Health Consultation

FORMER CHARLES A. BELL SCHOOL

CHATTANOOGA, HAMILTON COUNTY, TENNESSEE

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

Health Consultation: 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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Foreword

This document summarizes an environmental public health investigation performed by Environmental Epidemiology of the State of Tennessee Department of Health. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature. Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be actions items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Environmental Epidemiology
Tennessee Department of Health
1st Floor Cordell Hull Building
425 5th Avenue North
Nashville TN 37243

Or call us at: 615-741-7247 or toll-free 1-800-404-3006 during normal business hours

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Introduction

Troy Keith with the Tennessee Department of Environment and Conservation (TDEC), Division of Remediation (DoR) contacted the Tennessee Department of Health (TDH), Environmental Epidemiology Program (EEP) about the construction of a second recreational center in South Chattanooga as proposed by the Chattanooga-Hamilton County Regional Planning Agency (CHCRPA). Their plan is for two football/soccer fields and one playground to be built at the former location of the Charles A. Bell School (Figures 1 and 2). With this recreational center in mind, EEP has been involved with meetings, discussions, and planning with stakeholders. EEP was supplied environmental soil sampling data to review and were asked to provide recommendations as to whether or not a recreational center could safely be built at this site. The purpose of this health consultation is to document this review and the associated findings.

Background

The site of the former Charles A. Bell School has been identified as a potential brownfield site. A brownfield site is a property in which the expansion, redevelopment, or reuse is not possible because the area may be contaminated with a substance that is harmful to human health. To be able to reuse such property, the U.S. Environmental Protection Agency (EPA) developed the Brownfield Program in 1995 which allows interested parties to apply for money to clean up the contaminated area so that it is safe for community members to use (EPA 2007a).

The site of the former Charles A. Bell School is in the southern region of Chattanooga, Hamilton County, Tennessee. The address is 3501 Central Ave., Chattanooga, TN, Zip Code 37410. It is triangular-shaped and is approximately 10.17 acres in size (Figures 1 and 2). The L & N Railroad tracks which run in a north-northeast to south-southeast direction are to the west of the site and the Southern Wood Piedmont Company is to the north. To the east, Central Avenue separates the southern portion of the site from the residential area of Alton Park and the Demolition Landfill which was capped and closed in July 1992 (DE 1999).

The site of the former Charles A. Bell School is adjacent to the Demolition Landfill site. Given the proximity, there is a potential for the recreational site to be contaminated with metals and polycyclic aromatic hydrocarbons (PAHs).

Discussion

Environmental Sampling

The Law Engineering and Environmental Services, Inc. performed environmental soil sampling at 29 locations within the site of the former Charles A. Bell School. Soil sampling was done on June 11, 12, and July 10, 2001. To do so, they divided the site into 100-foot by 100-foot grids. Each grid was further divided into 50-foot by 50-foot subsets. Within each subset, four soil samples were collected at a maximum depth of 2 feet below ground surface. The four soil samples were then combined to get one composite sample representing each of the 29 subset locations. These 29 locations are labeled in Figure 3. In 2001, there was a reuse plan that considered six tennis courts, six basketball courts, and one parking lot to be built at this site rather than the two football/soccer fields and one playground that is currently being proposed. The areas where the previously proposed parking lot, tennis courts, and basketball courts were to be located did not get sampled because these areas were expected to be covered by hardtop. As such, exposure to soil would have been eliminated. There was however one exception to this. One sample was collected at location 29 because a previous soil sampling, done in February 2001, identified this location as being highly contaminated with PAHs. Surface sampling specifically targeting the top 0 to 3 inches of soil was not conducted at the site.

The contaminant concentrations were then compared to the Agency for Toxic Substances and Disease Registry (ATSDR) health screening Cancer Risk Evaluation Guides (CREGs) and to the EPA Region 9 direct contact exposure pathways Preliminary Remediation Goals (PRGs) for residential soil. CREGs and PRGs are screening levels commonly used during environmental public health investigations. Screening levels are chemical concentrations based on toxicology below which no adverse health effects are predicted to occur. When a screening level is exceeded, it does not immediately indicate that people would be expected to develop adverse health effects. Instead, it simply means that the potential health risk requires further investigation.

Table 1 lists the PAH soil data for each sample subset where a PAH constituent was identified as well as the CREG and PRG comparison values and the PAH toxicity equivalency factors. Benzo[a]pyrene is the only PAH that has a CREG. Of the 29 subsets tested, 14 had PAHs. Despite being identified as having high levels of PAHs in February 2001, there was no detection of PAHs in the soil sampled at location 29. Table 2 lists the total PAH soil data by sample location as well as their PAH toxicity equivalency. These values are graphically displayed in Figures 4 and 5, respectively.

Using the detected concentrations and one-half the detection limit for constituents reported as non-detect, the total PAH concentration for all 29 soil samples ranged from 1.16 (non-detect) to 86.10 mg/kg with an arithmetic mean of 22.61 milligrams per kilograms (mg/kg). The PAH toxicity equivalency of the entire site ranged from 0.22 to 22.33 mg/kg with an arithmetic mean of 5.21 mg/kg.

Worst-case scenarios can be evaluated by focusing on the contaminated areas of the site. Because soil was not sampled in some areas where construction is planned, the site cannot be

fully characterized. Of the 14 soil samples where PAHs were detected, the total PAH concentration ranged from 2.74 to 86.10 mg/kg with an arithmetic mean of 37.24 mg/kg. Soil sampling locations 7, 8, 10, 13, 14, and 15 had total PAH concentrations exceeding the average with locations 10 and 15 being more than twice the average. These locations are in the site's central portion and along the eastern tree-line. No PAH-contaminated soil was detected along the western border or the southern portion of the site (Figure 3). The PAH toxicity equivalency of the 14 soil samples ranged from 0.33 to 22.31 mg/kg with an arithmetic mean of 9.27 mg/kg. Soil sampling locations 7, 8, 10, 13, and 15 had PAH toxicity equivalencies exceeding this average. Again, sample locations 10 and 15 are greater than twice the average.

Iron was the only metal detected in the soil samples at concentrations greater than its respective EPA Region 9 soil PRG. It does not have a CREG. Iron levels exceeding the PRG were detected at 9 of the 29 subsets. The total iron concentration at the proposed site ranged from 23,800 mg/kg to 29,000 mg/kg with an arithmetic mean of 26,398 mg/kg. The maximum concentration of 29,000 mg/kg is only slightly higher than the background soil concentration of 26,000 mg/kg in Tennessee. Therefore, the iron found at the sight is likely due to natural background levels and not from contamination by an outside source.

Potentially Exposed Populations

Potentially exposed populations include both children and adults who play at the recreational center, work at the recreational center, or attend events at the recreational center.

Exposure Assessment

The term chemical of concern (COC) is often applied when the concentration of a screening level, such as a CREG or a PRG, is exceeded. Chemicals of concern require further investigation. With the identification of a chemical of concern, the exposure scenario, including exposure potential, dose, duration, and frequency, needs to be thoughtfully considered.

People have to come into physical contact with the PAH contaminated soils and there must be a *completed exposure pathway* for adverse health effects to occur. A completed exposure pathway consists of five main parts including:

1. a source of PAHs in the environment;
2. a means for the PAHs to migrate from its source to the soil;
3. a place where people come into contact with the PAHs;
4. a pathway (route) by which people come into contact with the PAHs such as ingesting, touching, or breathing; and,
5. people who could potentially be exposed (receptor population).

Pathways are also characterized based on whether the exposure occurred in the past, is occurring in the present, or may occur in the future.

Physical contact with PAHs in the environment by itself does not necessarily mean that a person would develop adverse health effects. The PAH's ability to affect public health is also controlled by a number of other factors, including:

- How much PAH a person is exposed to (dose)
- How long a person is exposed to the PAH (duration)
- How often a person is exposed to the PAH (frequency)
- The person's age
- The person's diet and nutritional habits

Because there were no samples of just the top 0 to 3 inches of soil, past exposures to surface conditions cannot be accurately evaluated. Currently, however, most of the former Charles A. Bell School site is well-vegetated. Vegetative cover is an effective barrier in limiting exposure to contaminated soils. Right now, incidental ingestion of soil and dermal contact with the soil are not expected to be major pathways of exposure because the site is well vegetated and people who use the site will be wearing shoes and clothing which provide a simple yet efficient barrier to dermal exposure. However, if the vegetative cover is worn away with frequent use, which it most likely will be at a recreational center, then incidental ingestion and dermal contact may occur. Inhalation of PAHs is not believed to be a major pathway of exposure at the former Charles A. Bell School site. This is because all of the PAHs identified at the proposed site are high molecular weight compounds. As such, they do not readily volatilize. Even if volatilization were to occur, the contaminated soil is located on or below ground surface whereas the breathing zone is several feet above ground surface. Over an area of this size, any PAHs that volatilize into the air are likely to be diluted, wind-mixed, and not detectable.

Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons, commonly called PAHs, are a group of chemicals derived following the incomplete combustion of organic materials such as coal, oil, gas, wood, garbage, tobacco or meat. PAHs usually are found as complex mixtures of chemicals rather than just as individual chemicals. Many of the PAHs are ever-present in the environment. PAHs occur naturally or can be manufactured. More than 100 types of PAHs are known to exist throughout the environment, including in the air, water, and soil. Only a few of these PAHs are known to be harmful. The ATSDR Toxicological Profile (1995) is a good source of information on the toxicology and epidemiology of polycyclic aromatic hydrocarbons.

PAHs including benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[j]fluoranthene, benzo[k]fluoranthene, chrysene, dibenzo[a,h]anthracene, and indeno[1,2,3-c,d]pyrene, have caused tumors in laboratory animals through inhalation, ingestion, and long-term dermal exposure. Studies of people showed that some individuals exposed, by inhaling or by skin contact, for long periods of time to mixtures that contain PAHs and other compounds can develop cancer (ATSDR 1995). The observed effect level for carcinogenic endpoints is much, much lower than for non-cancer endpoints. Thus, it is commonplace to focus on the potential cancer effects of PAHs.

There are many uncertainties in the toxicological assessment of PAHs. It is known that different PAHs have different toxic potencies. A Toxicity Equivalency Factor (TEF) methodology has been developed that combines the relative toxicities of individual PAHs in relation to benzo[a]pyrene, the PAH determined to be the most hazardous (EPA 2004a).

Using the detected concentrations and one-half the detection limit for constituents reported as non-detect, the toxicity equivalency concentrations for the entire site ranged from 0.22 to 22.33 mg/kg (Table 2) with an arithmetic mean of 5.21 mg/kg. The concentration range for benzo[a]pyrene (B[a]P) was 0.17 to 17.80 mg/kg with an arithmetic mean of 4.07 mg/kg.

For the 14 samples collected within the proposed recreational center where PAHs were detected, toxicity equivalency concentrations ranged from 0.33 to 22.31 mg/kg (Table 2) with an arithmetic mean of 9.27 mg/kg (Figure 5). The concentration range for benzo[a]pyrene (B[a]P) was 0.59 to 17.80 mg/kg (Table 1) with an arithmetic mean of 7.91 mg/kg. These values exceed the ATSDR health screening CREG for a one-in-a-million (10^{-6}) excess cancer risk of 0.1 mg/kg (ATSDR 2004). These values also exceed the EPA Region 9 direct contact exposure pathways PRG for B[a]P of 0.062 mg/kg for residential soil (EPA R9 2002).

The screening levels referenced are for residential exposure to bare soil. These screening levels are often derived from a scenario of constant, daily exposure over a lifetime. The nearby neighborhoods and the former Charles A. Bell School both have good ground vegetative cover. Likely exposure scenarios are not daily, nor constant. It is important to remember that although the former Charles A. Bell School is near a residential neighborhood; it is not a residential property. As mentioned earlier, when a chemical concentration exceeds a health screening level, it does not immediately indicate that people would be expected to develop adverse health effects. It does mean that the exposure scenario, including exposure potential, duration, and frequency, needs to be thoughtfully considered.

Calculating an Intake Dose

To determine if people are at an increased risk of adverse health effects from a contaminant, a health investigator will often calculate the dose received when various exposure scenarios are considered. The following equation can determine the amount of a contaminant a person ingests by incidentally eating contaminated soil:

$$Dose = \frac{Concentration \times AmountEaten \times FractionIngested \times ExposureDuration \times ExpFrequency}{BodyWeight \times AveragingTime}$$

Taking the maximum concentration of a contaminant coupled with a 2 hour per day exposure duration makes a worst case scenario example. Standard assumptions of 70 kg adult body weight and 30-year exposure duration were incorporated. For children, 35 kg and 16 years are common assumptions. The amount of soil incidentally ingested is also a standard assumption of 100 mg/day for adults and 200 mg/day for small children. We can assume the fraction ingested was 1 or all soil eaten is of maximum contaminant concentration. Also, assume complete contaminant absorption by the human body. In this scenario, exposure to contaminated soil happens for 2 hours every day, 365 days a year. Assuming exposure for 30 years for adults and

16 years for children, this equals a total exposure (averaging time) of 10,950 days for adults and 5,840 days for children.

PAH Intake Dose

At the site of the former Charles A. Bell School, the maximum PAH toxicity equivalency concentration was measured to be 22.31 mg/kg (Table 2). The following are worst case scenario calculations for adults and children exposed to PAHs at the former Charles A. Bell School site:

$$\frac{\frac{22.31mg}{kg}\times\frac{1kg}{10^6 mg}\times\frac{100mg}{day}\times 1\times\frac{2hrs}{day}\times\frac{1day}{24hrs}\times 30\,yrs\times\frac{365days}{yr}}{70kg\times 10{,}950days}=2.7x10^{-6}\,\frac{mg}{kg\times day}$$

$$\frac{\frac{22.31mg}{kg}\times\frac{1kg}{10^6 mg}\times\frac{200mg}{day}\times 1\times\frac{2hrs}{day}\times\frac{1day}{24hrs}\times 16\,yrs\times\frac{365days}{yr}}{35kg\times 5{,}840days}=1.1x10^{-5}\,\frac{mg}{kg\times day}$$

To determine if this worst case scenario dose is problematic for public health, the EPA-established 7.3E+0 as the slope factor for the carcinogenic effects of benzo[a]pyrene. A slope factor is a line derived from dose-response research outcomes that predicts a theoretical risk of excess cancers from exposure to the chemical. It has units of $(mg/kg\text{-}day)^{-1}$ and when multiplied by the dose provides a value for risk. The adult dose of $2.7x10^{-6}$ mg/kg-day produces a conservatively estimated theoretical risk of 1.9 excess cancers per 100,000 adults ($1.9x10^{-5}$). The child dose of $1.1x10^{-5}$ mg/kg-day equals to a conservatively estimated theoretical risk of 7.8 excess cancers per 100,000 children ($7.8x10^{-5}$).

Risk assessment aims for less than a one-in-a-million (10^{-6}) risk. Risk estimated to be less than one-in-ten thousand (10^{-4}) is often acceptable (EPA 1991). Therefore, given that the worst case scenario is in the acceptable range, lesser exposure scenarios would have even lower associated risk.

Children's Health Considerations

In the preparation of this public health document, the health and wellbeing of children was thoughtfully considered.

In communities faced with environmental contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children have lower body weights than adults. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. In addition, children have limited ability to understand environmental public health. Children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

PAHs will adhere to soil particles. Therefore, the hand-to-mouth behavior of young children requires special attention. Toddlers will sometimes display pica behavior. Older children and teenagers are likely to be the main population using this area for recreational purposes. In addition to incidental ingestion, PAHs adhered to soils can travel on clothes and pets into homes. Thus, the outdoor activities of children and teenagers, in relation to playing at the site of the former Charles A. Bell School, require thoughtful consideration.

That said, the worse case scenario for childhood exposure was calculated and did not show a problem. Therefore, careful consideration is appropriate for children, although no unique health risks associated with PAH exposure to children at the proposed recreational center were identified.

Community Concerns

In November 2007, a meeting regarding potential brownfield sites in the city of Chattanooga was held. At this meeting, community leaders expressed concerns over the contamination at the former Charles A. Bell School site and the ability to safely utilize this locality. Their main concern is that contamination will migrate upwards should this site flood, which it has done in the past. Most attending residents, however, expressed their support for building a recreational center at the former location of the Charles A. Bell School once the site undergoes the proper mitigation.

Recreational Center Considerations

The idea of using the location of the former Charles A. Bell School as a recreational center has merit. During a period in public health when overweight is the norm, asthma rates are on the rise, diabetes rates are increasing, and cardiovascular disease is a leading killer, opportunities for outdoor recreation and physical fitness are vital. The Centers for Disease Control and Prevention (CDC) state that, “Regular physical activity substantially reduces the risk of dying of coronary heart disease, the nation's leading cause of death, and decreases the risk for stroke, colon cancer, diabetes, and high blood pressure. It also helps to control weight; contributes to healthy bones, muscles, and joints; reduces falls among older adults; helps to relieve the pain of arthritis; reduces symptoms of anxiety and depression; and is associated with fewer hospitalizations, physician visits, and medications. Moreover, physical activity need not be strenuous to be beneficial; people of all ages benefit from participating in regular, moderate-intensity physical activity, such as 30 minutes of brisk walking five or more times a week (2006a).”

It is our understanding that the entire site is to be completely covered with 18 to 24 inches of clean soil as a remedial measure, thus eliminating the exposure pathway to PAH-contaminated soil. Any clearing, scraping, grading, trenching, or digging at the site is likely to uncover and bring to the surface PAH-contaminated soil. Therefore, construction activities such as improvements to irrigation and drainage, digging of goalposts, fence posts, and light posts, as well as installation of bleachers, benches, scoreboards, signs, and playground equipment should be carried out prior to covering the site with clean fill. This will ensure that clean soil is not cross-contaminated with potentially PAH-contaminated soil. Any potentially PAH-contaminated

soil that is unearthed during the construction process should be removed and a minimum of 1-foot of clean fill should be used to cover the site. In additional to soil caps, paved lots and buildings can be used to break the PAH exposure pathway.

Maintenance and erosion control of the recreational center should be considered during the planning process. Materials such as mulch, fill, and gravel are likely to be worn away with use. Furthermore, the wooded area in the northeastern corner of the site has soil contamination levels exceeding the site's average. If this area is not covered with clean, imported fill, then access to this area should be discouraged, perhaps with the use of decorative fencing. All of these concepts will require upkeep. Therefore, a plan for future maintenance and environmental health oversight that will ensure the coverage of contaminated soil is necessary.

Overall, ensuring public safety needs to be a main concern when considering future recreational uses of this site. Planning to maintain incomplete exposure pathways that will minimize potential exposure scenarios needs to be a priority. Construction that removes the exposure pathway to soil at the proposed site is a reasonable option.

Conclusions

1. Based on analysis of soil sampling data, no apparent public health hazard exists for children or adults who may come in contact with low levels of polycyclic aromatic hydrocarbons (PAHs) in soil at the site of the former Charles A. Bell School, Chattanooga, Hamilton County, Tennessee. However, some uncertainty exists in this conclusion because surface soil samples (0-3 inches) were not available for this evaluation.

2. Because soil was not sampled in some areas where construction is planned, the site has not been fully characterized. An indeterminate health hazard exits for exposure to PAHs in the areas of the site that have not been sampled.

Recommendations

1. Soil sampling was not conducted in all areas of the site. Therefore, any potential health risks associated with these areas can not be characterized and should be assumed to have the potential for PAH contamination at a level that could be harmful to public health.

2. As a matter of good public health policy, the recreational center should be planned in a safe manner by the City of Chattanooga. As such, the City of Chattanooga is to completely cover the entire site with 18 to 24 inches of clean soil and all construction, demolition, and earth moving activities should be performed in a manner that does not create potentially harmful site conditions. The use of clean fill soil and vegetative cover that will eliminate any potential exposure pathway can demonstrate thoughtful consideration to protecting public health. Furthermore, a site maintenance plan that will ensure the public's health and safety should be instituted by the City of Chattanooga so as to maintain the usefulness of the recreational center now and into the future.

Public Health Action Plan

1. The City of Chattanooga is responsible for any additional sampling at the site when needed.

2. The TDH DoR will provide assistance in assessing the situation should there be a concern regarding a flood that deposits sediment onto the site.

3. TDH EEP will provide copies of this health consultation to state, federal, and local government, academia, environmental groups, community groups, and others interested in the site at the former Charles A. Bell School.

4. TDH EEP will maintain dialogue with ATSDR, EPA, TDEC, CHCRPA, the City of Chattanooga, and other interested stakeholders to safeguard public health and to prevent people from future exposure to PAHs at the site of the former Charles A. Bell School.

5. TDH EEP will be available to review additional environmental data, as requested.

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Preparers of Report

Ms. Melissa K. Kranz, MPH, Environmental Epidemiologist

Tennessee Department of Health (TDH)
Communicable and Environmental Disease Services (CEDS)
Environmental Epidemiology Program (EEP)
1st Floor Cordell Hull Building
425 5th Avenue North
Nashville TN 37243

Reviewers of Report

Mr. Troy Keith, P.G., Field Office Manager
Tennessee Department of Environment and Conservation, Division of Remediation

Mr. David M. Borowski, MS, Assistant Director,
Tennessee Department of Health, Environmental Epidemiology Program

ATSDR Technical Project Officer

Mr. Trent LeCoultre, MSEH, REHS, LCDR US Public Health Service
Cooperative Agreement and Program Evaluation Branch (CAPEB)

Table and Figures

Table 1. Polycyclic aromatic hydrocarbon (PAH) soil sample analytical results where 14 out of 29 soil samples were identified as being contaminated with PAHs in 2001 at the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN.

PAH Constituents Identified at Site	CREG (mg/kg)	Residential Soil PRG (mg/kg)	Sample Location														PAH Toxicity Equivalency Factor (mg/kg)
			SS-3	SS-7	SS-8	SS-9	SS-10	SS-11	SS-12	SS-13	SS-14	SS-15	SS-20	SS-21	SS-22	SS- 23	
Benzo[a]anthracene	NA	0.62	--	**8.00**	**9.24**	**5.28**	**13.50**	**6.00**	**4.95**	**7.59**	**11.80**	**15.80**	--	**2.48**	**4.33**	0.46	0.1
Benzo[a]pyrene	0.1	0.062	--	**10.00**	**11.2**	**6.93**	**17.50**	**6.67**	**5.61**	**9.90**	**4.28**	**17.80**	**3.96**	**3.00**	**5.33**	**0.59**	1
Benzo[b]fluoranthene	NA	0.62	**3.30**	**11.00**	**13.2**	**8.25**	**22.80**	**9.00**	**7.26**	**12.5**	**17.40**	**21.80**	**5.28**	**4.46**	**7.33**	**0.89**	0.1
Benzo[g,h,i]perylene	NA	NA	--	3.67	4.29	--	4.62	--	--	--	4.28	--	--	--	--	--	0.01
Benzo[k]fluoranthene	NA	6.2	--	5.00	5.61	4.62	**9.57**	3.67	3.63	5.28	**7.57**	**7.92**	--	1.32	--	0.33	0.01
Chrysene	NA	62	--	8.00	9.57	5.28	12.50	5.67	4.29	6.93	11.50	14.20	--	2.31	4.33	0.46	0.001
Indeno[1,2,3-cd]pyrene	NA	0.62	--	**4.33**	**5.28**	--	**5.61**	--	--	--	**5.26**	**6.60**	--	1.12	--	--	0.1

CREG Cancer Risk Evaluation Guide.
PRG - Preliminary Remediation Goal.
Results reported milligrams per kilogram (mg/kg).
NA - Not available.
Bold type indicates constituent above EPA PRG for residential soil.

Table 2. Total PAHs and PAH toxicity equivalency by sample location where 14 out of 29 soil samples were identified as being contaminated with PAHs in 2001 at the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN.

Sample Location	Total PAHs (mg/kg) by Location	PAH Toxicity Equivalency (mg/kg) by Location
SS-3	3.30	0.33
SS-7	50.00	12.43
SS-8	58.39	14.08
SS-9	30.36	8.33
SS-10	86.10	21.85
SS-11	31.01	8.21
SS-12	25.74	6.87
SS-13	42.20	11.97
SS-14	62.09	7.86
SS-15	84.12	22.31
SS-20	9.24	4.49
SS-21	14.69	3.82
SS-22	21.32	6.50
SS-23	2.74	0.73
All PAH-Contaminated Sample Locations	521.3	129.78
Entire Site	655.78	151.23

FIGURE 1. USGS topographic map showing the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN at the former location of the Charles A Bell School.

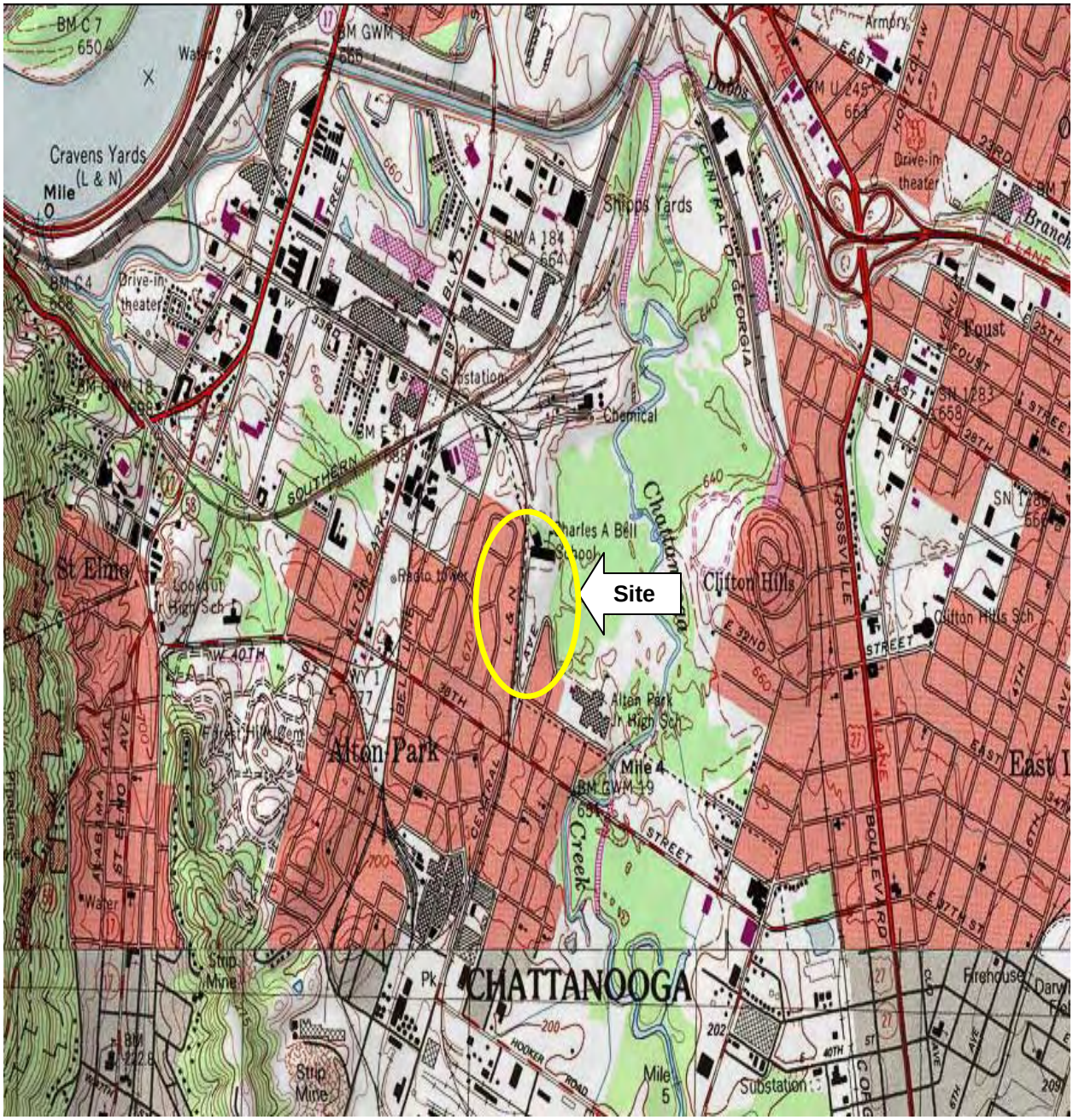


FIGURE 2. Aerial image showing the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN. The areas where soil samples were taken in 2001 are not noted. (Image credit: Google 2007)

FIGURE 3. Numbered cells indicating where composite soil samples were taken in 2001 at the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN. Cells with particularly high PAH concentrations are shaded in red. (Image credit: Law Engineering and Environmental Services, Inc.)

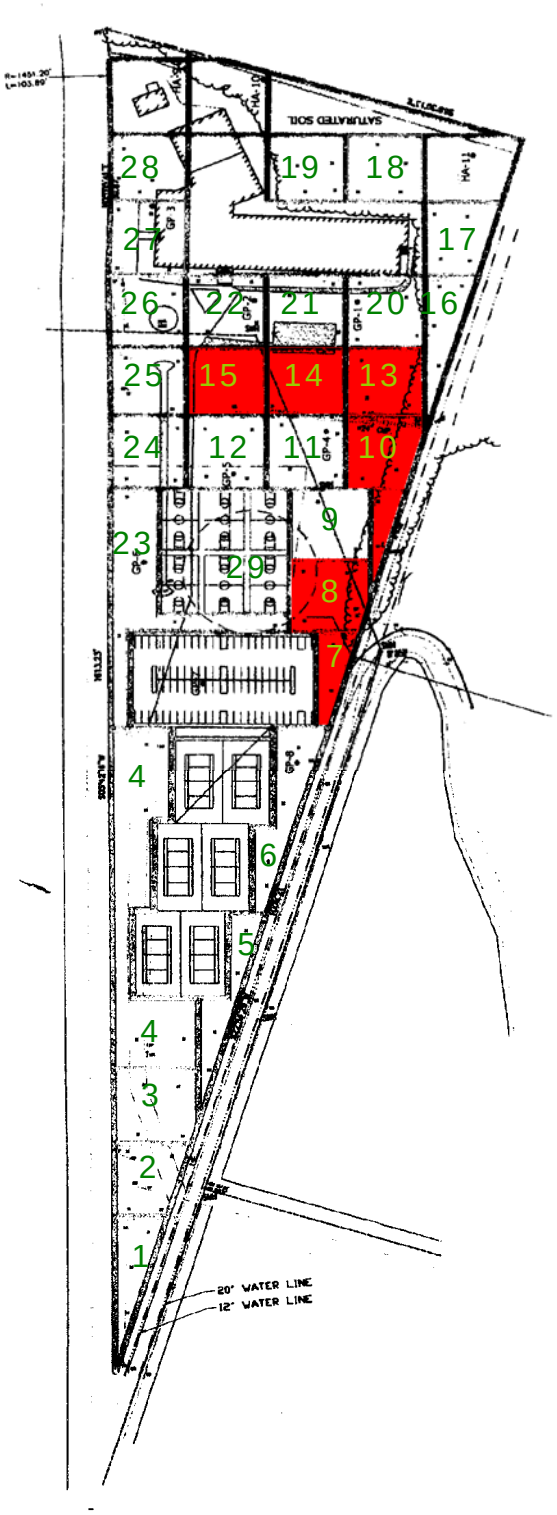


FIGURE 4. Total PAH concentrations where 14 out of 29 soil samples were identified as being contaminated with PAHs in 2001 at site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN. The average for the 14 samples was 37.24 mg/kg. The average for all 29 samples was 22.61 mg/kg.

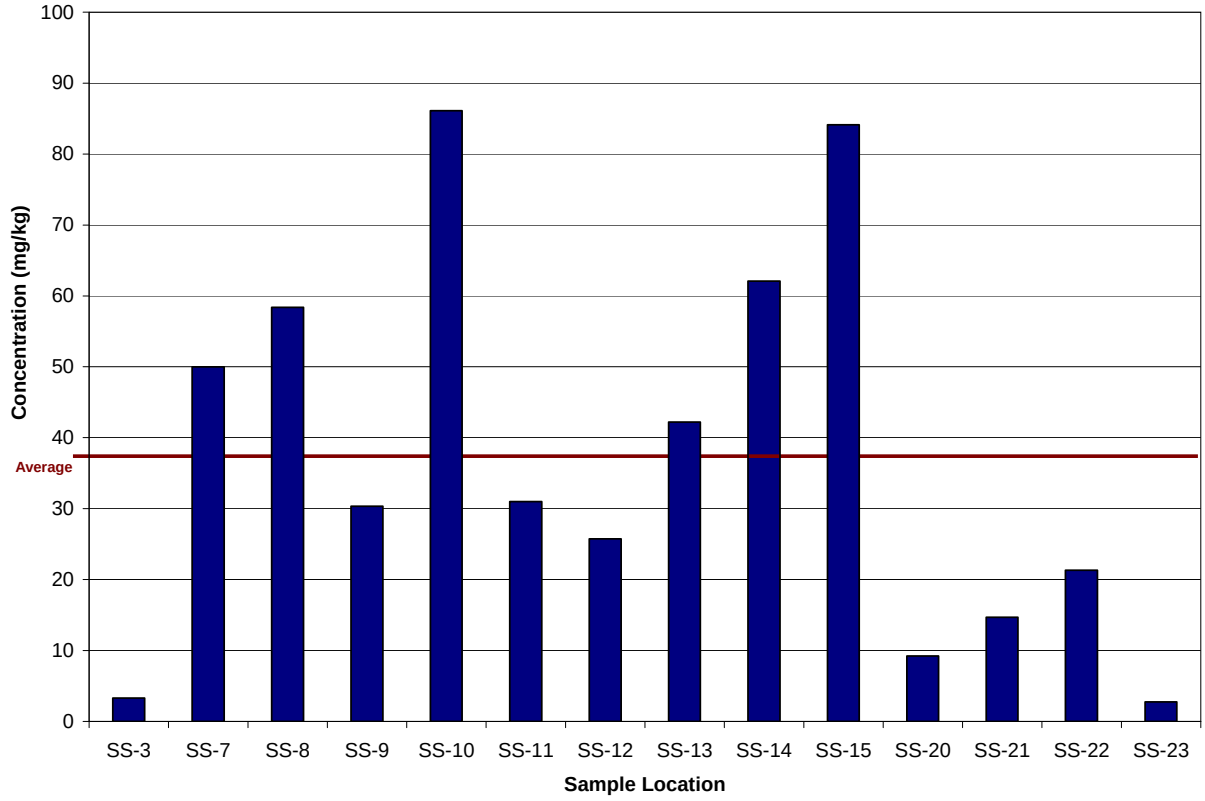
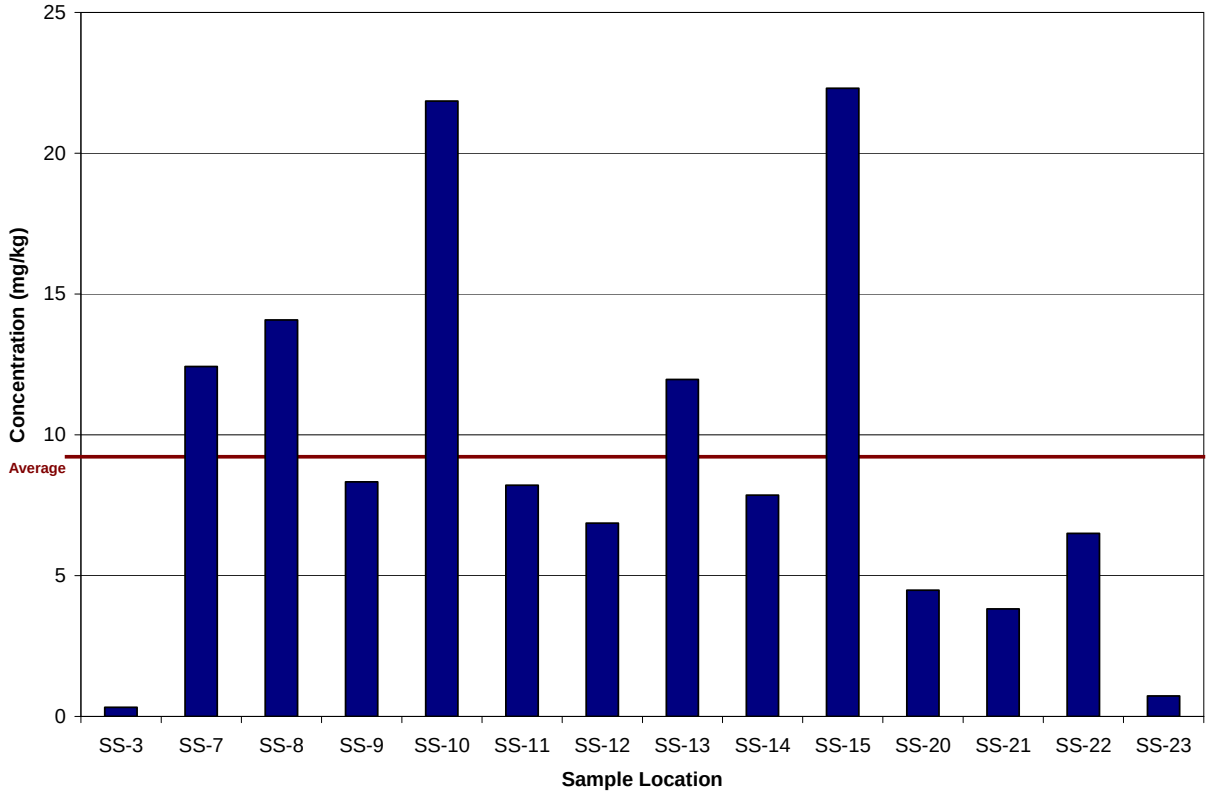


FIGURE 5. Toxicity equivalencies where 14 out of 29 soil samples were identified as being contaminated with PAHs in 2001 at the site of the former Charles A. Bell School, Chattanooga, Hamilton County, TN. The average for the 14 samples was 9.27 mg/kg. The average for all 29 samples was 5.21 mg/kg.



Certification

This Public Health Consultation: *Former Charles A. Bell School, Chattanooga, Hamilton County, Tennessee*, was prepared by the Tennessee Department of Health Environmental Epidemiology under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun. Editorial review was completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health assessment and concurs with the findings.

Team Leader, CAT, CAPEB, DHAC, ATSDR