pyrene | 7,810 | 4 | 28/47 | 1 | CT RSR |
| Benzo(b)fluoranthene | 8,510 | 4 | 28/47 | 1 | CT RSR |
| Benzo(g,h,i)perylene | 5,130 | 4 | 5/47 | 1000 | CT RSR |
| Benzo(k)fluoranthene | 3,660 | 4 | 15/47 | 8.4 | CT RSR |
| Chrysene | 8,470 | 4 | 5/47 | 84 | CT RSR |
| Dibenzo(a,h)anthracene | 1,240 | 4 | 20/47 | 1 | CT RSR |
| Fluoranthene | 23,000 | 4 | 5/47 | 1000 | CT RSR |
| Fluorene | 9,410 | 4 | 5/47 | 1000 | CT RSR |
| Indeno(1,2,3-cd)pyrene | 5,050 | 4 | 27/47 | 1 | CT RSR |
| 2-Methylnaphthalene | 7,490 | 5 | 5/47 | 474 | CT RSR |
| Naphthalene | 45,000 | 4 | 6/47 | 1000 | CT RSR |
| Phenanthrene | 39,600 | 4 | 5/47 | 1000 | CT RSR |
| Pyrene | 23,500 | 4 | 5/47 | 1000 | CT RSR |
| **Total Petroleum Hydrocarbons** | 217,000 | 5.5 | 3/14 | 500 | CT RSR |

^Connecticut Remediation Standard Regulations Direct Exposure Criteria (CT RSRs). CT RSRs are soil standards that were developed to be protective of children and adults who have contact with soils on a daily basis for many years (30 years).
ppm=parts per million

## DISCUSSION

*Exposure Pathway Analysis*

To evaluate potential exposures to soil contaminants in the trailer park, the 483 and 497 E. Main Street properties, and the 6-12 Business Park property, CTDPH evaluated the environmental data and considered how people might come into contact with contaminants in soil. The possible pathways of exposure are dermal, inhalation, and incidental ingestion. In other words, in order to be exposed to contaminants in soil, one most come into contact with the soil by touching the soil, breathing airborne soil particles, or eating soil adhered to fingers or food items.

Surface soils

Environmental data show that surface soils at the trailer court and 483 and 497 E. Main Street properties are contaminated with PAHs and TPH, and to a lesser extent, arsenic. Adults and children are likely to be exposed to surface soils because the contamination is in their yards. Children in the trailer court could come into contact with contaminated surface soils while playing outside in their yards and in the field located in the southern portion of the property. Adults could be exposed while doing yard work or other yard activities. Small children are more likely to have been exposed because they have more hand-to-mouth contact than older children and adults. The potential for exposure to surface soil also exists at the 483 and 497 E. Main Street properties. However, the exposure potential is not as great as the trailer court because children do not live at these properties and access is limited because the trailer court property is fenced. The primary exposure routes are considered to be dermal and ingestion. Inhalation is not considered to be a major pathway because most of the contaminated areas are either paved or covered with grass; this creates a very low potential for excessively dry and dusty soil conditions. Exposure to surface soils by ingestion and dermal routes at the trailer court and 483 and 497 E. Main Street properties is considered to be a complete exposure pathway and is evaluated further in the Public Health Implications Section.

It is possible, although not likely, that older children could access 6-12 Business Park Drive and come into contact with contaminated surface soil. Workers involved in clearing brush and trees from the property in August 2003 could have been exposed to contaminated surface soils through the dermal, ingestion and inhalation exposure routes. Workers involved in ongoing construction activities at the property could also be exposed to contaminated surface soils. However, these construction activities are being coordinated with CT DEP to minimize worker exposures.

Because exposure to surface soil is possible, the Business Park property is considered to be a complete exposure pathway. However, no data from this property adequately represent surface, accessible soils. As a result, quantitative evaluation of public health implications from exposure to surface soils is not possible. Instead, CTDPH performed a qualitative evaluation of available data from the most shallow depth interval at the 6-12 Business Park Drive property (0-2' and 1 foot). This evaluation is contained in the Public Health Implications Section of this health consultation.

Subsurface soils

Results from subsurface soil samples indicate that PAHs and TPHs are present at levels significantly above health-based comparison values at the trailer court, 483 and 497 E. Main Street properties and the 6-12 Business Park Drive property. Arsenic is present at elevated levels in subsurface soils at 483 and 497 E. Main Street.

In the past, neighborhood residents could have come into contact with subsurface soils during yard activities that penetrated into deep soils (e.g. planting trees or shrubs and installing fence posts or footings for a deck). With regard to the 6-12 Business Park Drive parcel, exposure to subsurface soils is less likely in the past because the parcel was undeveloped.

Quantitative evaluation of doses and health impacts to residents from past exposure to soils is difficult. Because contaminant levels in subsurface soils are high, CTDPH has conducted 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 public meetings and availability sessions. CTDPH continues to communicate its message about avoiding activities that penetrate into deep soils. Because of CTDPH's ongoing interventions, the current and future potential for exposure to soils at depth at the trailer court and at the 483 and 497 E. Main Street properties is very low.

Exposure to subsurface soils by 6-12 Business Park Drive residents and workers is possible because construction is ongoing at the site. Provided that proper precautions are taken to manage the contaminated soils, exposures to contaminated subsurface soils can be prevented. The construction activities at 6-12 Business Park Drive are being coordinated with CT DEP to ensure that exposure to subsurface soils is minimized during and after construction.

In summary, CTDPH considers exposure to subsurface soils to be a potential exposure pathway and it is not evaluated quantitatively in this Public Health Assessment.

*Public Health Implications for Adults and Children*

When determining the public health implications of exposure to hazardous contaminants, CTDPH considers how people might come into contact with contaminants and compares contaminant concentrations with health protective comparison values. When contaminant levels are below health-based comparison values, health impacts from exposure to those levels are unlikely. Contaminant levels exceeding comparison values do not indicate that health impacts are likely but instead warrant further evaluation. In this health consultation, CTDPH used Connecticut Remediation Standard Regulations direct contact residential soil standards (CT RSRs) as health protective screening values. As stated previously, these values are health-based levels developed to be protective of children and adults with frequent, long-term exposure to contaminants in soil.

Tables 1 and 3 indicate that arsenic, PAHs, and TPHs were detected in surface soil at levels above CT RSRs. Therefore, exposure to these contaminants is evaluated in the remaining sections of this health consultation. As stated in the previous section, exposure to contaminants in surface soils at the Trailer Court and 483 and 497 East Main Street properties will be quantitatively evaluated. Exposures to surface soils will be evaluated qualitatively at the 6-12 Business Park Drive Property because data representative of accessible surface soils is not available. General toxicology information on PAHs, TPHs, and arsenic, is provided in Appendix C.

In the Shoreline Trailer Court, PAHs and TPHs were detected in surface soil at levels exceeding the CT RSRs. It is important to note, however, that CT RSRs were developed to be protective of young children and adults exposed to soil everyday over a long term. It is unlikely that such frequent and intense soil exposure would occur at all three properties because the grass cover

would minimize direct contact with soil. In addition, during winter months, the ground would be frozen or snow-covered, and soil contact would be minimal. CTDPH evaluated cancer and noncancer health risks based on more realistic exposures to children and adults who may come into contact with soils at the trailer court. CTDPH assumed that contact with soil occurs 7 days per week, 9 months out of the year, for 30 years. Nine months was used instead of 12 exposure would be limited in the winter months.

In the case of the 483 and 497 E. Main Street properties, CTDPH assumed that contact with soil occurs 2 days per week, 9 months out of the year for 6 years. These exposure assumptions were made because a fence at the trailer court property limits access by trailer court residents. Nine months was used instead of 12 because exposure would be limited in the winter months. In addition, CTDPH interviews at the two properties made residents aware of the contamination and limited use of the southern end of their properties. Exposure assumptions on the 483 and 497 E. Main Street properties represent a youth (age 13-18 years) trespasser exposure scenario. Although it is unknown from interviews with the trailer court residents if teenagers actually frequent the 483 and 497 E. Main St. properties, CTDPH believes that this is a likely and realistic exposure scenario.

CTDPH used a central tendency soil exposure point concentration because it is more representative of the concentration to which people may be exposed over the long term than the maximum concentration. CTDPH relied upon the 95% Upper Confidence Limit (95% UCL) of the mean (an estimate of the central tendency), calculated using ProUCL (EPA 2001a). The 95% UCL provides a very conservative (health protective) estimate of the average (mean) concentration, especially for a small number of samples, which is the case at this site.

1. Shoreline Trailer Court

PAHs

In the Shoreline Trailer Court property, several PAHs were detected in the surface soil samples at levels exceeding CT RSRs. CTDPH calculated doses and theoretical cancer and noncancer risks from PAHs in surface soil. CTDPH used the surface soil data collected from the southern end of the trailer court property, in the open field used by the children living on the property. CTDPH did not use the one sample result (that was clean) from the northern part of the trailer court property because it is not representative of the area where children play on a regular basis. For cancer risk calculations, exposure was assumed to occur 7 days a week, 9 months a year for 30 years. For noncancer risk calculations, exposure was assumed to occur 7 days/week, 9 months/year (child, age 1-6 years). For an exposure point concentration, CTDPH relied on a 95% UCL. For cancer risk calculations, CTDPH adjusted the 95% UCL for each PAH by its respective Toxic Equivalency Factor (TEF) and summed the results to get a total TEF-adjusted exposure point concentration of 32.2 ppm. The EPA cancer potency factor for benzo(a)pyrene was used to calculate theoretical cancer risks for all carcinogenic PAHs. For noncancer risk calculations, CTDPH calculated a 95% UCL for total PAH concentration of 104 ppm and used the EPA oral reference dose for naphthalene as a surrogate toxicity factor for all PAHs (Appendix D). In addition, CTDPH compared the 95% UCL for total PAH concentration to

levels that have been seen to result in adverse noncancer health effects in toxicology literature for other PAHs besides naphthalene.

Noncancer risks from exposure to PAHs in the trailer court property are not significant (Appendix D). Noncancer risk PAH doses from the trailer court property are well below the EPA reference dose (safe dose) for noncancer health effects and levels seen in toxicology literature to result in adverse noncancer health effects from exposure to other PAHs besides naphthalene. Therefore, we do not expect to see any noncancer health effects in children exposed to PAHs in soil in the trailer court property.

If a person living in the Trailer Court was exposed to the contaminated soil everyday for 30 years, the theoretical excess lifetime cancer risk would be 3 in 10,000. This means that there might be three excess cancers in 10,000 trailer court residents who were exposed to PAHs in the soil every day for 30 years. This theoretical cancer risk estimate does not represent a significant incremental cancer risk from exposure to PAHs in the soil. However, it is within the risk range that would prompt environmental agencies to consider cleanup actions to reduce exposure. Furthermore, a large degree of uncertainty is related to the risk calculations because of the small number surface soil samples collected from the trailer court (there were only 6 samples taken). This uncertainty supports the idea that cleanup of soils is a prudent course of action.

It is important to note however, that the exposure duration for cancer risk (30 years) used in risk calculations may overestimate the true exposure because the wetland area was probably filled in the early 1980's. This would indicate that actual exposures would be not greater than 20 years. Even with 20 years of exposure rather than 30 years, the risks would still be in the range for cleanup actions.

It is also helpful to evaluate PAH doses at the trailer court in relation to PAH doses seen to cause cancer in scientific studies of humans and animals. Estimated PAH doses for cancer effects from the trailer court are 0.00004 mg/kg/day. This dose is 75,000 to 825,000 times lower than the cancer effect level of 3-33 mg/kg/day. This range of doses produced stomach and skin tumors in mice (ATSDR 1995).

It is also useful to present background cancer rates as a comparison to theoretical cancer risk calculations. Background rates of cancer in the United States are one in 2 or 3 (NCI 2001). In a population of 10,000, background numbers of cancer cases would be approximately 3300 to 5000. An excess risk of 3 cancers above a background rate of 3300 to 5000 presents a minimal excess cancer risk in the trailer court. Therefore, we do not expect to see a significantly increased cancer risk for residents in the Trailer Court who are exposed to PAHs in the soil.

Total Petroleum Hydrocarbons (TPHs)

In the trailer court, TPHs were detected at levels greater than the CT RSRs. Since TPHs is a complex mixture of many chemicals, it would be difficult to determine whether health effects are likely. Therefore, TPHs is not specifically evaluated in this health consultation. Many of the components of TPHs are PAHs, and health implications of PAHs are evaluated in detail in this

section. Moreover, since TPHs and PAHs are generally co-located, any remedial measures to address PAHs will also address TPHs.

2. 483 and 497 E. Main Street Properties

The level of surface soil contamination in the 483 and 497 E. Main Street properties was higher than in the trailer court. Surface soil samples indicated PAH, arsenic, and TPH levels to be above CT RSRs in the properties.

PAHs

In the 483 and 497 E. Main Street properties, several PAHs were detected in the surface soil samples at levels exceeding CT RSRs. CTDPH calculated doses and theoretical cancer and noncancer risks from PAH exposure in surface soil. For cancer risk calculations, exposure was assumed to occur 2 days a week, 9 months a year for 6 years (trespasser scenario, 13-18 years). For noncancer risk calculations, exposure was assumed to occur 2 days a week, 9 months a year for 6 years (trespasser scenario, 13-18 years). For noncancer risk calculations, CTDPH relied on a 95% UCL of 63.3 ppm and used the EPA oral reference dose for naphthalene. In addition, CTDPH compared the 95% UCL for total PAH concentration to levels that have been seen in toxicology literature to result in adverse noncancer health effects from exposure to other PAHs besides naphthalene.

For cancer risk calculations, CTDPH adjusted the 95% UCL for each PAH by its respective Toxic Equivalency Factor (TEF) and summed the results to get a total TEF-adjusted exposure point concentration of 19.13 ppm. The EPA cancer potency factor for benzo(a)pyrene was used to calculate theoretical cancer risks (Appendix D).

Noncancer risks from exposure to PAHs in the 483 and 497 E. Main Street properties are not significant (Appendix D). PAH doses from the 483 and 497 E. Main Street properties are below the EPA reference dose (safe dose) for noncancer health effects and below levels seen in toxicology literature to result in adverse noncancer health effects from exposure to other PAHs besides naphthalene. Therefore, we do not expect to see any noncancer health effects from children exposed to PAHs in the 483 and 497 E. Main Street properties.

Exposure to the contaminated soil at the 483 and 497 E. Main Street properties 2 days per week, 9 months per year, for 6 years, would result in a theoretical excess lifetime risk of 3 in 1,000,000. This means that there might be 3 excess cancer cases in 1,000,000 trespassers in the 483 and 497 E. Main Street properties who were exposed to the soil using the above assumptions. This theoretical cancer risk estimates indicates very minimal excess lifetime incremental cancer risk from exposure to PAHs in the soil. In addition, CTDPH considers that its risk assumptions are very conservative because we do not expect the average trespasser to have soil contact on this property 2 days per week, 9 months a year, for 6 years. Therefore, cancer effects from exposure to PAHs in surface soil on these properties are considered to be unlikely.

For the 483 and 497 E. Main Street properties, while estimated doses and risks from PAH exposure do not present a significant risk above background, these levels were only estimated for a trespasser scenario and do not represent long term exposures for residents with children. Typical residential exposures would result in much higher doses and risks than a trespasser scenario. A permanent cleanup must be protective of residential exposures. This suggests that cleanup of soils is a prudent course of action for the long term. Furthermore, the soil concentrations seen in the 483 and 497 E. Main Street properties exceeded cleanup levels (CT RSRs), further justifying the need for remediation.

Arsenic

In the 483 and 497 E. Main Street properties, arsenic was detected in less than half of all 16 samples at levels exceeding CT RSRs. The maximum exposure level is approximately twice the arsenic CT RSR of 10 ppm.

CTDPH relied up a 95% UCL of the mean when estimating noncancer and cancer risk calculations. Given the same assumptions about exposure frequency and duration used for PAHs and a 95% UCL exposure level of 11.18 ppm, the average daily dose from ingestion and dermal contact was estimated to be 0.0002 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 exposure of 0.0003 mg/kg/day and EPA's reference dose which is also 0.0003 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, noncancer effects from arsenic in soil at the 483 and 497 E. Main Street properties are unlikely.

CTDPH also calculated a lifetime average daily dose (based on a trespasser scenario of 6 years, aged 13-18 years) and theoretical cancer risks from long-term exposure to arsenic (Appendix D). The theoretical cancer risk from arsenic exposure is three excess cancers per 10,000,000 trespassers, which represents a very small incremental risk above the background cancer rate of approximately 1 in 2 or 3 (NCI 2001). Therefore, we do not expect to see any cancer effects from arsenic exposure from these properties.

Total Petroleum Hydrocarbons (TPHs)

In the 483 and 497 E. Main Street properties, TPHs were detected at levels greater than the CT RSRs. Since TPHs is a complex mixture of many chemicals, it would be difficult to determine whether health effects would be likely. Therefore, TPHs is not specifically evaluated in this health consultation. Many of the components of TPHs are PAHs and health implications of PAHs are evaluated in detail in this section. Moreover, since TPHs and PAHs are generally co-located, any remedial measures to address PAHs will also address TPHs.

3. 6-12 Business Park Drive Property

Soil data from the most shallow depth samples at the 6-12 Business Park Drive property (1 feet deep and 0-2' depth interval) show that PAH concentrations are very similar to concentrations

found in surface soils (0-3") at the 483 and 497 E. Main Street properties. The exposure scenario evaluated for the 483 and 497 E. Main Street properties (youth trespasser), is also a reasonable exposure scenario for the 6-12 Business Park Drive property. Another reasonable exposure scenario for the 6-12 Business Park Drive is a short-term worker scenario. Workers who were involved in clearing brush and trees from the property in August 2003 could have been exposed to surface soils for a short period of time during that work project. However, a child-trespasser scenario would still result in a greater exposure to soil than a short-term adult worker[1].

The PAH dose and risk estimates calculated for the 483 and 497 E. Main Street properties in the previous section show that PAHs present very minimal cancer and noncancer risks. Because the 6-12 Business Park Drive property has similar PAH concentrations and a similar exposure scenario as the 483 and 497 E. Main Street properties, we can say that the 6-12 Business Park Drive property also presents very minimal cancer and noncancer risks to trespassers. However, this analysis relies on the assumption that PAHs concentrations detected in shallow depths (1 feet and 0-2' depth interval) at the 6-12 Business Park Drive property are reflective of what a youth trespasser might come into contact with (i.e., surface, accessible soils). Because we do not have true surface soil data from the property, we cannot make a definitive conclusion regarding exposure and risk. Arsenic and TPHs were not detected at elevated levels in the most shallow depth samples from 6-12 Business Park Drive; therefore, they are not qualitatively evaluated.

## EVALUATION OF COMMUNITY CONCERNS

Community concerns were collected during an open house held in October 2003 in the Branford High School. CTDPH, ESHD, and CTDEP staff were also present. Concerns were also collected during home visits in early October 2003 in the trailer park. Community concerns collected by CTDPH are summarized below. A response to each concern is provided as well.

1. Parents of children who play in their backyards and in the field in the trailer court are concerned about the health of their children as well as themselves.

   *In some areas of the Trailer Court, high PAH levels were found in surface soil. Frequent, long term exposure could result in a small increased risk of cancer. CTDPH evaluated risk from exposure to the contaminated soil 7 days a week, 9 month a /year for 30 years. Such exposure does not result in a significant increased cancer risk above background rates. In addition, the doses of PAHs that someone could receive at the trailer court are below doses seen in toxicology literature to result in adverse health effects.*

   *In order for exposure to occur, direct contact with soil must occur on a frequent and continuing basis. The presence of grass and mulch on the soil will greatly decrease the level of exposure from the contaminants in the soil. In addition, residents can take action to further minimize their soil contact (exposure) and risk. These suggestions (listed in a fact*

[1] If it is assumed that a worker ingests 480 mg of soil per day (EPA 1997), 5 days per week, for a one month work project, the worker's soil dose is approximately 2 times less than a child trespasser, aged 13-18 years old, who ingests 50 mg of soil per day for 2 days per week, 9 months per year, for 6 years. Refer to risk calculations in Appendix D.

*sheet in Appendix E) include washing hands frequently after playing/working outside, vacuuming up dirt from outside, and wearing gloves.*

2. Residents of the Trailer Park are worried about the health of their pets who use the backyards as a play area.

   *We cannot estimate the risk of adverse health effects for animals. However, residents can reduce their pets' contact with soil by keeping their yards covered with grass or mulch (for bare soil areas), and wiping their pets' fur and paws before they enter the house to reduce the amount of soil that is brought inside.*

3. Residents of the Trailer Park are concerned about gardening in their backyards and whether this is safe.

   *Gardening can be done safely provided that several simple precautions are observed. Following these precautions will ensure that your contact with soil is minimized as much as possible (Appendix E).*

4. Three children in the trailer court are autistic, and their parents are concerned that their diagnosis is due to their exposure to the contaminants in the soil.

   *At least two of the children who are autistic live in trailers in the front of the property where backyards are not contaminated. In addition, no toxicological or epidemiological data support a link between PAH exposure and autism. The third child no longer lives in the trailer court, and it is unknown where the child lived in the Trailer Court or how long the child lived on the property.*

## CONCLUSIONS

Surface soil samples taken around the properties together called East Shore Trailer Park show the presence of elevated levels of PAHs, TPHs, and arsenic. In the southern end of the trailer court, surface soil samples exceed very conservative health-based comparison values that were developed to be protective of frequent, long-term contact with soil by young children and adults. However, most of the areas in the southern end of the trailer court are covered with grass which provides a protection barrier from direct contact with soil.

Surface soil samples from the southern end of the 483 and 497 E. Main Street properties exceeded CT RSRs for some PAHs, arsenic, and TPHs. Contamination levels in the 483 and 497 E. Main Street properties are higher than in the trailer court. The southern end of these properties are only partially covered by grass, but access to these properties by trailer court residents is limited by a fence that encloses the trailer court property.

Subsurface soil samples taken around the properties that comprise the East Shore Trailer Park also show the presence of elevated levels of PAHs and TPHs. Subsurface soils in the northern portion of the 6-12 Business Park Drive property have the highest levels of PAHs. Visual

observations of soils in test pits in this area indicate that soils have a black, tar-like appearance. CTDPH did not assess doses and risks from exposure to subsurface soils because it was not considered to be a complete exposure pathway.

CTDPH evaluated exposure doses and public health implications from exposure to PAHs, arsenic, and TPHs in surface soils using realistic exposure assumptions for the trailer court and the 483 and 497 E. Main Street properties. Exposures and risks from surface soils at the 6-12 Business Park Drive Property were not evaluated quantitatively because no data representative of surface soils from this area exist.

For the trailer court and the 483 and 497 E. Main Street properties, CTDPH concludes that exposures are not likely to pose a noncancer health threat. CTDPH also calculated theoretical cancer risks from exposure to contaminants at the site. Cancer risks from the trailer court and the 483 and 497 E. Main Street properties do not present a significant risk above background. In addition, doses from the properties are well below levels observed to cause cancer and noncancer effects in scientific literature studies. Therefore, CTDPH considers it to be unlikely that people have become sick from the soil contamination.

Even though CTDPH has concluded that the site is not likely to cause illness, CTDPH's evaluation strongly indicates the need for environmental cleanup. At the trailer court property, theoretical cancer risks are within the range that would prompt environmental agencies to consider cleanup actions to reduce exposure. In addition, a large degree of uncertainty exists in the risk calculations because of the small number surface soil samples collected from the trailer court (only 6 samples were taken). This uncertainty supports the idea that cleanup of soils is a prudent course of action. Furthermore, the soil concentrations seen in the trailer court exceeded cleanup levels (CT RSRs), further justifying the need for remediation.

The need for environmental cleanup is indicated at the 483 and 497 E. Main Street properties as well. Although the analysis shows that theoretical risks to a youth trespasser are not a concern, exposures to a young child in a residential exposure scenario would be much higher and could be a concern in the future. If the 483 and 497 E. Main Street properties are not cleaned up, they could pose a public health hazard to young children who may live at these properties in the future.

A permanent cleanup must be protective of residential exposures. This suggests that cleanup of soils at the 483 and 497 E. Main Street properties is a prudent course of action for the long term. Furthermore, the soil concentrations seen in the 483 and 497 E. Main Street properties exceeded cleanup levels (CT RSRs), further justifying the need for remediation.

For the 6-12 Business Park Drive property, a qualitative assessment of PAHs indicates that exposures and risks are unlikely to be greater than those estimated for the 483 and 497 E. Main Street properties and therefore are unlikely to pose a public health threat. However, like the 483 and 497 E. Main Street Properties, 6-12 Business Park Drive has PAHs present in soils that exceed cleanup levels (CT RSRs). Development of this parcel should minimize exposures to

contaminated soils during construction and prevent contact with contaminated soils after construction is complete and the parcel is used by office workers.

ATSDR has a categorization scheme whereby the level of public health hazard at a site is assigned to one of five conclusion categories (Appendix F). CTDPH has concluded that surface soils at the southern end of the 483 and 497 E. Main Street properties as well as the Shoreline Trailer Court present no apparent public health hazard under current conditions. Even though no apparent health threat exists under current conditions, CTDPH has concluded that environmental cleanup is needed because contaminant concentrations exceed CT residential soil cleanup standards (CT RSRs) and future exposures should be prevented. For these reasons, ATSDR and CTDPH also categorize the site as a future public health hazard.

RECOMMENDATIONS

1. CTDPH recommends that the trailer court owners continue to maintain the grass in the Trailer Court. In addition, the mulch cover should be maintained in areas where grass is not present. Grass should also be watered as needed to prevent the creation of dry, dusty conditions.

2. CTDPH recommends that the southern area of the trailer court as well as the 483 and 497 E. Main Street properties be remediated by CTDEP or EPA to prevent further exposure.

3. CTDPH recommends no digging and only raised-bed gardening in the southern end of the trailer court as well as the backyards of the 483 and 497 E. Main Street properties because contamination exists for several feet below surface.

4. CTDPH recommends that CTDEP continue to take actions in coordination with the property owners at the 6-12 Business Drive construction site to ensure that exposure to surface and subsurface soil is minimized during the construction activities and prevented after construction is complete and the parcel is used by office workers.

## PUBLIC HEALTH ACTION PLAN

*Actions Taken*

1. CTDPH participated in door-to-door visits to residents of the trailer court to inform them of the soil contamination and provide health information specific to the soil contamination. In addition, CTDPH has met with the owners of the 483 and 497 E. Main Street properties, the trailer court manager, and town leaders to inform them of the contamination to provide health-specific information relative to the site. CTDPH has distributed a fact sheet to the owners of the properties as well as the trailer court residents concerning exposure and health impacts from exposure related to soil contamination on the properties as well as measures to minimize soil exposure (Appendix E).

2. CTDPH participated in one public availability session with CTDEP and ESHD in October 2003 to provide information to the residents about exposure and health impacts related to soil contamination on the properties.

3. CTDPH provided assistance to the ESHD in responding to health questions and concerns from the residents of the properties.

*Actions Planned*

1. CTDPH will make this health consultation available to residents and property owners of the site.

2. CTDPH will hold a public availability session with CT DEP when this health consultation is released. During the public availability session, CTDPH will describe the actions that residents of these properties need to take to reduce their exposure. These actions include maintaining grass or mulch cover, gardening in raised beds, and avoiding digging.

3. CTDPH will continue to participate in public meetings regarding contamination at the East Shore Trailer Park site.

4. CTDPH will continue to work with CTDEP and ESHD to respond to health questions and concerns regarding hazardous contaminants at the East Shore Trailer Park Site.

5. CTDPH will review any addition data for this site and update this health consultation, if necessary.

## REFERENCES

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## CERTIFICATION

The Health Consultation for the Evaluation of Soil Data in East Shore Trailer Park in Branford, Connecticut was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated.

Gregory V. Ulirsch
Technical Project Officer
Superfund Site Assessment Program (SSAB)
Division of Health Assessment and Consultation (DHAC)
Agency for Toxic Substances and Disease Registry (ATSDR)

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

for RE

Roberta Erlwein
Chief, CAT, SSAB, DHAC, ATSDR

**Appendix A. Aerial Photo of East Shore Trailer Park Site (1990)**

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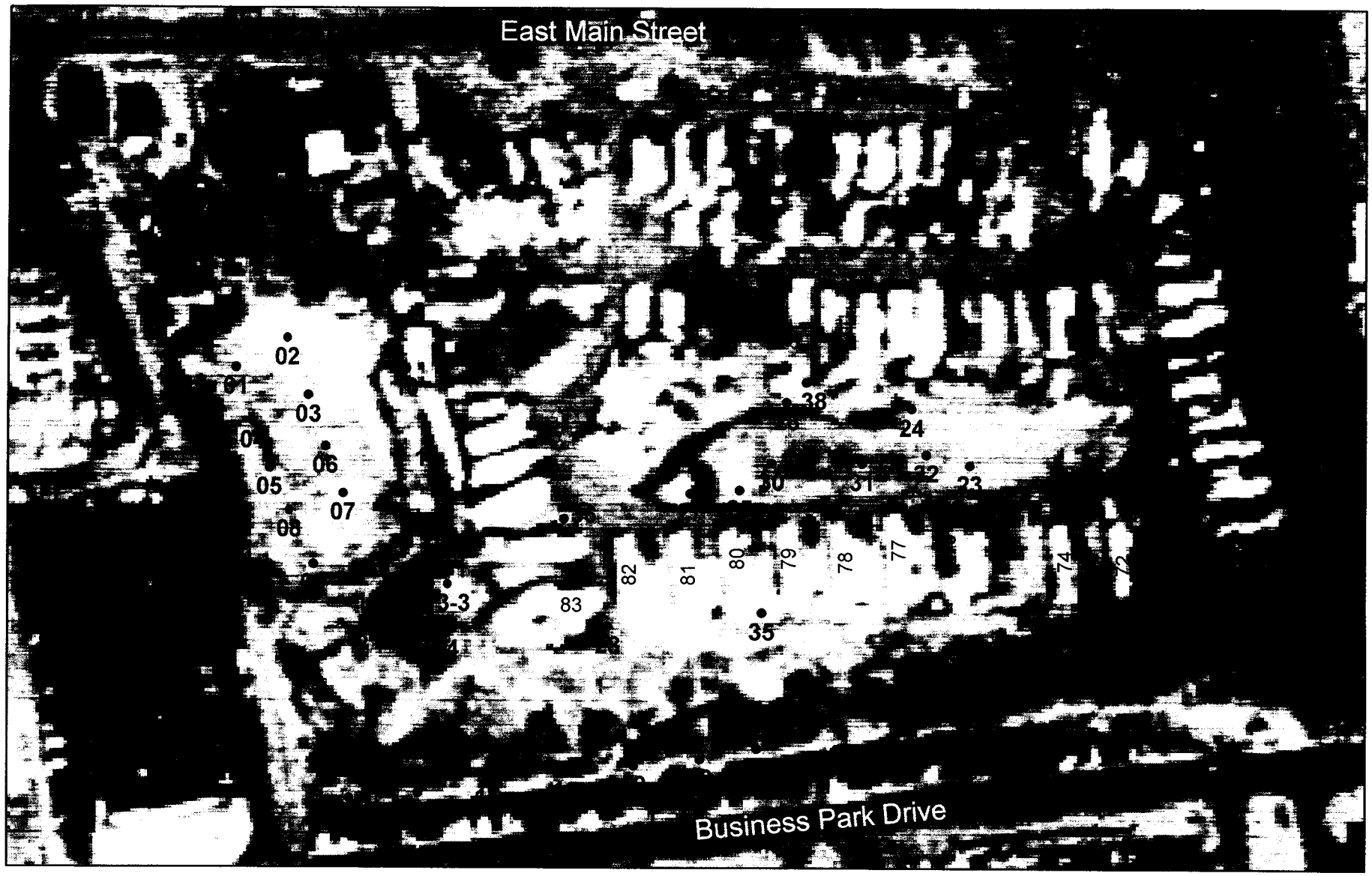
# Sampling Conducted at 509-545 East Main Street and Surrounding Properties, Branford




Soil samples collected July 22 - 23, 2003 (red) and October 20 - 21, 2003 (purple) by the Connecticut Department of Environmental Protection. Locations correspond to geoprobe, surface sample, and groundwater locations on attached tables. Sample locations from 7/2003 have been geolocated using GPS. Sample locations from 10/2003 are approximate. Source: CTDEP & USGS Aerial Photograph, Branford Quadrangle SE 1990. Map is for illustrative purposes only. Data may not be complete or current. Prepared by K. Lundeen (DEP), printed 5/10/2004.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

# POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

Agency for Toxic Substances and Disease Registry ToxFAQs September 1996

**This fact sheet answers the most frequently asked health questions (FAQs) about polycyclic aromatic hydrocarbons (PAHs). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. This information is important because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.**

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

## What are polycyclic aromatic hydrocarbons?

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

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

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

## What happens to PAHs when they enter the environment?

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

## How might I be exposed to PAHs?

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

- Nursing infants of mothers living near hazardous waste sites may be exposed to PAHs through their mother's milk.

## How can PAHs affect my health?

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

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

## How likely are PAHs to cause cancer?

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

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

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

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

## Has the federal government made recommendations to protect human health?

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

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

## Glossary

Carcinogen: A substance that can cause cancer.

Ingest: Take food or drink into your body.

## References

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

**Where can I get more information?** For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

# TOTAL PETROLEUM HYDROCARBONS (TPH)



**This fact sheet answers the most frequently asked health questions (FAQs) about total petroleum hydrocarbons (TPH). For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.**

**HIGHLIGHTS: TPH is a mixture of many different compounds. Everyone is exposed to TPH from many sources, including gasoline pumps, spilled oil on pavement, and chemicals used at home or work. Some TPH compounds can affect your nervous system, causing headaches and dizziness. TPH has been found in at least 23 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).**

## What are total petroleum hydrocarbons?

(Pronounced tōt'l pə-trō'lē-əm hī'drə-kär'bənz)

Total petroleum hydrocarbons (TPH) is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil. Crude oil is used to make petroleum products, which can contaminate the environment. Because there are so many different chemicals in crude oil and in other petroleum products, it is not practical to measure each one separately. However, it is useful to measure the total amount of TPH at a site.

TPH is a mixture of chemicals, but they are all made mainly from hydrogen and carbon, called hydrocarbons. Scientists divide TPH into groups of petroleum hydrocarbons that act alike in soil or water. These groups are called petroleum hydrocarbon fractions. Each fraction contains many individual chemicals.

Some chemicals that may be found in TPH are hexane, jet fuels, mineral oils, benzene, toluene, xylenes, naphthalene, and fluorene, as well as other petroleum products and gasoline components. However, it is likely that samples of TPH will contain only some, or a mixture, of these chemicals.

## What happens to TPH when it enters the environment?

- ❑ TPH may enter the environment through accidents, from industrial releases, or as byproducts from commercial or private uses.
- ❑ TPH may be released directly into water through spills or leaks.
- ❑ Some TPH fractions will float on the water and form surface films.
- ❑ Other TPH fractions will sink to the bottom sediments.
- ❑ Bacteria and microorganisms in the water may break down some of the TPH fractions.
- ❑ Some TPH fractions will move into the soil where they may stay for a long time.

## How might I be exposed to TPH?

- ❑ Everyone is exposed to TPH from many sources.
- ❑ Breathing air at gasoline stations, using chemicals at home or work, or using certain pesticides.
- ❑ Drinking water contaminated with TPH.
- ❑ Working in occupations that use petroleum products.
- ❑ Living in an area near a spill or leak of petroleum products.
- ❑ Touching soil contaminated with TPH.

## How can TPH affect my health?

Some of the TPH compounds can affect your central nervous system. One compound can cause headaches and dizziness at high levels in the air. Another compound can cause a nerve disorder called "peripheral neuropathy," consisting of numbness in the feet and legs. Other TPH compounds can cause effects on the blood, immune system, lungs, skin, and eyes.

Animal studies have shown effects on the lungs, central nervous system, liver, and kidney from exposure to TPH compounds. Some TPH compounds have also been shown to affect reproduction and the developing fetus in animals.

## How likely is TPH to cause cancer?

The International Agency for Research on Cancer (IARC) has determined that one TPH compound (benzene) is carcinogenic to humans. IARC has determined that other TPH compounds (benzo[a]pyrene and gasoline) are probably and possibly carcinogenic to humans. Most of the other TPH compounds are considered not to be classifiable by IARC.

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

There is no medical test that shows if you have been exposed to TPH. However, there are methods to determine if you have been exposed to some TPH compounds. Exposure to kerosene can be determined by its smell on the breath or clothing. Benzene can be measured in exhaled air and a breakdown product of benzene can be measured in urine. Other TPH compounds can be measured in blood, urine, breath, and some body tissues.

## Has the federal government made recommendations to protect human health?

There are no regulations or advisories specific to TPH. The following are recommendations for some of the TPH fractions and compounds:

The EPA requires that spills or accidental releases into the environment of 10 pounds or more of benzene be reported to the EPA.

The Occupational Safety and Health Administration has set an exposure limit of 500 parts of petroleum distillates per million parts of air (500 ppm) for an 8-hour workday, 40-hour workweek.

## Glossary

Carcinogenicity: Ability to cause cancer.

CAS: Chemical Abstracts Service.

Immune system: Body organs and cells that fight disease.

Pesticides: Chemicals used to kill pests.

## References

Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for total petroleum hydrocarbons (TPH). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

**Where can I get more information?** For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs Internet address via WWW is http://www.atsdr.cdc.gov/toxfaq.html ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Appendix C
PAH, TPH and Arsenic Fact Sheets

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

# ARSENIC
## CAS # 7440-38-2

Division of Toxicology ToxFAQs™ December 2003

**This fact sheet answers the most frequently asked health questions (FAQs) about arsenic. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.**

**HIGHLIGHTS: Exposure to higher than average levels of arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. At high levels, inorganic arsenic can cause death. Exposure to lower levels for a long time can cause a discoloration of the skin and the appearance of small corns or warts. Arsenic has been found at 1,014 of the 1,598 National Priority List sites identified by the Environmental Protection Agency (EPA).**

### What is arsenic?

Arsenic is a naturally occurring element widely distributed in the earth's crust. In the environment, arsenic is combined with oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Arsenic in animals and plants combines with carbon and hydrogen to form organic arsenic compounds.

Inorganic arsenic compounds are mainly used to preserve wood. Organic arsenic compounds are used as pesticides, primarily on cotton plants.

### What happens to arsenic when it enters the environment?

- ❑ Arsenic cannot be destroyed in the environment. It can only change its form.
- ❑ Arsenic in air will settle to the ground or is washed out of the air by rain.
- ❑ Many arsenic compounds can dissolve in water.
- ❑ Fish and shellfish can accumulate arsenic, but the arsenic in fish is mostly in a form that is not harmful.

### How might I be exposed to arsenic?

- ❑ Eating food, drinking water, or breathing air containing arsenic.
- ❑ Breathing contaminated workplace air.
- ❑ Breathing sawdust or burning smoke from wood treated with arsenic.
- ❑ Living near uncontrolled hazardous waste sites containing arsenic.
- ❑ Living in areas with unusually high natural levels of arsenic in rock.

### How can arsenic affect my health?

Breathing high levels of inorganic arsenic can give you a sore throat or irritated lungs. Ingesting high levels of inorganic arsenic can result in death. Lower levels of arsenic can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, damage to blood vessels, and a sensation of "pins and needles" in hands and feet.

Ingesting or breathing low levels of inorganic arsenic for a long time can cause a darkening of the skin and the

appearance of small "corns" or "warts" on the palms, soles, and torso.

Skin contact with inorganic arsenic may cause redness and swelling.

Organic arsenic compounds are less toxic than inorganic arsenic compounds. Exposure to high levels of some organic arsenic compounds may cause similar effects as inorganic arsenic.

## How likely is arsenic to cause cancer?

Several studies have shown that inorganic arsenic can increase the risk of lung cancer, skin cancer, bladder cancer, liver cancer, kidney cancer, and prostate cancer. The World Health Organization (WHO), the Department of Health and Human Services (DHHS), and the EPA have determined that inorganic arsenic is a human carcinogen.

## How can arsenic affect children?

We do not know if exposure to arsenic will result in birth defects or other developmental effects in people. Birth defects have been observed in animals exposed to inorganic arsenic.

It is likely that health effects seen in children exposed to high amounts of arsenic will be similar to the effects seen in adults.

## How can families reduce the risk of exposure to arsenic?

❑ If you use arsenic-treated wood in home projects, you should wear dust masks, gloves, and protective clothing to decrease exposure to sawdust.
❑ If you live in an area with high levels of arsenic in water or soil, you should use cleaner sources of water and limit contact with soil.

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

There are tests to measure the level of arsenic in blood, urine, hair, or fingernails. The urine test is the most reliable test for arsenic exposure within the last few days. Tests on hair and fingernails can measure exposure to high levels or arsenic over the past 6-12 months. These tests can determine if you have been exposed to above-average levels of arsenic. They cannot predict how the arsenic levels in your body will affect your health.

## Has the federal government made recommendations to protect human health?

EPA has set limits on the amount of arsenic that industrial sources can release to the environment and has restricted or canceled many uses of arsenic in pesticides. EPA has set a limit of 0.01 parts per million (ppm) for arsenic in drinking water.

The Occupational Safety and Health Administration has set limits of 10 µg arsenic per cubic meter of workplace air (10 µg/m$^3$) for 8 hour shifts and 40 hour work weeks.

## Source of Information

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological Profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

**Where can I get more information?** For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Appendix B
Site Photo With Soil Sampling Location

Appendix D. Risk Calculations

Shoreline Trailer Court
Branford, Connecticut

**A. Noncancer risks, child aged 1-6 years**
**1a. Ingestion Dose-PAHS**
In this calculation, we are estimating the average daily dose of PAHs a child, aged 1-6 years, would receive from via ingestion of soil.

$ADD_i = Ir_c$ * [Soil]*$EF_1$*ED*C1*C2*C3*$EF_2$*1/$BW_c$*1/$AT_{nc}$
$ADD_i$=100 mg/d*103.66 mg/kg*275d/y*6 yr*7 days/week *1 week/7 days*$10^{-6}$ kg/mg* y/365d *1/16kg*1/6 yr
**=4.88 E-4 mg/kg/day**

**2a. Dermal Dose-PAHs**
In this calculation, we are estimating the average daily dose of PAHs a child, aged 1-6 years, would receive from dermal exposure to soil.

$ADD_d$=[Soil]*AF*$ABS_d$*SA*$EF_1$*ED*F*C1*C2*C3*$EF_2$*1/$BW_c$*1/$AT_{nc}$
$ADD_d$=103.66 mg/kg*0.2 mg/$cm^2$/-ev*0.13*3307$cm^2$*7 days/week *1 week/7 days *275d/y* 6 yr*1ev/d*$10^{-6}$ kg/mg*y/365d*1/16kg*1/6yr
**=4.20E-4 mg/kg/day**

**3a. Noncancer Hazard Index-PAHs**
*HI= ($ADD_i$ + $ADD_d$)/RfD*
HI=(4.89E-4 mg/kg/day + 4.20 E-4 mg/kg/day)/0.02 mg/kg/day
HI=0.045

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

***B. Cancer Risks, child/adult age 1-30***
***1b. Ingestion Dose-PAHs***
In this calculation, we are estimating the average daily dose of PAHs a child/adult, age 1-30 years would receive during ingestion of soil.

*$LADD_c$=$IR_c$*[Soil]*$EF_1$*$EF_2$*ED*C1*C2*C3*1/$BW_c$*1/$AT_c$*
*$LADD_c$=100 mg/d *32.2 mg/kg * 275 d/yr *6 yr*$10^{-6}$ kg/mg*yr/365d*7 days/week *1 week/7 days *1/16 kg*1/70 yr*
***=1.30E-5mg/kg/day***

*$LADD_a$=$IR_a$*[Soil]*$EF_1$*$EF_2$*ED*C1*C2*C3*1/$BW_a$*1/$AT_c$*
*$LADD_a$= 50 mg/d *32.2 mg/kg * 275 d/yr *24 yr*$10^{-6}$ kg/mg*yr/365d*7 days/week *1 week/7 days *1/70 kg*1/70 yr*
***= 5.94E-6 mg/kg/day***

***Dermal Dose-PAHs (Child/Adult 1-30 Years)***

*$LADDD_c$=[Soil]*AF*$ABS_d$*SA*$EF_1$*$EF_2$*ED*F*C1*C2*C3*1/$BW_c$*1/$AT_c$*
*$LADDD_c$=32.2 mg/kg*0.2 mg/$cm^2$/-ev*0.13*3307$cm^2$*275d/y*7 days/week *1 week/7 days *6yr* 1 ev/d*$10^{-6}$ kg/mg*y/365d*1/16 kg*1/70 yr*
***=1.12E-5mg/kg/day***

*$LADDD_a$=[Soil]*AF*$ABS_d$*SA*$EF_1$*$EF_2$*ED*F*C1*C2*C3*1/$BW_a$*1/$AT_c$*
*$LADDD_a$=32.2 mg/kg*0.07 mg/$cm^2$/-ev*0.13*10,695$cm^2$*275d/y*7 days/week *1 week/7 days *24yr* 1 ev/d*$10^{-6}$ kg/mg*y/365d*1/70 kg*1/70 yr*
***= 1.16E-5 mg/kg/day***

***2b. Cancer Risk-PAHs***
*ELCR=($LADD_c$ + $LADD_a$ +$LADDD_c$ + $LADDD_a$)*CSF*
*ELCR=(1.30E-5 + 5.94E-6+1.12E-5 + 1.16E-5)*7.3 $(mg/kg/day)^{-1}$*
***ELCR=3.05E-4***

The Estimated Lifetime Risk for PAHs is 3 E-4 (3 in 10,000). This means that if 10,000 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 3 cancers above the number of cancers that would normally be expected to occur in the population of 10,000. Background rates of cancer in the U.S. are one in 2 or 3 (NCI 2001). This means that in a population of 10,000 background numbers of cancer cases would be approximately 3300 to 5000. PAHs exposure could result in a theoretical increase of 3 cancer cases above the background number of 3300 to 5000 cancer cases. This represents minimal increased cancer risk.

***483 and 497 E. Main Street Properties***

**A. Noncancer risks, trespasser, aged 13-18 years**
**1a. Ingestion Dose-PAHS**
In this calculation, we are estimating the average daily dose of PAHs a trespasser, aged 13-18 years, would receive from via ingestion of soil.

$ADD_i$=$Ir_a$ [Soil]*$EF_1$ *$EF_2$*ED*C1*C2*C3*1/$BW_t$*1/$AT_{nc}$
$ADD_i$=50 mg/d*63.3 mg/kg*275d/y*6 yr*2 days/week*1 week/7 days*$10^{-6}$ kg/mg* y/365d *1/60kg*1/6 yr
**= 1.1 E-5 mg/kg/day**

**2a. Dermal Dose-PAHs**
In this calculation, we are estimating the average daily dose of PAHs a trespasser, age 13-18 years, would receive from dermal exposure to soil.

$ADD_d$=[Soil]*AF*$ABS_d$*SA*$EF_1$*$EF_2$*ED*F*C1*C2*C3*1/$BW_t$*1/$AT_{nc}$
$ADD_d$=63.3 mg/kg*0.01 mg/$cm^2$/-ev*0.13*9697$cm^2$*2 days/week*1 week/7 days *275d/y*6 yr*1ev/d*$10^{-6}$ kg/mg*y/365d*1/60kg*1/6yr
**= 2.86 E-6 mg/kg/day**

**3a. Noncancer Hazard Index-PAHs**
*HI= ($ADD_i$ + $ADD_d$)/RfD*
HI=(1.1E-5 mg/kg/day + 2.86 E-6 mg/kg/day)/0.02 mg/kg/day
HI=0.000693

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

***B. Cancer Risks, trespasser, aged 13-18***
***1b. Ingestion Dose-PAHs***
In this calculation, we are estimating the average daily dose of PAHs a trespasser, age 13-18 years would receive during ingestion of soil.

*$LADD_t$=$IR_a$*[Soil]*$EF_1$*$EF_2$*ED*C1*C2*C3*1/$BW_t$*1/$AT_c$*
*$LADD_t$= 50 mg/d *19.13 mg/kg * 275 d/yr *6 yr*$10^{-6}$ kg/mg*yr/365d*2 days/week*1 week/7 days *1/60 kg*1/70 yr*
***= 2.94 E-7mg/kg/day***

***2b. Dermal Dose-PAHs***

*$LADDD_t$=[Soil]*AF*$ABS_d$*SA*$EF_1$*$EF_2$*ED*F*C1*C2*C3*1/$BW_t$*1/$AT_c$*
*$LADDD_t$=19.13 mg/kg*0.01 mg/$cm^2$/-ev*0.13*9697$cm^2$*275d/y*2 days/week*1 week/7 days *6yr* 1 ev/d*$10^{-6}$ kg/mg*y/365d*1/60 kg*1/70 yr*
***= 7.41 E-8 mg/kg/day***

***3b. Cancer Risk-PAHs***
*ELCR=($LADD_t$ + $LADDD_t$)*CSF*
*ELCR=(2.94 E-7 + 7.41 E-8)*7.3 (mg/kg/day)$^{-1}$*
***ELCR= 2.68 E-6***

The Estimated Lifetime Risk for PAHs is 3 E-6 (4 in 1,000,000). This means that if 1,000,000 people were exposed to PAHs in soil at the concentration, frequency, and duration of exposure assumed in the calculation detailed above, there would be a theoretical increase of 3 cancers above the number of cancers that would normally be expected to occur in the population of 1,000,000. Background rates of cancer in the U.S. are one in 2 or 3 (NCI, 2001). This means that in a population of 1,000,000, background numbers of cancer cases would be approximately 330,00 to 500,000. PAH exposure could result in a theoretical increase of 4.47 cancer cases above the background number of 330,000 to 500,000 cancer cases. This represents a very minimal increased cancer risk above background.

***C. Noncancer risks, trespasser, aged 13-18 years***

***1c. Ingestion Dose-Arsenic***

In this calculation, we are estimating the average daily dose of a trespasser, age 13-18 years would receive from incidental ingestion of soil.

$ADD_i = Ir_a\ [Soil] * EF_1 * EF_2 * ED * C1 * C2 * C3 * 1/BW_t * 1/AT_{nc}$

*$ADD_i$=50 mg/d*11.18 mg/kg*275d/y*6yr*2 days/week*1 week/7 days *$10^{-6}$ kg/mg*y/365d*1/60kg*1/6 yr*

***=2.0E-6 mg/kg/day***

***2c. Dermal Dose-Arsenic***

In this calculation, we are estimating the average daily dose of arsenic a trespasser, age 13-18 years, would receive through dermal contact.

*$ADD_d$=[Soil]*AF*$ABS_d$*SA*$EF_1$*$EF_2$*ED*F*C1*C2*C3*1/$BW_t$*1/$AT_{nc}$*

*$ADD_d$ =11.18 mg/kg*0.01 mg/$cm^2$/-ev*0.03*9697$cm^2$*275d/y*2 days/week*1 week/7 days *6 yr* 1 ev/d*$10^{-6}$ kg/mg*y/365d*1/16kg*1/6 yr*

***= 4.38E-7 mg/kg/day***

***3c. Noncancer Hazard Index-Arsenic***

*HI= ($ADD_i$ + $ADD_d$)/RfD*

*HI= (2.0E-6 + 4.38E-7)/3.4E-4*

***HI= 0.0072***

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

***D. Cancer Risks, trespasser, aged 13-18 years***

***1d. Ingestion Dose-Arsenic***

In this calculation, we are estimating the lifetime average daily dose of arsenic a trespasser, age 13-18 years would receive from ingestion of soil

$LADD_t = IR_c * [Soil] * EF_1 * EF_2 * ED * C1 * C2 * C3 * 1/BW_t * 1/AT_c$
$LADD_t = 50\ mg/d * 11.18\ mg/kg * 275d/y * 6yr * 10^{-6}\ mg/kg * y/365\ d * 2\ days/week * 1\ week/7\ days * 1/60\ kg * 1/70yr$
**$= 1.72E\text{-}7\ mg/kg/day$**

***2d. Dermal Risk-Arsenic***

In this calculation, we are estimating the average daily dose of arsenic a trespasser, aged 13-18 years would receive from dermal contact.

$LADDD_t = [Soil] * AF * ABS_d * SA * EF_1 * EF_2 * ED * F * C1 * C2 * C3 * 1/BW_t * 1/AT_c$
$LADDD_t = 11.18\ mg/kg * 0.01\ mg/cm^2\text{-}ev * 0.03 * 9697cm^2 * 275d/y * 2\ days/week * 1\ week/7\ days * 6yr * 1\ ev/d * 10^{-6}\ kg/mg * y/365d * 1/60\ kg * 1/70\ yr$
**$= 1E\text{-}8\ mg/kg/day$**

***3d. Cancer Risk-Arsenic***

$ELCR = (LADD_t + LADDD_t) * CSF$
$ELCR = (1.72E\text{-}7 + 1E\text{-}8) * 1.5\ (mg/kg/day)^{-1}$
**$ELCR = 2.73E\text{-}7$**

The Estimated Lifetime Risk for arsenic is 3 E-7 (3 in 10,000,000). This means that if 10,000,000 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 3 cancers above the number of cancers that would normally be expected to occur in the population of 10,000,000. Background rates of cancer in the U.S. are one in 2 or 3 (NCI 2001). This means that in a population of 10,000,000, background numbers of cancer cases would be approximately 3,300,000 to 5,000,000. Arsenic exposure could result in a theoretical increase of 3 cancer cases above the background number of 3,300,000 to 5,000,000 cancer cases. This represents an insignificant increased cancer risk. .

WHERE:

| | | |
|---|---|---|
| $ADD_i$ | = | average daily dose from ingestion |
| $ADD_d$ | = | average daily dose from dermal contact |
| $LADD_c$ | = | lifetime average daily dose from ingestion for child, aged 1-6 years |
| $LADD_t$ | = | lifetime average daily dose from ingestion for trespasser, aged 13-18 years |
| $LADD_a$ | = | lifetime average daily dose from ingestion for adult, aged 7-30 years |
| $LADDD_a$ | = | lifetime average dermal daily dose for child, aged 1-6 years |
| $LADDD_c$ | = | lifetime average dermal daily dose for adult, aged 7-30 years |
| $LADDD_t$ | = | lifetime average dermal daily dose for trespasser, aged 13-18 years |
| $IR_c$ | = | soil ingestion rate for a child; 100 mg/day (EPA 1997)* |
| $IR_a$ | = | soil ingestion rate for an adult; 50 mg/day (EPA 1997)* |
| AF | = | skin-soil adherence factor for default residential child; 0.2 $mg/cm^2$-ev; default residential adult; 0.07 $mg/cm^2$-ev. trespasser teenager; 0.01 $mg/cm^2$-ev. (EPA 2001b) |
| $ABS_d$ | = | Soil dermal absorption fraction |

Arsenic: 0.03 (EPA 2001b), PAHs: 0.13 (EPA 2001b)

SA = Skin surface area, 50th %ile legs, feet, hands, and arms, child aged 1-6; 3307 $cm^2$ (EPA 1997), legs, arms, hands, and feet, trespasser teenager age 13-18; 9697 $cm^2$, adult; 10,695 $cm^2$ (EPA 2001b)

[Soil] = soil concentration; Shoreline Trailer Court: PAHs (noncancer calculation): 103.66 mg/kg (Total 95% UCL for all PAHs) PAHs (cancer calculation): 32.2 mg/kg (Total TEF-adjusted 95% UCL for all PAHs); 483 and 497 E. Main St. Properties: Arsenic: 11.18 mg/kg (95% Upper Confidence Limit of the arithmetic mean), PAHs (noncancer calculation): 139.34 mg/kg (Total 95% UCL for all PAHs) PAHs (cancer calculation): 31.83 mg/kg (Total TEF-adjusted 95% UCL for all PAHs)

$EF_1$ = exposure frequency; 275 days/year

$EF_2$ = exposure frequency, 7 days/week, resident; 2 days/week, trespasser

F = event frequency, 1 ev/day

ED = exposure duration; 6 years for child, 24 years for adult, 6 years for trespasser

C1 = conversion factor; $10^{-6}$ kg/mg

C2 = conversion factor; 1 year/365 days

C3 = conversion factor, 1 week/7 days

$Bw_c$ = child 50th %tile body weight for age 1-6 yrs (EPA 1997); 16 kg

$Bw_a$ = adult 50th %tile body weight (EPA 1997); 70 kg

$Bw_t$ = teenager body weight, 13-18 years (EPA 1997); 60kg

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

$AT_c$ = averaging time for cancer risk; 70 years

$AT_{ac}$ = average time for noncancer risk; 7 days

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

CSF = Cancer Slope Factor
Arsenic: 1.5 $(mg/kg/day)^{-1}$ (IRIS)
PAHs: benzo(a)pyrene; 7.3 (mg/kg/day)-1 (IRIS)

HI = Hazard Index

CSF = Cancer Slope Factor

** EPA (1997) recommends using soil ingestion rates of 100 mg/day for child < 6 years and 50 mg/day a child/adult ⊃6 years. EPA states that these values represent best estimates of average soil ingestion rates. EPA programs have used 200 mg/day and 100 mg/day as conservative estimates of average soil intake rates. CTDPH 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 the Trailer Court, 483 and 497 E. Main Street 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.*

Appendix D: Table 1. Values Used to Calculate PAH Concentrations for Cancer and Noncancer Risk Calculations for the Shoreline Trailer Court

| PAH | 95% UCL (ppm) | Toxic Equivalency Factor (TEF) | TEF Adjusted Concentration (ppm) |
|---|---|---|---|
| Benzo(a)anthracene | 36.75 | 0.145 | 5.33 |
| Benzo(a)pyrene | 19.62 | 1 | 19.62 |
| Benzo(b)fluoranthene | 19.60 | 0.167 | 3.27 |
| Benzo(k)fluoranthene | 12.77 | 0.020 | 0.256 |
| Dibenzo(a,h)anthracene | 2.77 | 1.11 | 3.07 |
| Indeno(1,2,3-cd)pyrene | 12.15 | 0.055 | 0.67 |
| Total of 95% UCLs | 103.66 | --- | 32.2 |

Appendix D:Table 2. Values Used to Calculate PAH Concentrations for Cancer and Noncancer Risk Calculations for the 483 and 497 E. Main Street Properties

| PAH | 95% UCL (ppm) | Toxic Equivalency Factor (TEF) | TEF Adjusted Concentration (ppm) |
|---|---|---|---|
| Benzo(a)anthracene | 21.81 | 0.145 | 3.16 |
| Benzo(a)pyrene | 11.22 | 1 | 11.22 |
| Benzo(b)fluoranthene | 14.19 | 0.167 | 2.37 |
| Benzo(k)fluoranthene | 6.72 | 0.020 | 0.13 |
| Dibenzo(a,h)anthracene | 1.65 | 1.11 | 1.83 |
| Indeno(1,2,3-cd)pyrene | 7.71 | 0.055 | 0.42 |
| Total of 95% UCLs | 63.3 | --- | 19.13 |

**Appendix E**
**What Can I Do to Reduce my Exposure to Soil in My Yard?**
Fact Sheet

# 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 two main ways you could be exposed to chemicals in soil in your yard:

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

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

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

- **Discourage children from playing in bare soil if possible**, and make sure they wash their hands after playing outside, especially before eating.
- Bare soil areas underneath play equipment can be covered with mulch or clean topsoil.
- Wash toys before bringing them into the house, or leave them outside.
- Pets can bring dirt inside on their paws or fur. Try to keep pets clean.
- Clean up dirt that is tracked into the house. Wet cleaning is recommended, but vacuuming is ok. Try to avoid sweeping.
- Consider using raised beds with fresh soil for gardening.

### For More Information

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## What are the chemicals that DEP sampled for?

DEP analyzed soil samples for a wide variety of chemicals. There are three main chemicals that DEP has found at elevated levels in some areas. These chemicals are total petroleum hydrocarbons (TPHs), arsenic, and polycyclic aromatic hydrocarbons (PAHs).

### PAHs:

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

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

### 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.

### Total Petroleum Hydrocarbons (TPH):

TPH's are a large group of compounds that originally come from crude oil and the products made from it. Since TPH's can come in a variety of forms and concentrations, it is very difficult to describe health effects. At high levels, some compounds can affect the central nervous system, some can cause fatigue, headache nausea and drowsiness. Usually, if someone's exposure is eliminated, adverse effects also go away. However, some chronic exposures to high levels of TPH's can result in permanent health effects which include central nervous system damage, cancer, or birth defects.