Health Consultation

Evaluation of Surface Soil and Garden Produce Exposures

35th AVENUE SITE

BIRMINGHAM, ALABAMA

EPA FACILITY ID: ALN000410750

JANUARY 18, 2017

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

Central Branch
Division of Community Health Investigations
Agency for Toxic Substances and Disease Registry

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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
ACLPPP	Alabama Childhood Lead Poisoning Prevention Project
ADPH	Alabama Department of Public Health
ALM	Adult Lead Methodology
BaP	benzo(a)pyrene
BaP-TE	benzo(a)pyrene toxic equivalent
bgs	below ground surface
BLL	blood lead level
CCA	chromated copper arsenate
CDC	Centers for Disease Control and Prevention
CI	confidence interval
COPD	chronic obstructive pulmonary disease
CREG	cancer risk evaluation guide
CSF	cancer slope factor
CTE	central tendency exposure
CV	comparison value
DHHS	Department of Health and Human Services
EMEG	environmental media evaluation guide
IARC	International Agency for Research on Cancer
IEUBK	Integrated Exposure Uptake Biokinetic Model for Lead in Children
JCDH	Jefferson County Department of Health
LOAEL	lowest-observed-adverse-effect-level
µg/day	micrograms per day
µg/dL	micrograms per deciliter
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
MRL	minimal risk level
NBCC	Northern Birmingham Community Coalition
NHANES	National Health and Nutrition Examination Survey
NOAEL	no-observed-adverse-effect-level
PAH	polycyclic aromatic hydrocarbon
PEF	potency equivalency factor
PHC	public health consultation
PM	particulate matter

ppm	parts per million
QA/QC	quality assurance/quality control
RAL	removal action level
RBA	relative bioavailability
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RME	reasonable maximum exposure
RML	removal management level
RSE	Removal Site Evaluation
TCL	Target Compound List
TCRA	time critical removal action
TSS	Technical Services Section
US EPA	U.S. Environmental Protection Agency
XRF	X-ray fluorescence spectrometer

1. Executive Summary

Introduction	The Agency for Toxic Substances and Disease Registry's (ATSDR's) purpose is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent people from coming into contact with harmful toxic substances. In November 2014, the United States Environmental Protection Agency (US EPA) Region 4 requested that ATSDR evaluate environmental sampling data collected for the 35th Avenue site in North Birmingham, Jefferson County, Alabama. The site includes residential properties in Collegeville, Fairmont, and Harriman Park. US EPA requested that ATSDR focus its evaluation on arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) found in residential surface soil and homegrown garden produce in these communities. US EPA provided ATSDR with sampling results for surface soil samples collected from November 2012 through January 2016, and homegrown garden produce samples collected in July 2013. US EPA tested for arsenic and lead in soil at over 1,200 properties using laboratory or X-ray fluorescence spectrometer (XRF) methods, or both. In the public comment version of this report, ATSDR provided the laboratory and XRF results together. In response to public comments about the accuracy of the XRF measurements, ATSDR not only provides the results together, but added tables and information to this report that show the results of the laboratory measurements separately. The purpose of this public health consultation (PHC) is to evaluate the public health significance of exposures to contaminants in residential surface soil and homegrown garden produce in these communities.
Conclusions	Following its review of the 35th Avenue residential surface soil and homegrown garden produce data, ATSDR reached three health-based conclusions.
Conclusion 1	ATSDR concludes that past and current exposure to arsenic found in surface soil of some residential yards could harm people's health. Children are especially at risk.
Basis for Decision 1	• Based on the laboratory and XRF data combined, 31 of 1,234 (2.5%) tested properties in the past and 12 of 1,113 (1.1%) properties currently have soil arsenic levels of public health concern for children who intentionally eat soil (which leads to a higher than normal soil intake) for acute (short-term) exposures.

Based on the laboratory data alone, 15 of 543 (2.8%) tested properties in the past and 10 of 424 (2.4%) properties currently are of public health concern for children who intentionally eat soil. These children may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Also, the maximum levels of arsenic at two properties (one based on laboratory analysis and one on XRF) in the past and one property (based on laboratory analysis) currently were and are of concern for short-term exposures for all children, even those who do not intentionally eat soil. Children who frequently engage in activities like digging with shovels and other tools, and playing with toys (such as toy trucks and action figures) on the ground surface at these properties are especially at risk.

- For chronic (long-term) exposures, laboratory and XRF data combined showed 13 of 1,234 (1.1%) tested properties in the past and 5 of 1,113 (0.4%) properties currently have soil arsenic levels of potential public health for children for noncancerous dermal health effects (e.g., hyperpigmentation and hyperkeratosis). Based on the laboratory data alone, 6 of 543 (1.1%) tested properties in the past and 4 of 424 (0.9%) currently are of public health concern for dermal health effects. Children who engage in activities like digging with shovels and playing with toys on the ground surface every day for longer than a year are at risk, especially at properties with gardens and play areas with bare soil.
- ATSDR also estimated the proportion of a population that may be affected by a carcinogen during a lifetime of exposure. Based on the laboratory and XRF data combined, cancer risk estimates for arsenic in soil are at and exceed 1 in 10,000 people for 80 of 1,234 (6.5%) tested properties in the past and 43 of 1,113 (3.9%) properties currently. Based on the laboratory data alone, 36 of 543 (6.6%) tested properties in the past and 22 of 424 (5.2%) properties currently are at and exceed this cancer risk level. Thus, exposure to arsenic in soil for many years results in an increased risk of cancer at those properties.
- Arsenic in soil at most properties is not at levels of health concern for noncancer, harmful health effects and is in the range considered to be a low cancer risk.
- Ingestion of arsenic in homegrown garden produce alone is not of health concern. However, exposure to the maximum arsenic

level found in the garden produce may add to the health risk for those also exposed to elevated levels of arsenic in surface soil.

Conclusion 2

ATSDR concludes that past and current exposure to lead found in surface soil of some residential yards could harm people's health. Swallowing this lead-contaminated soil, along with lead from other sources such as lead paint, could cause harmful health effects, especially in children and in the developing fetus of pregnant women.

Basis for Decision 2

- Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects. ATSDR notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
- There are some residential properties with high levels of lead in surface soil, indicating the potential for elevating blood lead levels (BLLs) in children who live at or visit these properties. Children who intentionally eat soil are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.
- Other indoor and outdoor sources of lead may result in elevating BLLs even further. Also, multiple factors that have been associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race).
- Although ingestion of lead in garden produce is not of health concern, it will increase the risk of harm with increasing soil lead concentrations. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

Conclusion 3

ATSDR concludes that long-term exposure (i.e., many years) to PAHs found in the surface soil of some residential yards increases the risk of cancer. Conversely, long-term exposure to the levels of PAHs found in surface soil are not expected to result in noncancer harmful health effects.

Basis for Decision 3	• Several PAHs have been linked with tumors in laboratory animals when they breathed, ate, or had long periods of skin exposure to these substances. Benzo(a)pyrene (BaP) has been linked with stomach cancer and dibenz(ah)anthracene with lung cancer. • Seven PAHs were detected in residential surface soil. For six of these PAHs, ATSDR calculated a benzo(a)pyrene toxic equivalent (BaP TE) value for each sample. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. The BaP TE value is the sum of these six PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP. About 181 of 1,234 (15%) tested properties in the past and 116 of 1,113 (10%) properties currently have soil BaP TE levels that result in an increased risk of cancer, with estimates at and exceeding 1 in 10,000 people. • For dibenz(ah)anthracene, 16 of over 1,234 (1.3%) tested properties in the past and 3 of 1,113 (0.3%) properties currently have soil levels that result in an increased risk of cancer, with estimates at and exceeding 1 in 10,000 people. • Overall, ATSDR considers long-term PAH soil exposures at most residential properties to represent a low cancer risk. ATSDR also considers it unlikely that any noncancerous harmful health effects from PAH soil exposure would occur in children or adults. • PAHs were not detected in garden produce.
Blood Lead Level Data	ATSDR reviewed available BLL data from two sources. 1. In July 2013, the Jefferson County Department of Health conducted a limited site-specific BLL screening event of 44 participants (1–70 years of age). Thirteen participants were children 1–5 years of age, although two of these children did not live within the site boundaries. No BLLs exceeded the current 5 micrograms per deciliter (µg/dL) reference level[1] for children 1–5 years of age. Overall, 15 of the 44

[1] This reference level is based on the highest 2.5% of the U.S. population of children ages 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES). NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. As part of the examination component, blood, urine, and other samples are collected and analyzed for various chemicals. The NHANES test population is selected to be representative of the civilian, noninstitutionalized population of the United States.

participants (34%) did not actually live within the boundaries of the site.

2. The site lies in ZIP code 35207. The Alabama Department of Public Health provided ATSDR with 2010–2014 BLL data for 560 children ≤ 21 years of age living within this ZIP code. This ZIP-code review indicated 25 children 1–5 and 6–11 years of age had BLLs at and above 5 µg/dL. However, the ZIP-code level BLL data may not necessarily be representative of the site area.

Next Steps

Following its review of available information, ATSDR recommends

1. Parents monitor their children's behavior while playing outdoors and prevent their children from intentionally or inadvertently eating soil, especially for those yards with elevated arsenic, lead, and PAH levels that have not yet been cleaned up and for those yards that have not yet been tested.
2. Residents take measures to reduce exposures to residential soil and to protect themselves, their families, and visitors (see Appendix C), especially for those yards with elevated arsenic, lead, and PAH levels that have not yet been cleaned up and for those yards that have not yet been tested.
3. Parents follow the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012].
4. Residents take steps to reduce lead uptake (see Appendix D).
5. Residents take measures to reduce exposure to lead from other possible sources (see Table 13B, Appendix B, and Appendix E).
6. US EPA test the bioavailability of metals (arsenic and lead) in the soil.
7. US EPA continue with its plans to remediate additional properties to reduce arsenic, lead, and PAH levels in residential surface soil.

For More Information

Call ATSDR at 1-800-CDC-INFO and ask for information on the 35th Avenue site.

2. Statement of Issues

The United States Environmental Protection Agency (US EPA) Region 4 requested that the Agency for Toxic Substances and Disease Registry (ATSDR) evaluate the public health significance of environmental sampling data collected in North Birmingham, Jefferson County, Alabama. In 2012 and 2013, US EPA sampled residential properties[2] including areas of Collegeville, Fairmont, and Harriman Park. These residential properties are now part of US EPA's 35th Avenue site (see Figure 1A, Appendix A).

Specifically, US EPA requested ATSDR focus on exposures to arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) found in

- Surface soil, and
- Homegrown garden produce.

Arsenic, lead, and PAHs were found in surface soil at levels that exceeded US EPA Region 4 residential removal management levels (RMLs). In some instances, garden plants can take up soil contaminants into the root or other edible portions of the plant. The purpose of this public health consultation (PHC) is to evaluate the public health significance of exposures to contaminants in residential surface soil and homegrown garden produce in these communities.

3. Background

3.1. Site Description

In North Birmingham, residential properties in areas of Collegeville, Fairmont, and Harriman Park are a large part of US EPA's 35th Avenue site. Churches, schools, and parks with recreational activities are also a part of the site. Other land use within the site boundaries and surrounding area varies between heavy industry, light industry, commercial, retail, and rail lines [USEPA 2013a].

Residential dwellings in the Collegeville neighborhood were present as late as 1929. The Harriman Park neighborhood was constructed in the early 1950s. Construction of residential dwellings in the Fairmont neighborhood appear to have begun as late as 1951 and continued through the late 1970s [OTIE 2012; OTIE 2013b]. Surface topography in the area ranges from very flat (Collegeville) to hilly (Fairmont). Numerous creeks, drainage channels, and storm water drain pipe systems exist in the site area. Portions of Collegeville are prone to periodic flooding and are located within a 100-year floodplain [USEPA 2013a].

The Birmingham area of Alabama has been heavily industrialized for decades. The site area is surrounded by industrial facilities historically and currently associated with coke and chemical

[2] "Residential properties" refer to parcels of land in the study area including single-family homes, multi-unit housing, churches, schools, and recreational parks. Residential properties also include parcels of land reclaimed by the City of Birmingham due to lien or flooding. These reclaimed parcels are currently empty lots with no structures or have abandoned structures but are still appropriate for residential use.

manufacturing, and iron foundries and pipe manufacturing. Several manufacturing facilities in North Birmingham have operated since the early 1900s [USEPA 2015a].

3.2. Site Activities

This section provides a brief discussion of a few site activities; it is not intended to provide a complete history of actions that have occurred at the 35th Avenue site.

In addition to large portions of the three residential areas of Collegeville, Fairmont, and Harriman Park being a part of the site area, a large portion of the Walter Coke facility[3] is within the site boundary too (see Figure 1A, Appendix A). Historic or ongoing activities at Walter Coke include manufacturing of coke, manufacturing of toluene sulfonyl acid, production of pig iron from iron ore, manufacturing of mineral fibers (mineral wool), and a biological treatment facility and sewers designed to treat wastewater generated at the facility [CH2MHill 2005]. The US EPA Region 4 Resource Conservation and Recovery Act (RCRA) Division has been involved with the Walter Coke facility for over 20 years. This includes sampling and analysis activities to identify the nature and extent of contamination in surface soil.

Under US EPA oversight, Walter Coke collected soil samples from 78 residential properties located in Collegeville, Fairmont, and Harriman Park in 2005 and 2009 [USEPA 2014a]. In 2013, ATSDR released a PHC that evaluated arsenic and PAH levels in surface soil from these two sampling events. The 2013 PHC recommended remediation at properties with the highest contaminant concentrations to decrease soil exposures (see http://www.atsdr.cdc.gov/HAC/pha/WalterCokeInc/WalterCokeIncHC(Final)08012013_508.pdf). As a result of those sampling events, Walter Coke agreed to remediate several offsite properties.

In addition to the soil data evaluated in its 2013 PHC, ATSDR also evaluated US EPA and Jefferson County Department of Health (JCDH) air sampling results from 2005–2006, 2009, and 2011–2012. Air samples were collected in the Collegeville, Fairmont, and Harriman Park communities as well as in Providence (a rural location near Birmingham for background comparisons). The samples were tested for many chemicals and particulate matter (PM). ATSDR reviewed the sample results to see whether any chemical levels in air were high enough to cause health problems for people who live or work in the community (see http://www.atsdr.cdc.gov/HAC/pha/NorthBirminghamAirSite/35th%20Avenue%20Site_PHA_Final_04-21-2015_508.pdf). ATSDR recommended JCDH continue checking the PM levels in air because people who have asthma, chronic obstructive pulmonary disease (COPD), and heart disease may cough or have trouble breathing when they breathe PM.

On July 18 and July 23, 2013, JCDH conducted blood lead level (BLL) screening events for the 35th Avenue community. Of the 44 participants (1–70 years of age), 42 were children under 19 years of age, with 13 being 1–5 years of age [JCDH 2013]. No BLLs exceeded 5 micrograms per deciliter (µg/dL). However, 15 of the 44 participants did not actually live within the boundaries of the site [JCDH 2013]. Therefore, these results do not likely represent BLLs for the general site population.

In 2012 and 2013, US EPA conducted soil sampling at the 35th Avenue site in areas of Collegeville, Fairmont, and Harriman Park. Based on the results, US EPA proposed a time critical removal action

[3] Note that the Walter Coke facility is mentioned in this section because a large portion of the facility is within the site boundary. However, in this document, ATSDR does not attempt to determine contaminant sources and notes there are many facilities in the surrounding area.

(TCRA), which included three phases. For each phase, US EPA developed site-specific soil removal action levels (RALs) for arsenic, lead, and benzo(a)pyrene aimed to reduce exposure risks for community members living on properties with the highest levels of soil contamination.

- **Phase 1**: US EPA removed soil at approximately 50 properties that exceeded one or more Phase 1 RAL. Removal activities began in February 2014 and were substantially[4] complete in August 2014.
- **Phase 2**: US EPA removed soil at about 30 properties that exceeded one or more Phase 2 RAL *and* had children or pregnant women, or both, living on the property. This phase was substantially complete in March 2015. Phase 2 included three schools and two apartment buildings.
- **Phase 3**: US EPA removed soil at about 35 properties that exceed one or more Phase 3 RAL. Soil removal activities were substantially complete in July 2015.

Since the completion of Phase 3, US EPA began a fourth phase of soil removal activities. Phase 4 will likely take a few years to complete and will likely include over 200 properties.

In general, TCRA soil removal activities included inventorying the property, removing impediments to excavation efforts (like plants, grasses, utilities, and fences), excavating contaminated soil, backfilling with clean soil, replacing or repairing damaged items (like piping and fences), and re-establishing vegetation. US EPA is currently determining its options toward future phases of removal action.

As part of its regional Superfund Reuse Initiative, US EPA Region 4 sponsored the formation of the Northern Birmingham Community Coalition (NBCC) to plan for future revitalization of Northern Birmingham communities, which include the Collegeville, Fairmont, and Harriman Park neighborhoods. The Coalition includes neighborhood representatives as well as business, faith-based, academic and non-profit groups, community leaders and government agencies. The NBCC has been holding monthly meetings since March 2013 and has identified priorities for further exploration including [USEPA 2014a]:

- Increasing access to health care and health facilities to improve health outcomes.
- Promoting commercial revitalization with a particular focus on access to grocery stores and affordable, healthy food, and neighborhood-oriented shopping and Service stations.
- Improving housing conditions, with a particular focus on rehab of existing housing and stemming housing demolition.

Currently, the NBCC is in the process of reviewing and revising their action plan. Additional details are available at http://www2.epa.gov/north-birmingham-project.

3.3. Demographic Statistics

Using 2010 Census of Population and Housing data and an area-proportion spatial analysis technique, ATSDR calculated that 3,585 persons reside within the boundaries of the 35th Avenue site [US Census Bureau 2010a]. Of these, about 98% are black. Within the site's boundary, approximately 13% are age 65 and older and 16% are children 6 years or younger. Figure 2A, Appendix A, provides additional demographic statistics.

[4] US EPA continues to respond to community concerns regarding its removal activities. For example, if the grass did not take following a yard's removal activities, the agency might plant new grass in that area.

4. Exposure Pathway Evaluation

To determine whether people are 1) now exposed to contaminants or 2) were exposed in the past, ATSDR examines the path between a contaminant and a person or group of people who could be exposed. Completed exposure pathways have five required elements. ATSDR evaluates a pathway to determine whether all five factors are present. Each of these five factors or elements must be present for a person to be exposed to a contaminant:

1. A contamination source,
2. Transport through an environmental medium,
3. An exposure point,
4. A route to human exposure, and
5. People.

For the 35th Avenue site, ATSDR considers exposures to surface soil and homegrown garden produce to be completed exposure pathways.

Surface soil at the 35th Avenue site could be impacted by aerial deposition from facility emissions in the area (chemicals moving as wind-blown particulates and as soot, and landing on the soil), as well as through surface water runoff from these facilities and flooding. Because many of the homes in the area were built before 1960, they may contain heavily leaded paint. Some homes built as recently as 1978 may also contain lead paint. Deteriorating lead paint from window frames, the outside of homes, or other surfaces, could enter the soil. Some homeowners used leftover product from area facilities in their yards as soil fill material.

Exposure to contaminants in surface soil occurs primarily through dermal contact. In addition, people might accidentally ingest surface soil, as well as dust generated from disturbing the soil. Preschool age children tend to swallow more soil than do any other age group because they have more contact with soil through their play activities and they tend to exhibit mouthing of objects and hand-to-mouth behavior. Children in elementary school, teenagers, and adults tend to swallow much smaller amounts of soil. Of note, some children eat non-food items like soil. Groups that are at an increased risk for this behavior are children 1–3 years of age. The amount of vegetative or other soil cover in an area, the amount of time spent outdoors, and weather conditions also influence people's exposure to soil.

For this PHC, ATSDR considers two exposure scenarios: past and current exposures to arsenic, lead, and PAHs in surface soil. In general, ATSDR considers "past exposure" to be exposure to the chemical levels found in surface soil prior to removal activities and "current exposure" to be exposure to the chemical levels that remain at the site after the TCRA.

Homegrown garden produce could be impacted by aerial deposition (chemicals landing on the surface of the produce) and root uptake (movement of the chemicals from the soil into the produce). Garden produce could also be impacted by "direct soil contact" as some heavy fruits (tomatoes) and leafy vegetables (greens) lay on the surface of the soil whereby rain events or garden activity can cause soil particles to adhere to the surface of the produce. Exposure occurs through ingestion of soil contaminants on or in the homegrown garden produce.

5. Environmental Data

During the public health assessment process, ATSDR reviews environmental data and evaluates these data in the context of its site-specific exposure pathway assessment. From November 2012 until June 2013, US EPA conducted environmental sampling activities during a Removal Site Evaluation (RSE) where access was granted to over 1,200 of the approximately 2,000 parcels in the 35th Avenue site study area. Additional sampling activities occurred in conjunction with the TCRA. This PHC focuses on surface soil and homegrown garden produce sampling conducted from November 2012 through January 2016 [USEPA 2016a].

5.1. Surface Soil Sampling Design and Analysis

For the purpose of this PHC, ATSDR calls each distinct composite sampling area on a residential property a “grid”. The removal report states the exact number of aliquots per composite sample was determined in the field based on sampling area size but did not exceed five points [OTIE 2013b]. Most of the 5-point composite surface soil samples US EPA collected were 0–4 inches below ground surface (bgs), although some (less than 10%) were 0–6 inches bgs. US EPA collected composite samples based on the parcel lot size as follows [OTIE 2012, 2013b]:

- For residential properties with a total parcel lot size equal to or less than (≤) 5,000 square feet, two composite samples were collected—one in the front yard and one back yard. If the property had a substantial side yard, then one composite soil sample was also collected from the side yard. Aliquots were collected away from drip lines and burn areas in a five dice configuration (each of the four corners and the center).
- For residential properties with a total parcel lot size greater than (>) 5,000 square feet and ≤ ¼-acre, the property was divided into two roughly equal surface area grids and a composite sample collected from each grid. If the property had a substantial side yard, then one composite soil sample was also collected from the side yard (primarily corner lots). Aliquots were collected away from drip lines and burn areas with reasonably equal spacing between aliquots.
- Residential properties over ¼-acre in parcel lot size were divided into ¼-acre sections, with each section representing a grid. When dividing any such property with a substantial side yard, one composite soil sample was also collected from the side yard. Aliquots were collected away including drip lines and burn areas in a five dice configuration, if possible, with reasonably equal spacing between aliquots.

In addition, US EPA collected grab surface soil samples from locations with active play sets and from low-lying areas. A 3-point composite surface soil sample was collected from distinct vegetable gardens. Quality assurance/quality control (QA/QC) samples, including field duplicates, rinsate blanks, field blanks, and preservative blanks, were also collected. Samples were not collected under paved areas or under stationary fixed structures, such as houses, sheds, buildings, concrete pads, and driveways.

Information identifying the location, sample point, date, and time were recorded for all samples. If the sample’s moisture content was greater than 20% (as measured with a portable soil moisture meter), the sample was dried before sieving or analysis was performed. Once the sample was dried, a portion of samples (about 60%) were sieved using a 2 millimeter sieve [OTIE 2012, 2013b].

US EPA's primary focus was to collect surface soil samples to assess whether PAHs and RCRA 8 metals[5] were present at concentrations above RMLs. The samples were submitted to a laboratory for Target Compound List (TCL) PAH analysis. PAH laboratory analysis was conducted on the unsieved portion of the samples. All soil samples were first field screened for RCRA 8 metals using X-ray fluorescence spectrometer (XRF) and then about 10% of the samples were split and submitted to the laboratory for RCRA 8 metals analysis. Due to the nonhomogeneous nature of the soils present in the study area, US EPA used the bin approach to identify which samples were sent to the laboratory [OTIE 2013b]. RCRA metals were analyzed in the field and laboratory from both the sieved and unsieved portions of the samples [OTIE 2012, 2013b].

5.1.1. Soil Sampling Data Quality

No chemical measurement has value for decision-making unless its accuracy is known and understood. The field XRF method can provide a fast and cost-effective way of measuring metals in soil. Laboratory analysis methods can provide precise and accurate chemical measurements that are reproducible. Because of the need for additional steps such as sample handling, transportation, and chain-of-custody documentation, laboratory methods take longer and are more expensive.

Although variations in sample collection, sample handling, sample preparation (including aliquot collection and homogenization), and analysis can affect measurements, the laboratory confirmatory method should match the field XRF method as well as possible. Based on the positive correlations between the laboratory and XRF data reported in a 2013 US EPA memorandum [USEPA 2013a], ATSDR gave the same weight to the reported XRF concentration data as the agency gave to the reported laboratory concentration data for all of the arsenic and lead analyses in the public comment release version of this report.

Based on concerns submitted to the agency during the public comment period regarding the arsenic and lead XRF concentration data, ATSDR performed its own analyses to determine the correlations in the complete data set. The data do not show strong positive correlations between XRF and laboratory measurements. Overall, ATSDR considers the XRF measurements to be reliable data, but with less accuracy in the reported concentrations (i.e., the true concentration of the chemical in soil may be lower or higher than the reported XRF concentration). In this final version of the health consultation, the agency kept its tables that provided the laboratory and XRF data combined. However, because concerns were expressed about the arsenic and lead XRF concentration data, ATSDR also provided two new tables (i.e., Tables 7B and 9B, Appendix B) in this report that contain just arsenic and lead laboratory data.

5.2. Homegrown Garden Produce Sampling Design and Analysis

On July 23 and 24, 2013, US EPA collected vegetable samples for laboratory analysis from residential gardens. US EPA intended on sampling produce from 10 gardens but only about five gardens had enough vegetables for analysis [OTIE 2013a].

A total of 20 vegetable tissue samples, including two field duplicate samples, were collected from the gardens. Both washed and unwashed samples of tomatoes, cucumbers, collard greens, and zucchinis were submitted for arsenic, lead, and PAH laboratory analysis. Washed samples of green onion, okra, and pepper were submitted for arsenic and lead laboratory analysis [OTIE 2013a].

[5] RCRA 8 metals are arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.

6. Data Screening

The screening analysis process enables ATSDR to identify chemicals that might need closer evaluation. The screening process compares measured chemical concentrations with health-based comparison values (CVs) [ATSDR 2005].

A health-based CV is an estimate of daily human exposure to a chemical that is not likely to result in harmful health effects over a specified exposure duration. ATSDR has developed CVs for specific media (e.g., air, water, and soil). ATSDR CVs are generally available for three specified exposure periods: acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) [ATSDR 2005].

Some of the CVs and health guidelines ATSDR scientists use include ATSDR's cancer risk evaluation guides (CREGs), environmental media evaluation guides (EMEGs), and minimal risk levels (MRLs) (see Appendix F). Health-based CVs and health guidelines, as well as all other health-based screening criteria, are conservative levels of protection—they are not thresholds of toxicity. Although concentrations at or below a CV represent low or no risk, concentrations above a CV are not necessarily harmful. To ensure that they will protect even the most sensitive populations (e.g., children or the elderly), CVs are designed intentionally to be much lower, usually by two or three orders of magnitude,[6] than the corresponding no-observed-adverse-effect-levels (NOAELs) or lowest-observed-adverse-effect-levels (LOAELs) on which the CVs are based. Most NOAELs and LOAELs are established in laboratory animals; relatively few are derived from epidemiologic (i.e., chiefly worker) studies. All ATSDR health-based CVs are nonenforceable—they are for screening purposes and are only used to determine the chemicals that require further evaluation.

For this PHC, US EPA asked ATSDR to focus its health evaluation on arsenic, lead, and PAH levels in residential surface soil and homegrown garden produce. The following text provides information about the ATSDR CVs used in this report [ATSDR 2013] for these environmental media and compounds.

- No ATSDR health-based CVs exist for screening chemical levels in garden produce.
- Arsenic surface soil levels are screened using the ATSDR chronic child EMEG[7] of 15 parts per million (ppm).
- No ATSDR health-based CV exists for screening lead in surface soil because there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
- Seven PAHs were detected in surface soil. No ATSDR health-based CV exists for the PAH dibenz(ah)anthracene. The other six PAHs are screened using ATSDR's benzo(a)pyrene (BaP) CREG of 0.096 ppm [ATSDR 2013] and benzo(a)pyrene toxic equivalent (BaP TE) values. The BaP TE value is the sum of the different PAHs detected in the soil sample with their concentrations

[6] "Order of magnitude" refers to an estimate of size or magnitude expressed as a power of ten. An increase of one order of magnitude is the same as multiplying a quantity by 10, an increase of two orders of magnitude equals multiplication by 100, an increase of three orders of magnitude is equivalent of multiplying by 1000, and so on. Likewise, a decrease of one order of magnitude is the same as multiplying a quantity by 0.1 (or dividing by 10), a decrease of two orders of magnitude is the equivalent of multiplying by 0.01 (or dividing by 100), and so on.

[7] The CREG for arsenic in soil (0.47 ppm) is below background levels, so the recommended soil CV is the EMEG (15 ppm) [ATSDR 2013].

adjusted for their toxicity relative to BaP; that is, the BaP TE equals the sum of the individual PAH concentrations multiplied by their respective potency equivalency factor (PEF). Those specific PAHs and PEFs are in Table 1.

Table 1. Potency Equivalency Factors

Polycyclic Aromatic Hydrocarbon	Potency Equivalency Factor
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Indeno(123-cd)pyrene	0.1

Source: Cal EPA 2005.

6.1. Surface Soil Results

In this PHC, ATSDR considers both past and current exposures to arsenic, lead, and PAHs in surface soil, which the agency defines for this document as 0–6 inches bgs. ATSDR decided that each grid was a separate exposure point. Tables 2B–5B, Appendix B, provide general descriptive statistics[8] for all samples for arsenic, lead, BaP TE, and dibenz(ah)anthracene. For its public health evaluation of each chemical, ATSDR provided information based on both grids and properties following these procedures:

- Grids: For its metals screening analysis of each grid based on both laboratory and XRF data combined (i.e., Tables 6B and 8B, Appendix B), ATSDR selected the maximum composite sample value to represent that grid regardless of whether that maximum value was from a field sample or a field duplicate, from a sample that was sieved or unsieved, or from an XRF measurement or laboratory analysis. For its metals screening analysis of each grid based on just laboratory data alone (i.e., Tables 7B and 9B, Appendix B), ATSDR selected the maximum laboratory composite sample value to represent that grid regardless of whether that maximum laboratory value was from a field sample or a field duplicate, or from a sample that was sieved or unsieved. For PAHs (Tables 10B and 11B, Appendix B), ATSDR selected the maximum composite sample value to represent that grid regardless of whether that maximum value was from a field sample or a field duplicate. ATSDR notes PAH analyses were completed in the laboratory on unsieved samples only.
- Properties: For each property, ATSDR selected the grid with the maximum value to represent that property.

ATSDR notes that changes in descriptive statistics and grid/property counts when comparing the past and current exposure scenarios are dependent on several factors including that 1) the TCRA only targeted properties with the highest levels of contamination, 2) the RALs chosen for each chemical

[8] Table 1B, Appendix B, provides a definition of the statistical terms used in Tables 2B–5B.

varied for each phase of the TCRA, and 3) some property owners allowed access for sampling activities, but then denied access for removal activities.

In Table 2B, Appendix B, ATSDR provides descriptive statistics for arsenic in surface soil. Overall, 4,368 of 6,416 samples (68%) in the past had a concentration exceeding arsenic's chronic child EMEG. Because of US EPA removal actions, arsenic levels in surface soil are no longer above the arsenic chronic child EMEG at 117 properties (based on the laboratory and XRF data combined) and 110 properties (based on the laboratory data alone).

In Table 3B, Appendix B, ATSDR provides descriptive statistics for lead in surface soil. However, ATSDR could not provide comparisons of site-specific concentrations to a health-based screening value. As stated previously, no ATSDR health-based CV exists for screening lead surface soil levels because there is no clear threshold for some of the more sensitive health effects associated with lead exposures.

For each grid sampled, ATSDR calculated a BaP TE value by adding the sum of six PAHs detected in the surface soil sample with their concentrations adjusted for their toxicity relative to BaP. In Table 4B, Appendix B, ATSDR provides descriptive statistics for BaP TE in surface soil. Overall, 3,416 of 4,004 (85%) samples in the past had a concentration exceeding the ATSDR BaP CREG of 0.096 ppm. Because of US EPA removal actions, BAP TE levels in surface soil are no longer above the BaP CREG at 118 properties.

In Table 5B, Appendix B, ATSDR provides descriptive statistics for dibenz(ah)anthracene in soil. However, ATSDR could not provide comparisons of site-specific concentrations to a health-based screening value. As stated previously, no ATSDR health-based CV exists for screening dibenz(ah)anthracene in soil.

ATSDR retains for public health evaluation those chemicals exceeding CVs as well as those chemicals with no CVs. Therefore, further evaluation is needed to determine whether arsenic, lead, and PAH exposures were or are of public health concern at the 35th Avenue site.

6.2. Garden Produce Results

PAHs were not detected in any of the 20 vegetable samples. Arsenic was detected in only one sample, an unwashed collard green sample at a concentration of 0.069 milligrams per kilogram (mg/kg). Lead was detected in four garden produce samples: 0.063 mg/kg (unwashed cucumber), 0.16 mg/kg (unwashed collard green), 0.43 mg/kg (unwashed tomato), and 0.57 mg/kg (washed green onion) [OTIE 2013a]. ATSDR could not provide comparisons of site-specific concentrations to health-based screening values. As stated previously, no ATSDR health-based CVs exist for screening chemical levels in garden produce.

7. Public Health Evaluation

In this section, ATSDR addresses the question of whether exposure to arsenic, lead, and PAHs at the concentrations detected would result in adverse health effects. While the relative toxicity of a chemical is important, the human body's response to a chemical exposure is determined by several additional factors. These factors include

- the concentration (how much) of the chemical the person was exposed to,
- the amount of time the person was exposed (how long), and
- the way the person was exposed (through breathing, eating, drinking, or direct contact with something containing the chemical).

Lifestyle factors (for example, occupation and personal habits) have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any harmful health effects the individual may suffer from exposure.

As part of its evaluation, ATSDR typically derives exposure contaminant doses for children and adults. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (like soil). Exposure doses help ATSDR determine the likelihood that exposure to a chemical might be associated with harmful health effects.

Two key steps in ATSDR's analysis involve (1) comparing the estimated site-specific exposure doses with observed effect levels reported in critical studies and (2) carefully considering study parameters in the context of site exposures [ATSDR 2005]. This analysis requires the examination and interpretation of reliable substance-specific health effects data. This includes reviews of epidemiologic (human) and experimental (animal) studies. These studies are summarized in ATSDR's chemical-specific toxicological profiles. Each peer-reviewed profile identifies and reviews the key literature that describes a hazardous substance's toxicological properties. When evaluating a site, ATSDR health assessors also review more recently released studies in the scientific literature to ensure that our public health evaluations are based on the most current scientific knowledge.

Overall, assessing the relevance of available epidemiologic and experimental studies with respect to site-specific exposures requires both technical expertise and professional judgment. Because of uncertainties regarding exposure conditions and the harmful effects associated with environmental levels of chemical exposure, definitive answers about whether health effects will or will not occur are not feasible. However, providing a framework that puts site-specific exposures and the potential for harm in perspective is possible [ATSDR 2005].

In the following section, ATSDR summarizes the relevant epidemiologic and experimental information for arsenic, lead, and PAHs. ATSDR then provides its public health evaluation of each chemical.

7.1. Arsenic

Arsenic, a naturally occurring element, is widely distributed in the Earth's crust, which contains about 3.4 ppm arsenic [Wedepohl 1991]. Most arsenic compounds have no smell or distinctive taste. Although elemental arsenic sometimes occurs naturally, arsenic is usually found in the environment in two forms—inorganic (arsenic combined with oxygen, chlorine, and sulfur) and organic (arsenic combined with carbon and hydrogen). Sometimes, the specific form of arsenic present in the environment is not determined. Therefore, what form of arsenic a person may be exposed to is not always known.

Most simple organic forms of arsenic are less harmful than the inorganic forms [ATSDR 2007a]. Once in the environment, arsenic cannot be destroyed; it can only change forms or become attached to or separated from particles (e.g., by reacting with oxygen or by the action of bacteria in soil). Some forms of arsenic may be so tightly attached to particles or embedded in minerals that they are not taken up by plants and animals.

Arsenic is released to the environment through natural sources such as wind-blown soil and volcanic eruptions. However, anthropogenic (man-made) sources of arsenic release much higher amounts of arsenic than natural sources. These anthropogenic sources include nonferrous metal mining and smelting, pesticide application, coal combustion, wood combustion, and waste incineration. About 90% of all commercially produced arsenic is used to pressure-treat wood [ATSDR 2007a]. In the past, arsenic was widely used as a pesticide; in fact, some organic arsenic compounds are still used in pesticides. US EPA states that pesticide manufacturers have voluntarily phased out certain chromated copper arsenate (CCA) use for wood products around the home and in children's play areas; effective December 31, 2003, no wood treater or manufacturer may treat wood with CCA for residential uses, with certain exceptions [USEPA 2011a].

People may be exposed through incidentally ingesting soil containing arsenic. Arsenic concentrations for uncontaminated soils generally range from 1–40 ppm, with a mean of 5 ppm [ATSDR 2007a]. Arsenic concentrations in soils from various countries range from 0.1 to 50 ppm and can vary widely among geographic regions. The US Geological Survey reports a mean of 7.2 ppm and a range of less than 0.1–97 ppm in the United States [Shacklette and Boerngen 1984]. Higher arsenic levels may be found in the vicinity of arsenic-rich geological deposits, some mining and smelting sites, or agricultural areas where arsenic pesticides had been applied in the past.

People may be exposed through ingestion of garden produce containing arsenic. Garden plants grown in arsenic-contaminated soils take up small amounts of arsenic in their roots [Thorton 1994; Samsøe-Petersen et al. 2002; ATSDR 2007a]. In these studies, the arsenic concentrations in the plant roots were a small fraction of arsenic concentrations in the soils and the arsenic concentrations in the plants did not exceed regulatory standards for food items [Thorton 1994; Stillwell 2002]. Several studies also indicated that the plants took in more arsenic from air (and atmospheric deposition) than from uptake through their roots from soil [Larsen et al. 1992; Thorton 1994; Stillwell 2002]. Arsenic in leafy vegetables (kale) was by direct atmospheric deposition, while arsenic in the root crops (potatoes and carrots) was a result of both soil uptake and atmospheric deposition [Larsen et al. 1992]. US dietary intake of inorganic arsenic has been estimated to range from 1 to 20 micrograms per day (µg/day), with a mean of 3.2 µg/day; these estimates of inorganic arsenic intakes are based on measured inorganic arsenic concentrations from a market basket survey [Schoof et al. 1999a, 1999b].

Ingestion of arsenic-contaminated soil and garden produce is one way that arsenic can enter the body. Dermal exposure to arsenic is usually not of concern because only a small amount will pass through skin and into the body (4.5% of inorganic arsenic in soil) [Wester et al. 1993]. The metabolism of inorganic arsenic has been extensively studied in humans and animals. Several studies in humans indicate that arsenic is well absorbed across the gastrointestinal tract (approximately 95% absorption for inorganic arsenic compounds and 75–85% for organic arsenic compounds) [Bettley and O'Shea 1975; Buchet et al. 1981; Marafante et al. 1987; Zheng et al. 2002]. Once in the body, the liver changes (i.e., through methylation) some of the inorganic arsenic to less harmful organic forms that are more readily excreted in urine. In addition, inorganic arsenic is also directly excreted in the urine. Most forms of organic arsenic appear to undergo little metabolism. It is estimated that more than 75% of the absorbed arsenic dose is excreted in urine [Marcus and Rispin 1988]. Studies have shown that 45–85% of arsenic is eliminated within one to three days [Apostoli et al. 1999; Buchet et al. 1981; Crecelius 1977; Tam et al. 1979]. However, there appears to be an upper-dose limit to this mechanism working successfully to reduce arsenic toxicity [ATSDR 2007a].

As noted above, water-soluble forms of inorganic arsenic are well absorbed. Ingesting less soluble forms of arsenic results in reduced absorption. Studies in laboratory animals show that arsenic in soil is only one-half to one-tenth as bioavailable as soluble arsenic forms [Casteel et al. 1997; Freeman et al. 1993; Freeman et al. 1995; Groen et al. 1994; Rodriguez et al. 1999]. In one study, approximately 80% of the arsenic from ingested soil was eliminated in the feces compared with 50% of the soluble oral dose [Freeman et al. 1993]. The bioavailability of arsenic in soil may be reduced due to low solubility and inaccessibility [Davis et al. 1992]. Most of the bioavailable arsenic in water and soil is expected to be present as inorganic arsenic (trivalent arsenic and pentavalent arsenic, specifically) [Health Canada 1993]. US EPA conducted an analysis and external independent peer review of arsenic's relative bioavailability (RBA) in soil, and concluded that [USEPA 2012a, 2012b]

1. available research information suggests that an RBA of arsenic in soils can be expected to be less than 100%,
2. the upper percentile of US data results in a default RBA arsenic in soil value of 60%, and
3. the default RBA for arsenic in soils should only be used if site-specific assessments for arsenic RBA are not feasible.

ATSDR's acute oral minimal risk level[9] (MRL) of 0.005 milligrams per kilogram per day (mg/kg/day) is based on a study in which 220 people in Japan were exposed to arsenic contaminated soy sauce for a 2–3 week period. The dose was estimated to be 0.05 mg/kg/day*,* which is considered the LOAEL. Facial edema and gastrointestinal symptoms (nausea, vomiting, and diarrhea) were considered to be the critical effects seen at this dose [Mizuta et al. 1956]. The MRL is further supported by the case of a man and woman in upstate New York who experienced gastrointestinal symptoms after drinking arsenic-tainted water at an estimated dose of 0.05 mg/kg/day [Franzblau and Lilis 1989].

The chronic oral MRL (0.0003 mg/kg/day) is based on a study in which a large number of farmers (both male and female) were exposed to high levels of arsenic in well water in Taiwan. US EPA's oral reference dose (RfD) is also 0.0003 mg/kg/day [USEPA 2008]. A clear dose-response relationship was observed for characteristic skin lesions. A control group consisting of 17,000 people was exposed to 0.0008 mg/kg/day and did not experience adverse health effects. This is considered to be the NOAEL. Hyperpigmentation and keratosis of the skin were reported in farmers exposed to 0.014 mg/kg/day (less serious LOAEL). Those exposed to 0.038–0.065 mg/kg/day experienced an increased incidence of dermal lesions [Tseng et al. 1968; Tseng 1977]. The MRL is supported by a number of well-conducted epidemiological studies that identify reliable NOAELs and LOAELs for dermal effects [Borgoño and Greiber 1972; Cebrían et al. 1983; Guha Mazumder et al. 1988; Haque et al. 2003; Harrington et al. 1978; USEPA 1981; Valentine et al. 1985; Zaldívar 1974]. Collectively, these studies indicate that the threshold dose for dermal effects (ex., hyperpigmentation and hyperkeratosis) is approximately 0.002 mg/kg/day.

The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and US EPA have all determined that inorganic arsenic is carcinogenic to humans. There is convincing evidence from a large number of epidemiological studies and case reports that ingestion of inorganic arsenic increases the risk of developing skin cancer [Alain et al. 1993; Beane Freeman et al. 2004; Bickley and Papa 1989; Cebrián et al. 1983; Chen et al. 2003; Haupert et al. 1996; Hsueh et al. 1995; Lewis et al. 1999; Lüchtrath 1983; Mitra et al. 2004; Morris et al. 1974; Sommers and McManus 1953; Tay and Seah 1975; Tsai et al. 1998; Tsai et al. 1999; Tseng 1977; Tseng et al. 1968; Zaldívar 1974;

[9] The acute oral MRL is considered provisional because it is based on a serious LOAEL.

Zaldívar et al. 1981]. A report by the National Research Council suggests that the risks calculated based on increases in incidence of lung and bladder cancers may be greater than those calculated based on incidences of skin cancer [NRC 2001]. In 2010, US EPA proposed a revised cancer slope factor (CSF) for inorganic arsenic based on a review of the scientific basis supporting the human health cancer hazard and dose-response assessment of inorganic arsenic [USEPA 2010].

For this PHC, ATSDR derived exposure doses for community members exposed to arsenic in soil (see Exhibit 1).

Exhibit 1: Exposure Dose Equation for Ingestion of Soil

$$D = \frac{C \times IR \times EF \times AF \times CF}{BW}$$

where,

D	=	exposure dose in milligrams per kilogram per day (mg/kg/day)
C	=	chemical concentration in milligrams per kilogram (mg/kg)
IR	=	intake rate in milligrams per day (mg/day)
EF	=	exposure factor (unitless)
AF	=	bioavailability factor
CF	=	conversion factor, 1×10^{-6} kilograms/milligram (kg/mg)
BW	=	body weight in kilograms (kg)

As part of its evaluation, ATSDR also calculated cancer risk estimates using the US EPA arsenic oral CSF of 1.5 $(mg/kg/day)^{-1}$. Under quantitative cancer risk assessment methodology, cancer risk estimates are expressed as a probability (see Exhibit 2).

Exhibit 2: Cancer Risk Equation

$$\textbf{Age-Specific Cancer Risk} = D \times CSF \times (ED / 78)$$

where,

D	=	age-specific exposure dose in milligrams per kilogram per day (mg/kg/day)
CFS	=	cancer slope factor in $(mg/kg/day)^{-1}$
ED	=	age-specific exposure duration in years

Cancer risk estimates are expressed as the proportion of a population that may be affected by a carcinogen during a lifetime of exposure (24 hours/day, 365 days/year, for life). For example, an estimated cancer risk of 2×10^{-6} represents potentially two excess cancer cases in a population of one million over a lifetime of continuous exposure.

7.1.1. Soil Exposure

ATSDR calculated exposure doses for both central tendency exposure (CTE), which refers to persons who have an average or typical soil intake rate, and reasonable maximum exposure (RME), which refers to persons who are at the upper end of the exposure distribution (approximately the 95th percentile). The RME scenario assesses exposures that are higher than average but still within a realistic exposure range. In the absence of complete exposure-specific information regarding soil exposures, ATSDR applied several conservative exposure assumptions to define site-specific CTE and RME (see Table 12B, Appendix B). Site-specific assessments for arsenic's RBA in soil are not available; therefore, the bioavailability of arsenic was assumed to be 60% [USEPA 2012a, 2012b].

In Tables 6B (laboratory and XRF data combined) and 7B (laboratory data alone), Appendix B, ATSDR provides estimated doses for the most highly exposed groups for various arsenic concentration ranges. ATSDR also provides in these tables the number of 35th Avenue properties with arsenic concentrations within the specified ranges. Overall, these tables indicates there are fewer properties in the current scenario with arsenic levels within the highest concentration ranges. In addition, Table 2B, Appendix B, indicates that although the mean arsenic level for properties targeted for removal actions is 39.1 ppm, following removal actions, the mean for the remaining properties is 21.5 ppm.

However, laboratory and XRF data combined in Table 6B, Appendix B, indicate there are 31 of 1,234 (2.5%) tested properties in the past and 12 of 1,113 (1.1%) properties currently with surface soil levels of arsenic ≥ 90 ppm. Laboratory data alone in Table 7B, Appendix B, indicate there are 15 of 543 (2.8%) properties in the past and 10 of 424 (2.4%) properties currently with surface soil levels of arsenic ≥ 90 ppm. For children who intentionally eat soil (which leads to a higher than normal soil intake), arsenic concentrations ≥ 90 ppm were and are at a level of public health concern for acute (short-term) exposures because the estimated doses approach and exceed the arsenic LOAEL of 0.05 mg/kg/day. The maximum levels of arsenic (1,000 ppm and 1,336 ppm) for two properties (one based on laboratory analysis and one on XRF) were and are of concern for children who do not intentionally eat soil because the estimated dose approaches the arsenic LOAEL. By definition, LOAEL doses cause harmful health effects. The likelihood of harmful health effects increases as site-specific doses approach a LOAEL, and are of particular concern when the LOAEL is classified as "serious"[10], such as is the case of the arsenic LOAEL. If children live at or visit the two properties and participate in contact-intense activities[11], it is plausible that they may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Children who eat dirt are especially at risk. ATSDR would not expect adults, including women and gardeners, to experience harmful health effects from short-term exposures to arsenic in surface soil.

[10] ATSDR classifies LOAELs into "less serious" or "serious" effects. "Serious" effects are those that evoke failure in a biological system. "Less serious" effects are those that are not expected to cause significant dysfunction [ATSDR 2007a].

[11] Contact-intense activities include digging with shovels and other tools, and playing with toys (like toy trucks and action figures) on the ground surface. Children can be exposed by putting soiled hands or toys in their mouth or by breathing or eating dust generated by their activities.

ATSDR would not expect adults, including women and gardeners, to experience noncancer harmful health effects from long-term exposures to arsenic in surface soil. For chronic[12] child exposures (i.e., those lasting a year or longer), arsenic levels in surface soil ≥ 150 ppm are at and exceed the threshold dose for dermal effects of 0.002 mg/kg/day. Laboratory and XRF sample results combined show 13 of 1,234 (1.1%) properties in the past and 5 of 1,113 (0.4%) properties currently have arsenic in soil above levels that may lead to dermal effects. Laboratory data alone show 6 of 543 (1.1%) properties in the past and 4 of 424 (0.9%) properties currently are of public health concern for dermal health effects. Note that it is more likely that children will come into frequent, repeated contact with the soil in residential yards that contain gardens or play areas with bare soil. Overall, ATSDR considers long-term exposure to elevated arsenic concentrations of potential public health concern for children for noncancerous health effects, especially at properties with gardens and play areas with bare soil.

With regard to cancer risk, ATSDR calculated cancer risk estimates using the formula shown in Exhibit 2 and the US EPA arsenic oral CSF of 1.5 $(mg/kg/day)^{-1}$. To determine cancer risk, ATSDR looked at two exposure populations: children exposed from birth to 21 years of age and adults exposed for 33 years. For children, exposure to surface soil with levels of arsenic ≥ 61 ppm may result in estimated cancer risks at and exceeding 1×10^{-4} (one case in ten thousand persons), which ATSDR considers a level of concern for lifetime cancer risk [ATSDR 2004]. For adults, arsenic surface soil levels ≥ 120 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}.

Based on the laboratory and XRF data combined, cancer risk estimates for arsenic in soil were at and exceeding 1 in 10,000 people for about 80 of 1,234 (6.5%) properties in the past and 43 of 1,113 (3.9%) properties currently. Based on the laboratory data alone, 36 of 543 (6.6%) properties in the past and 22 of 424 (5.2%) properties currently are at and exceeding this cancer risk level. The American Cancer Society estimates 1 in 3 Americans will get some form of cancer during their lifetime. That means for every 10,000 people, on average 3,333 will get some kind of cancer. A cancer risk estimate of 1 in 10,000 people may make the lifetime risk of getting cancer higher by one case – from 3,333 to 3,334. The actual number of people getting cancer caused by exposure to arsenic in soil may be higher or lower, and could be none, because this is an estimate.

Note also that the harmful health effects observed in the studies on arsenic ingestion involved daily, long-term ingestion of elevated arsenic levels in drinking water. It is not likely that ingestion of large amounts of soil would occur 365 days a year for life. Therefore, ATSDR considers arsenic soil exposures at most properties to represent a low cancer risk.

7.1.2. Homegrown Garden Produce

As stated previously, garden plants grown in arsenic-contaminated soils can take up small amounts of arsenic in their roots and arsenic can be deposited as a particulate on the surface of the plant [Thorton 1994; Samsøe-Petersen et al. 2002; ATSDR 2007a]. For the 35th Avenue site, arsenic was detected in only 1 of 20 samples, an unwashed collard green sample, at a concentration of 0.069 mg/kg. For the highest

[12] Note that some preschool children might intentionally eat soil once during their preschool years, while others might go through a stage of eating soil several times during a week or even over several months [ATSDR 2014]. Overall, though, intentionally eating soil is not considered to occur over the long-term, i.e., every day for longer than a year.

exposed group (i.e., children 1 to > 2 years of age), the arsenic dose[13] for this garden produce sample would be 0.001 mg/kg/day, which is below arsenic's threshold dose for chronic effects of 0.002 mg/kg/day. Overall, because arsenic was not detected in the majority of garden produce samples and because the estimated dose is below the arsenic chronic threshold dose, ATSDR would not expect ingestion of arsenic in garden produce alone to be of health concern. However, the maximum garden produce level may be of health concern for people who are also exposed to elevated levels of arsenic in their garden soil. The combined exposure to arsenic in surface soil and garden produce may exceed the threshold dose for chronic effects.

People who are concerned about arsenic contamination may reduce their exposure to chemicals in their homegrown produce by peeling root crop vegetables, such as carrots and potatoes. Another way to minimize exposures is to remove dirt from garden produce before bringing it into the home. Washing homegrown produce thoroughly will also remove soil particles that may contain arsenic. See Appendix C for prudent public health measures people can take to reduce soil and garden produce exposures and to protect themselves, their families, and visitors.

7.2. Lead

Lead is a naturally occurring bluish-gray metal found in the earth's crust and it has many different uses. It is used in the production of batteries, ammunition, metal products (solder and pipes), and devices to shield X-rays. Because of health concerns, lead from paints and ceramic products, caulking, and pipe solder has been dramatically reduced in recent years. Prior to 1955, there were no limits on lead in paint, but it is estimated that it was between 2.5% and 5%. After 1978, there is less than 0.06% lead in paint. Using lead as an additive to gasoline was banned in 1996 in the United States.

Today, lead can be found in all parts of the environment because of human activities including burning fossil fuels, mining, manufacturing, and past uses [ATSDR 2007b, 2007c]. Because of this, lead is often found in the body in low levels. In the past three decades, however, blood lead levels (BLLs) in the general public have decreased by 78% as a result of the regulation of lead in gasoline, paint, and plumbing materials [ACCLPP 2007].

Lead has no physiological value, and if it gets into the body, lead can affect various organ systems and be stored in the bones. Lead that is not stored in bones leaves the body as waste. About 99% of the amount of lead taken into the body of an adult will be excreted in the waste within a couple of weeks, while about 30% of the lead taken into the body of a child will leave in the waste [ATSDR 2007b]. Most of the remaining lead moves into bones and teeth. Lead can stay in bones for decades; however, some lead can leave bones and reenter the blood and organs under certain circumstances; for example, during pregnancy, after a bone is broken, and during advancing age.

Lead can be found in many products and locations. Lead-based paint and contaminated dust are the most widespread and dangerous high-dose source of lead exposure for young children [CDC 2009]. However, lead exposure can occur from many indoor, outdoor, and other sources [CDC 2009; NYDOH 2010]. Table 13B, Appendix B, provides additional information about these sources.

[13] For its calculation, ATSDR used the US EPA 95th percentile for consumer-only intake of fruits and vegetables for 1 to > 2 years of age, which is 21.4 g/kg-day, and US EPA's formula for residential ingestion of fruits and vegetables [USEPA 1989, 2011b].

Lead uptake, especially from the gastrointestinal tract, is influenced by nutrients such as calcium and iron as they occur in meals or with intermittent eating. Lead uptake generally increases as dietary levels of these nutrients decrease. Appendix D provides ways people can reduce lead uptake, such as eating healthy foods. In addition, lead uptake is a function of age, administered dose, the chemical species, and the particle size of the lead-containing media [USEPA 1994a].

Lead-contaminated dust can be inhaled or ingested. Once airborne lead deposits onto soil, it does not dissipate, biodegrade, or decay easily. Lead usually binds to soil and indoor dust and can become a long-term source of lead exposure. Exposure to lead-contaminated soil can be affected by particle size, ground cover, soil conditions, seasonal variation, behavior patterns, a person's age, outdoor activity, and a variety of other risk factors. Many factors can influence uptake, such as lead bioavailability and individual nutritional status, and therefore the blood lead levels.

Exposure to lead can occur through garden produce grown in lead-contaminated soil. One study showed that all garden vegetable plants grown in contaminated soil accumulate lead to some level, and that the majority of the contamination is in the plant root. Smaller levels of lead were found in the plant shoot, with low to non-detectable levels in the edible fruit (e.g., tomatoes, peppers, beans, and zucchini) [Finster et al. 2004]. Most lead compounds are relatively insoluble; therefore, natural plant uptake is minimal [Barocsi et al. 2003].

In addition to contact with lead-contaminated environmental media, multiple factors have been associated with increased risk of higher BLLs. These factors include [Bernard and MecGeehin 2003; CDC 2005, 2013a, 2013b; Dixon et al. 2009; Holstege et al. 2013; Jones et al. 2009; Lee et al. 2005; Mielke et al. 2010; Shannon et al. 2005; US Census Bureau 2010b; USEPA 2013b]

- Children[14] less than 6 years of age
- Blacks and Hispanics
- People who live in homes built before 1978
- People who live in rental property
- Those in poverty
- New immigrant and refugee populations
- People born in Mexico
- Living in an urban area
- Living in specific regions of the U.S. (i.e., Northeast > Midwest > South> West)

Blood Lead Levels and Health Effects

Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects [ATSDR 2007b, 2007c].

[14] Lead can also harm a developing fetus, so pregnant women or women likely to become pregnant should be especially careful to avoid exposure to lead [Mayo Clinic 2015].

In May 2012, the Centers for Disease Control and Prevention (CDC) updated its recommendations on children's blood lead levels. By shifting the focus to primary prevention of lead exposure, CDC wants to reduce or eliminate dangerous lead sources in children's environments before they are exposed.

- *Blood Lead Reference Level now 5 µg/dL* – Until recently, children were identified as having a blood lead level of concern if the test result was 10 or more micrograms per deciliter (µg/dL) of lead in blood. Experts now use a reference level of 5 µg/dL. This reference level is based on the highest 2.5% of the U.S. population of children 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES) [ACCLPP 2012; CDC 2012a, 2012b]. The current (2011–2012) geometric mean BLL for that age group is 0.97 µg/dL [CDC 2015].
- *No Change in Blood Lead Levels Requiring Medical Treatment* – What has not changed is the recommendation for when to use medical treatment for children. Experts recommend chelation therapy when a child is found with a test result equal to and greater than 45 µg/dL [CDC 2014], however chelation is not without risks.
- *Health Effects in Children with Measurable Blood Lead Levels less than 5 µg/dL and 10 µg/dL* – There is no clear threshold for some of the more sensitive health effects associated with lead exposures. In children, the National Toxicology Program reports conclusions on health effect studies of low-level lead exposure for both <5 µg/dL and <10 µg/dL where there is sufficient evidence of [NTP 2012]
    - Decreased academic achievement (<5 µg/dL),
    - Decreased intelligence quotient (IQ) (<5 µg/dL and <10 µg/dL),
    - Decreased specific cognitive measures (<5 µg/dL),
    - Increased incidence of attention-related and problem behavior (<5 µg/dL),
    - Decreased hearing (<10 µg/dL),
    - Reduced postnatal growth (<10 µg/dL), and
    - Delays in puberty (<10 µg/dL).
- *Health Effects of Lead on Developing Fetuses* – Lead crosses the placenta; consequently, it can pass from a pregnant woman to her developing fetus. Follow-up testing, increased patient education, and environmental, nutritional and behavioral interventions are indicated for all pregnant women with BLLs greater than or equal to 5 µg/dL to prevent undue exposure to the developing fetus and newborn [CDC 2013c]. Too much lead in a pregnant women's body can [CDC 2013C]
    - Put her at risk for miscarriage,
    - Cause the baby to be born too early or too small,
    - Hurt the baby's brain, kidneys, and nervous system, and
    - Cause the child to have learning or behavior problems.
- *Health Effects for Adults* – Adults who are exposed to lead over many years could develop kidney problems, high blood pressure, cardiovascular disease, and cognitive dysfunction [Kosnett et al. 2007].

Neither ATSDR nor US EPA has developed a MRL or RfD for exposure to lead. Therefore, ATSDR cannot use the usual approach of estimating human exposure to an environmental contaminant and then comparing that dose to a health based comparison value (such as an MRL of RfD). Instead, lead is evaluated using a biological model that predicts blood lead concentrations that could result from human exposure to environmental lead contamination. Specifically for this PHC, ATSDR evaluated exposure to lead by using US EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children.

Note also that the US EPA developed the Adult Lead Methodology (ALM) to predict the risk of elevated blood lead levels in nonresidential settings, such as the workplace, for adult women's exposures to soil; however, the ultimate receptor is the fetus. More information about US EPA's adult lead methodology can be found at http://www.epa.gov/superfund/lead/products.htm.

IEUBK Model

The IEUBK model calculates exposure from lead in air, water, soil, dust, diet, paint, and other sources and predicts the risk of elevated blood lead levels in children 6 months to 7 years of age. The model can also be used to predict risk for specific age groups up to age 7. There is currently no generally accepted model for predicting blood lead concentrations for children 7 years of age and older.

The IEUBK model is designed to integrate exposure with pharmacokinetic modeling to predict blood lead concentrations. The four main components of the current IEUBK model are: 1) an exposure model that relates environmental lead concentrations to age-dependent intake of lead into the gastrointestinal tract; 2) an absorption model that relates lead intake into the gastrointestinal tract and lead uptake into the blood; 3) a biokinetic model that relates lead uptake in the blood to the concentrations of lead in several organ and tissue compartments; and 4) a model for uncertainty in exposure and for population variability in absorption and biokinetics [USEPA 1994a].

The IEUBK model results can be viewed as a predictive tool for estimating changes in blood concentrations as exposures are modified [USEPA 1994a]. The IEUBK model provides choices a user may make in estimating a child's blood lead concentration. These are referred to "user-specified" parameters or decisions. The reliability of the results obtained using the model is very dependent on the selection of the various coefficients and default values that were used. Section 7.4 discusses some of the limitations of the model.

7.2.1. Soil

ATSDR ran the IEUBK model (IEUBKwin Model 1.1 Build 11) using default parameters for all inputs except 1) the soil level, which was set to various lead levels for each model run, and 2) the BLL reference level for risk estimation, which was set to 5 µg/dL.

In Tables 8B (laboratory and XRF data combined) and 9B (laboratory data alone), Appendix B, ATSDR provides the IEUBK estimated probability of exceeding a BLL of 5 µg/dL and the geometric mean BLLs for various lead concentration ranges. ATSDR also provides in this table the number of 35th Avenue grids and properties with lead concentrations within the specified ranges.

Tables 8B and 9BB, Appendix B, shows there are properties with high levels of lead in soil, indicating the potential for elevating BLLs in children who live at or visit these properties. Children who intentionally eat dirt are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Other indoor and outdoor sources (see Table 13B, Appendix B) may result in elevating BLLs even further. Also, multiple factors that have been associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race)[15]. Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.

Overall though, US EPA reduced exposure to lead-contaminated soil through its TCRA. Tables 8B and 9B, Appendix B, indicates there are fewer properties in the current scenario with lead levels within the highest concentration ranges. In addition, Table 3B, Appendix B, shows that although the mean lead level for properties targeted for removal actions is 737 ppm, following removal actions, the mean lead level for the remaining properties is 206 ppm.

However, lead cannot be entirely eliminated from the environment so there will always be some residual levels following cleanup actions at lead-contaminated sites and children may be exposed to non-site-specific sources of lead (e.g., lead-based paint in homes built before 1978). Eliminating exposure pathways by controlling contamination sources and practicing good personal hygiene can help prevent high levels of lead in blood (see Appendices D and E).

7.2.2. *Homegrown Garden Produce*

As stated previously, garden produce grown in contaminated soil can accumulate lead to some level. At the 35th Avenue site, lead was detected in 4 of 20 samples (20%), with the maximum level of 0.57 mg/kg in a washed green onion sample.

ATSDR ran the IEUBK model (IEUBKwin Model 1.1 Build 11) using default parameters for all inputs except 1) the soil level, which was set to 100 ppm[16], 2) the vegetable diet value[17], which was set to 100% homegrown with 0.57 mg/kg lead, and 3) the BLL reference level for risk estimation, which was set to 5 µg/dL. The IEUBK output shows a 4.7% probability of exceeding a BLL of 5 µg/dL.Based on these results, the risk of elevated BLLs in children 6 months to 7 years of age from eating garden produce alone is low. However, with increasing soil lead concentrations, the IEUBK outputs show increasing probabilities of exceeding a BLL of public health concern. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

7.2.3. *Blood Lead Data Review*

ATSDR reviewed available BLL data from two sources: the Jefferson County Department of Health (JCDH) and the Alabama Department of Public Health (ADPH).

1. On July 18 and July 23, 2013, JCDH conducted BLL screening events specifically for the 35th Avenue community. Of the 44 participants (1–70 years of age), JCDH found that no BLLs exceeded 5 µg/dL. Overall though, 15 of the 44 participants (34%) did not actually live within the

[15] For the population within the site boundaries, 98% are black [US Census Bureau 2010a]. The site straddles two census tracts, and 95% of the housing was built before 1978 in tract 01073005500 and 98% in tract 01073000700 [US Census Bureau 2013]. About 24% of the population was below the poverty line in tract 01073005500 and 41% in tract 01073000700 [US Census Bureau 2010b].

[16] US EPA recommends < 100 ppm lead in soil for gardens [USEPA 2014b].

[17] The alternative diet component of the IEUBK model is calculated as the summation of the lead intake rates for meat, vegetables, fruit and other sources [USEPA 1994b]. The vegetables could be canned, fresh, or homegrown. When we ran the model, we set the vegetable intake to 100% homegrown and 0.57 mg/kg lead, but did not change the default parameters for meat, fruit, and other sources.

boundaries of the site [JCDH 2013]. About 30% (13 participants) were children 1–5 years of age, but two of these children did not live within the site area. For all 13 children 1–5 years of age who participated, the geometric mean BLL was 1.4 µg/dL, with a 95% confidence interval (CI) on the geometric mean of 1.1–1.9 µg/dL (see Table 14B, Appendix B). For the 11 children 1–5 years of age who live within the site boundary, the geometric mean BLL was 1.3 µg/dL, with a 95% CI on the geometric mean of 1.0–1.7 µg/dL.

2. ADPH conducts the Alabama Childhood Lead Poisoning Prevention Project (ACLPPP). ACLPPP has the following mission [ADPH 2015]:

   > Our mission is to help every child in Alabama develop to his or her maximum potential by promoting a lead free environment and healthy lifestyle. To accomplish this mission ACLPPP provides public outreach and education, case investigation, and case management[18] services to help prevent further lead exposure in Alabama's children.

   Per a request from ATSDR, ADPH provided 2010–2014 BLL data for children in the ZIP code 35207 [ATSDR 2015]. The 35th Avenue site lies within this ZIP code (see Figure 1A, Appendix A). A total of 560 BLL results were available for children ≤ 21 years of age. For children 1–5 years of age, 16 of 329 BLL tests (4.9%) were ≥ 5 µg/dL (see Table 15B, Appendix B). The maximum BLL was 16 µg/dL and the geometric mean was 1.7 µg/dL (95% CI of 1.6–1.9 µg/dL). For children 6–11 years of age, 9 of 214 BLL tests (4.2%) were ≥ 5 µg/dL. The maximum BLL was 10 µg/dL and the geometric mean was 1.9 µg/dL (95% CI of 1.7–2.0 µg/dL). However, the ZIP-code level BLL data may not necessarily be representative of the site area because 1) the ACLPPP endeavors to test children with the highest risk for elevated blood lead levels, and 2) the ZIP code data encompassed a larger area than just the site.

US EPA is currently determining its options toward future phases of removal action. Because ATSDR recognizes that even low levels of lead in blood have been shown to have harmful effects, the agency supports additional efforts by US EPA to reduce lead levels in soil at the 35th Avenue site. The agency also understands parents with young children may still be concerned about lead exposures. ATSDR recommends parents consider following the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012]. ATSDR also recommends concerned residents take prudent public health measures to reduce their exposure (see Appendices C, D, and E). Further, ATSDR supports any future health education efforts undertaken by the JCDH. ATSDR can address questions about exposure to lead (toll-free 1-800-CDC-INFO.) When contacting ATSDR, please state you are requesting information related to the 35th Avenue site.

7.3. Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are produced by the incomplete combustion of organic materials such as coal, oil, wood, tobacco, and even food products [ATSDR 1995]. They are also found in petroleum products such as asphalt, coal tar, creosote, and roofing tar. As a result, they are very common in the environment from such processes as volcanic eruptions, forest fires, home wood

[18] Case management is defined as identifying an individual's needs and problems and devising a method to meet those appropriately and cost-effectively. Consultation with other health professionals and agencies helps the person take advantage of appropriate treatments and procedures. The goal is to assure proper follow-up for children with elevated blood lead levels [ADPH 2004].

burning, and vehicle exhaust. More than 100 PAHs are known to exist, and they are usually found in the environment as mixtures. The most studied PAH is benzo(a)pyrene (BaP).

Current ATSDR guidance indicates six of the seven PAHs detected in 35th Avenue soil should be evaluated as a mixture using a calculated benzo(a)pyrene toxic equivalent (BaP TE) value. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. As stated in Section 6, the BaP TE value is the sum of the different PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP.

PAHs tend to bind to soil particles. In soil, microbial metabolism is the major process for the degradation of PAHs. The rate and extent of biodegradation of PAHs in soil are affected by environmental factors such as the organic content, the structure and particle size of the soil, and the characteristics of the microbial population. BaP background concentrations for agricultural soil range from 0.0046–0.9 ppm, and 0.165–0.22 ppm for urban soil [ATSDR 1995].

Studies indicate elevated concentrations of PAHs can exist in soil at contaminated sites. Soil samples collected from the Fountain Avenue Landfill in New York City contained PAH concentrations ranging from 0.4–10 ppm [Black et al. 1989]. In a 1988 study at a hazardous waste land treatment site for refinery process wastes, average PAH concentrations in surface soils ranged from not detected for several PAHs to 340 ppm for dibenz(ah)anthracene [Loehr et al. 1993].

In general, plants may take up chemical contaminants either by absorbing them through their root system or through their leaves and stems. Chemicals in air may also settle on the above ground parts of plants [Simonich and Hites 1995]. Based on a review of the available scientific literature, chemicals such as PAHs are not thought to be taken into most plants by the root system [Wild et al. 1992; Simonich and Hites 1995; Samsøe-Petersen et al. 2002]. Studies also suggest that these chemicals may get into crops such as carrots and potatoes, but are located primarily in the peel [Wild et al. 1992; Samsøe-Petersen et al. 2002].

Swallowing soil or dust particles and eating garden produce that contain PAHs are routes for these chemicals to enter a person's body, but absorption is generally slow when PAHs are swallowed. PAHs also could enter through skin that comes into contact with soil containing high levels of PAHs. PAHs tend to be stored mostly in the kidneys, liver, and fat. Most PAHs that enter the body leave within a few days, primarily in the feces and urine [ATSDR 1995].

ATSDR has not derived oral MRLs for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for noncancer health effects. The animal oral data are limited because of conflicting results across studies, the use of inconsistent protocols (e.g., varying numbers of animals, administration of the test compound during different times of gestation), the use of only one dose, lack of study details, and most data are available only for BaP.

Although serious reproductive and developmental effects in animals associated with acute oral exposure to PAHs have been reported, these are not appropriate end points for the derivation of an acute MRL. The lowest BaP acute exposure levels reported in ATSDR's Toxicological Profile for Polycyclic Aromatic Hydrocarbons [ATSDR 1995] are for developmental effects in mice at 10 mg/kg/day (NOAEL) and 40 mg/kg/day (LOAEL); and for reproductive effects in mice at 40 mg/kg/day (NOAEL) [Makenzie and Angevine 1981]. Noncancer effects noted in longer term oral toxicity studies in animals include increased liver weight and aplastic anemia (a serious effect), neither of which is an appropriate end point for the derivation of an MRL [ATSDR 1995]. These longer-term effects were seen in mice at levels starting at 120 mg/kg/day (LOAEL) [Robinson et al. 1975].

Tumors were observed in laboratory animals when they breathed, ate, or had long periods of skin exposure to PAHs. Human data specifically linking BaP to a carcinogenic effect are lacking. There are, however, multiple animal studies demonstrating BaP to be carcinogenic following administration by numerous routes [USEPA 1992].

Creosote contains PAHs. Workers who had long-term skin contact with creosote, especially during wood treatment or manufacturing processes, reported increases in skin cancer and cancer of the scrotum. Cancer of the scrotum has been associated with long-term exposure to soot and coal tar creosotes of chimney sweeps. Animal studies have also shown an association between creosote exposure and skin cancer [ATSDR 2002].

The CSF for BaP of 7.3 $(mg/kg/day)^{-1}$ is based on the geometric mean of four different dose response models using multiple species and both sexes. There were several types of cancer observed: forestomach, squamous cell papillomas and carcinomas; forestomach, larynx and esophagus, papillomas and carcinomas (combined). The US EPA considers the available human cancer data to be inadequate but the animal carcinogenic data on which the CSF is based to be sufficient [UPEPA 1992]. For dibenz(ah)anthracene, a potency of 4.1 $(mg/kg/day)^{-1}$ was derived using the linearized multistage model with the only dose-response data set available—a drinking water study (Snell and Stewart 1962) which reported alveolar carcinomas of the lung in male mice [Cal EPA 2005].

7.3.1. Soil

Similar to arsenic, ATSDR calculated exposure doses for CTE and RME for BaP TE and dibenz(ah)anthracene concentration ranges. ATSDR applied several conservative exposure assumptions to define site-specific CTE and RME (see Table 12B, Appendix B). PAH bioavailability was assumed to be 100%.

In Tables 10B and 11B, Appendix B, ATSDR provides estimated doses for various BaP TE and dibenz(ah)anthracene concentration ranges. ATSDR also provides in these tables the number of 35th Avenue properties with BaP TE and dibenz(ah)anthracene concentrations within the specified ranges. These tables indicates there are fewer properties in the current scenario with PAH levels within the highest concentration ranges. In addition, Table 4B, Appendix B, indicates that although the mean BaP TE level for properties targeted for removal actions is 18 ppm, following removal actions, the mean level for the remaining properties is 1.2 ppm. Table 5B, Appendix B, indicates that although the mean dibenz(ah)anthracene level for properties targeted for removal actions is 0.96 ppm, following removal actions, the mean level for the remaining properties is 0.14 ppm.

ATSDR has not derived oral MRLs for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for appropriate noncancer health effects. However, the doses at which noncancer health effects occurred in mice were many orders of magnitude higher than the PAH doses from soil exposures at this site. Therefore, it is unlikely that any noncancerous harmful health effects from PAH soil exposure would occur in children or adults.

With regard to cancer risk, ATSDR calculated cancer risk estimates using the US EPA oral CSF of 7.3 $(mg/kg/day)^{-1}$ for BaP and 4.1 $(mg/kg/day)^{-1}$ for dibenz(ah)anthracene. To calculate cancer risk, ATSDR followed US EPA's proposed risk calculations for chemicals that act with a mutagenic mode of action[19] for carcinogenesis [USEPA 2005]. For children, BaP TE surface soil levels ≥ 1.8 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}, which ATSDR considers a level of concern for lifetime cancer risk [ATSDR 2004]. For adults, BaP TE surface soil levels ≥ 25 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. For children, dibenz(ah)anthracene surface soil levels ≥ 3.5 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. For adults, dibenz(ah)anthracene surface soil levels ≥ 45 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}.

The cancer risk estimates for BaP TE levels in soil were at and exceeding 1 in 10,000 people for 181 of 1,234 (15%) properties in the past and 116 of 1,113 (10%) properties currently. For dibenz(ah)anthracene soil levels, 16 of 1,234 (1.3%) properties in the past and 3 of 1,113 (0.3%) properties currently are at and exceeding the cancer risk estimate of 1 in 10,000 people.

As stated in the arsenic section, the American Cancer Society estimated 1 in 3 Americans will get some form of cancer during their lifetime. That means for every 10,000 people, on average 3,333 will get some kind of cancer. A cancer risk estimate of 1 in 10,000 people may make that number higher by one case – from 3,333 to 3,334. The actual number of people getting cancer caused by exposure to PAHs in soil may be higher or lower, and could be none, because this is an estimate.

Of note though, it is not likely that ingestion of large amounts of soil would occur 365 days a year for life. Therefore, ATSDR considers PAH soil exposures at most properties to represent a low cancer risk.

7.3.2. Homegrown Garden Produce

As stated previously, studies indicate that most plants do not take up significant amounts of PAHs from soil. Because PAHs were not detected in any of the 20 vegetable samples at the 35th Avenue site, PAHs in homegrown garden produce at this site are not at levels of health concern.

7.4. Limitations

ATSDR's public health evaluation has several limitations, some of which are noted here.

- Estimating an exposure dose required identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in the water and soil. ATSDR made several assumptions for site-specific exposure scenarios (see Table 12B, Appendix B). Although ATSDR's assumptions were conservative, each person's exposure might be higher or lower depending on his or her lifestyle and individual characteristics that influence contact with contaminated media.
- Although sample location, collection, and quality assurance procedures were established and resulted in a consistent, well-documented data set, ATSDR notes that not all property owners allowed access for sampling activities. About 1,100 of the approximately 2,000 parcels (about 55%) in the 35th Avenue site study area were tested. The untested properties may have elevated levels of soil contamination. The agency also notes that some property owners allowed access for sampling activities, but then denied access for removal activities.

[19] Because BaP and dibenz(ah)anthracene are without chemical-specific data on early life exposures, age-dependent adjustment factors were applied [USEPA 2005].

- ATSDR's evaluation required the examination and interpretation of reliable, substance-specific, health effects data. The evaluation included a review of epidemiologic (human) and experimental (animal) studies. A study based on human data would hold the greatest weight in describing relationships between a particular exposure and a human health effect. However, in some cases, only animal studies were available.
- Substance-specific health effects data are generally expressed in terms of "ingested dose" rather than "absorbed dose." With regard to heavy metal exposure in soil, however, the distinction between ingested dose and absorbed dose is important. In general, ingestion of a metal in contaminated soil may be absorbed into the body to a much lesser extent than when the metal is in drinking water.
- The IEUBK model depends on reliable estimates of site-specific information for several key parameters that include the following:
  - Lead concentration in outdoor soil (fine fraction) and indoor dust,
  - Soil/dust ingestion rate,
  - Lead concentration in deteriorating paint and indoor paint dust,
  - Individual variability in child blood lead concentrations affecting the Geometric Standard Deviation (GSD) and,
  - Rate and extent of lead absorption from soil (i.e., bioavailability).

  If reliable site-specific inputs are not available, the model will use default parameters which are considered conservative. For its soil evaluation, ATSDR used default parameters for all inputs except 1) the soil level was set to various lead levels for each model run, and 2) the BLL reference level for risk estimation was set to 5 µg/dL.
- A limitation of the IEUBK model is that the model was designed to evaluate relatively stable exposure situations, rather than rapidly varying exposures or exposures occurring for less than a year. The IEUBK model was also not developed to assess lead risks for age groups older than 7 years. The model does not take into account the soil cover (e.g., vegetation) and whether there is limited contact with the bare soil. The model assumes that children do not have any nutritional challenges or intentionally eat soil.
- The available site-specific and ZIP code level BLL data may not necessarily be representative of the site area. For the site-specific BLL events, 34% of the overall BLL participants did not actually live within the boundaries of the site. The ZIP code data encompassed a larger area than just the site.

Overall, there are recognized uncertainties in ATSDR's evaluation. But providing a framework that puts site-specific exposures and the potential for harm into perspective is one of the primary goals of this health evaluation process [ATSDR 2005].

8. Conclusions

For the 35th Avenue site, US EPA provided ATSDR with arsenic, lead, and PAH sampling results for surface soil samples collected from November 2012 through January 2016 and garden produce samples collected in July 2013. Following its review of the residential surface soil and homegrown garden produce data, ATSDR reached three health-based conclusions.

1. ATSDR concludes that past and current exposure to arsenic found in surface soil of some residential yards could harm people's health. Children are especially at risk.

   - Based on the laboratory and XRF data combined, 31 of over 1,234 (2.5%) tested properties in the past and 12 of 1,113 (1.1%) properties currently have soil arsenic levels of public health concern for children who intentionally eat soil (which leads to a higher than normal soil intake) for acute (short-term) exposures. Based on the laboratory data alone, 15 of 543 (2.8%) tested properties in the past and 10 of 424 (2.4%) properties currently are of public health concern for children who intentionally eat soil. These children may have experienced and may currently experience transient harmful effects (nausea, vomiting, and diarrhea) following their short-term arsenic exposures. Also, the maximum levels of arsenic at two properties (one based on laboratory analysis and one on XRF) in the past and one property (based on laboratory analysis) currently were and are of concern for short-term exposures for all children, even those who do not intentionally eat soil. Children who frequently engage in activities like digging with shovels and other tools, and playing with toys (such as toy trucks and action figures) on the ground surface at these properties are especially at risk.
   - For chronic (long-term) exposures, laboratory and XRF data combined showed 13of 1,234 (1.1%) tested properties in the past and 5 of 1,113 (0.4%) properties currently have soil arsenic levels of potential public health for children for noncancerous dermal health effects (e.g., hyperpigmentation and hyperkeratosis). Based on the laboratory data alone, 6 of 543 (1.1%) tested properties in the past and 4 of 424 (0.9%) currently are of public health concern for dermal health effects. Children who engage in activities like digging with shovels and playing with toys on the ground surface every day for longer than a year are at risk, especially at properties with gardens and play areas with bare soil.
   - ATSDR also estimated the proportion of a population that may be affected by a carcinogen during a lifetime of exposure. Based on the laboratory and XRF data combined, cancer risk estimates for arsenic in soil are at and exceed 1 in 10,000 people for 80 of 1,234 (6.5%) tested properties in the past and 43 of 1,113 (3.9%) properties currently. Based on the laboratory data alone, 36 of 543 (6.6%) tested properties in the past and 22 of 424 (5.2%) properties currently are at and exceed this cancer risk level. Thus, exposure to arsenic in soil for many years results in an increased risk of cancer at those properties.
   - Arsenic in soil at most properties is not at levels of health concern for noncancer, harmful health effects and is in the range considered to be a low cancer risk.
   - Ingestion of arsenic in homegrown garden produce alone is not of health concern. However, exposure to the maximum arsenic level found in the garden produce may add to the health risk for those also exposed to elevated levels of arsenic in surface soil.

2. ATSDR concludes that past and current exposure to lead found in surface soil of some residential yards could harm people's health. Swallowing lead-contaminated soil, along with lead from

other sources such as lead paint, could cause harmful health effects, especially in children and in the developing fetus of pregnant women.

- Although lead can affect almost every organ and system in the body, the main target for lead toxicity is the nervous system. In general, the level of lead in a person's blood gives a good indication of recent exposure to lead and correlates well with harmful health effects. ATSDR notes there is no clear threshold for some of the more sensitive health effects associated with lead exposures.
- There are some residential properties with high levels of lead in surface soil, indicating the potential for elevating blood lead levels (BLLs) in children who live at or visit these properties. Children who intentionally eat soil are especially at risk. In addition, properties with high levels of lead in soil indicate the potential for elevating BLLs in the developing fetuses of pregnant women. Therefore, ATSDR considers that residents' (especially children's) daily exposure to soil at properties with elevated lead concentrations could have in the past and could currently be harming their health.
- Other indoor and outdoor sources of lead may result in elevating BLLs even further. Also, multiple factors that have been associated with increased risk of higher BLLs can be found in this community (e.g., age of housing, poverty, race).
- Although ingestion of lead in garden produce is not of health concern, it will increase the risk of harm with increasing soil lead concentrations. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.

3. ATSDR concludes that long-term exposure (i.e., many years) to PAHs found in the surface soil of some residential yards increases the risk of cancer. Conversely, long-term exposure to the levels of PAHs found in surface soil are not expected to result in noncancer harmful health effects.

- Several PAHs have been linked with tumors in laboratory animals when they breathed, ate, or had long periods of skin exposure to these substances. Benzo(a)pyrene (BaP) has been linked with stomach cancer and dibenz(ah)anthracene with lung cancer.
- Seven PAHs were detected in residential surface soil. For six of these PAHs, ATSDR calculated a benzo(a)pyrene toxic equivalent (BaP TE) value for each sample. These six PAHs are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(123-cd)pyrene. The BaP TE value is the sum of these six PAHs detected in the soil sample with their concentrations adjusted for their toxicity relative to BaP. About 181 of 1,234 (15%) tested properties in the past and 116 of 1,113 (10%) properties currently have soil BaP TE levels that result in an increased risk of cancer, with estimates at and exceeding 1 in 10,000 people.
- For dibenz(ah)anthracene, 16 of 1,234 (1.3%) tested properties in the past and 3 of 1,113 (0.3%) properties currently have soil levels that result in an increased risk of cancer, with estimates at and exceeding 1 in 10,000 people.
- Overall, ATSDR considers long-term PAH soil exposures at most residential properties to represent a low cancer risk. ATSDR also considers it unlikely that any noncancerous harmful health effects from PAH soil exposure would occur in children or adults.

In addition to these three health conclusions, ATSDR also reviewed available BLL data from two sources.

- In July 2013, the Jefferson County Department of Health conducted a limited site-specific BLL screening event of 44 participants (1–70 years of age). Thirteen participants were children 1–5 years of age, although two of these children did not live within the site boundaries. No BLLs exceeded the current 5 micrograms per deciliter (µg/dL) reference level[20] for children 1–5 years of age. Overall, 15 of the 44 participants (34%) did not actually live within the boundaries of the site.
- The site lies in ZIP code 35207. The Alabama Department of Public Health provided ATSDR with 2010–2014 BLL data for 560 children ≤ 21 years of age living within this ZIP code. This ZIP-code review indicated 25 children 1–5 and 6–11 years of age had BLLs at and above 5 µg/dL. However, the ZIP-code level BLL data may not necessarily be representative of the site area.

9. Recommendations

After its review of available information, ATSDR recommends

1. Parents monitor their children's behavior while playing outdoors and prevent their children from intentionally or inadvertently eating soil, especially for those yards with elevated arsenic, lead, and PAH levels that have not yet been cleaned up and for those yards that have not yet been tested.
2. Residents take measures to reduce exposures to residential soil and to protect themselves, their families, and visitors (see Appendix C), especially for those yards with elevated arsenic, lead, and PAH levels that have not yet been cleaned up and for those yards that have not yet been tested.
3. Parents follow the American Academy of Pediatric Guidelines and have their children tested for blood lead at 1 and 2 years of age [AAP 2012].
4. Residents take steps to reduce lead uptake (see Appendix D).
5. Residents take measures to reduce exposure to lead from other possible sources (see Table 13B, Appendix B, and Appendix E).
6. US EPA test the bioavailability of metals (arsenic and lead) in the soil.
7. US EPA continue with its plans to remediate additional properties to reduce arsenic, lead, and PAH levels in residential surface soil.

[20] This reference level is based on the highest 2.5% of the U.S. population of children ages 1 to 5 years of age from the 2009-2010 National Health and Nutrition Examination Survey (NHANES). NHANES is a program of studies designed to assess the health and nutritional status of adults and children in the United States. As part of the examination component, blood, urine, and other samples are collected and analyzed for various chemicals. The NHANES test population is selected to be representative of the civilian, noninstitutionalized population of the United States.

10. Public Health Action Plan

The purpose of the public health action plan is to ensure that this evaluation not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment.

ATSDR provided its recommendations to US EPA and JCHD. ATSDR supports continued health education efforts by these entities to address the health concerns of the community and continued efforts to identify and reduce exposure to chemicals in the soil wherever possible.

11. Public Comments

From July 22, 2015, through September 30, 2015, ATSDR released this public health consultation for public review and comment. Appendix G contains both the written comments received during the public comment period and ATSDR's responses to those comments.

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Appendix A. Figures

Figure 1A. Area Map for the 35th Avenue Site, Birmingham, Alabama

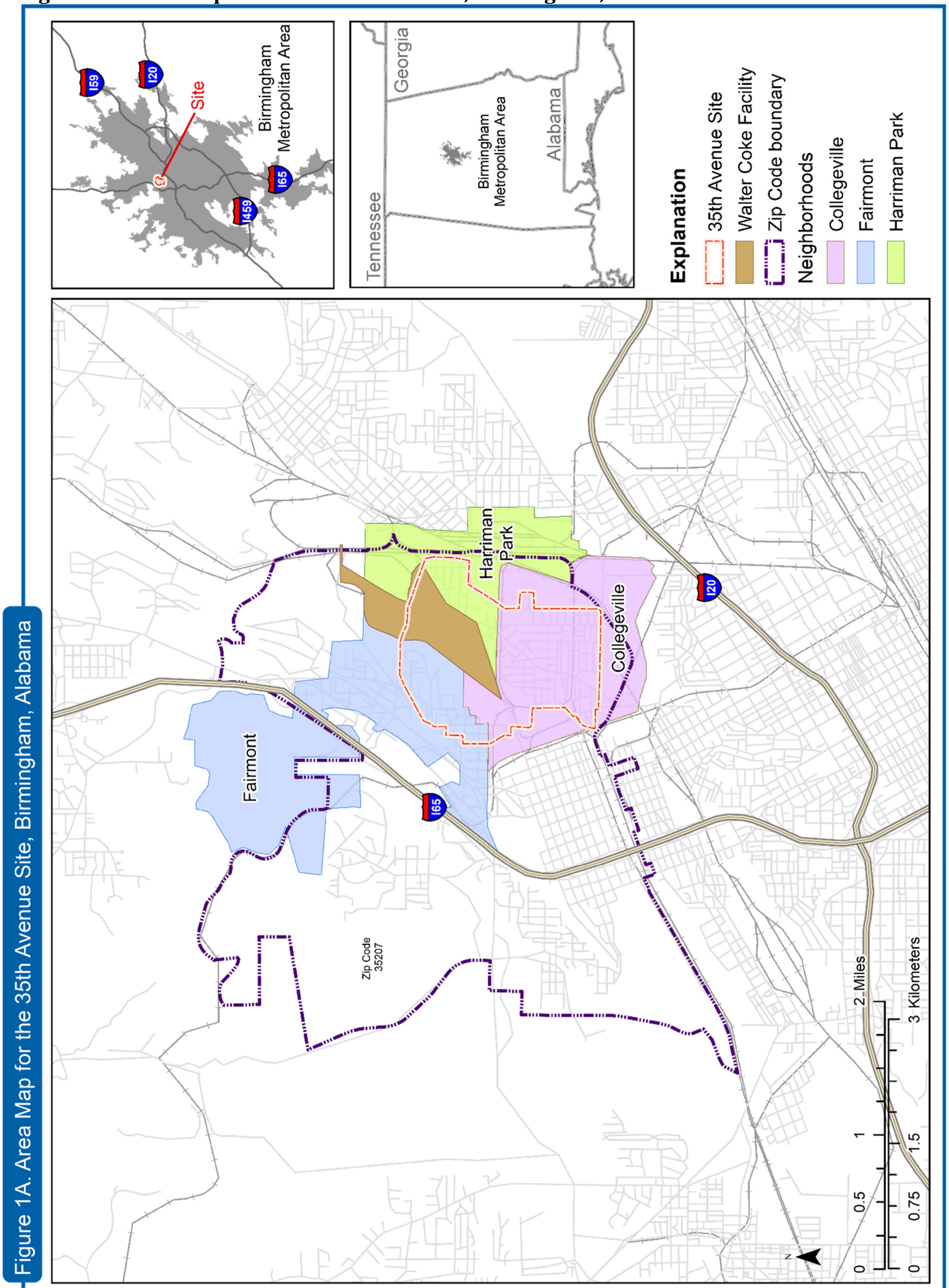
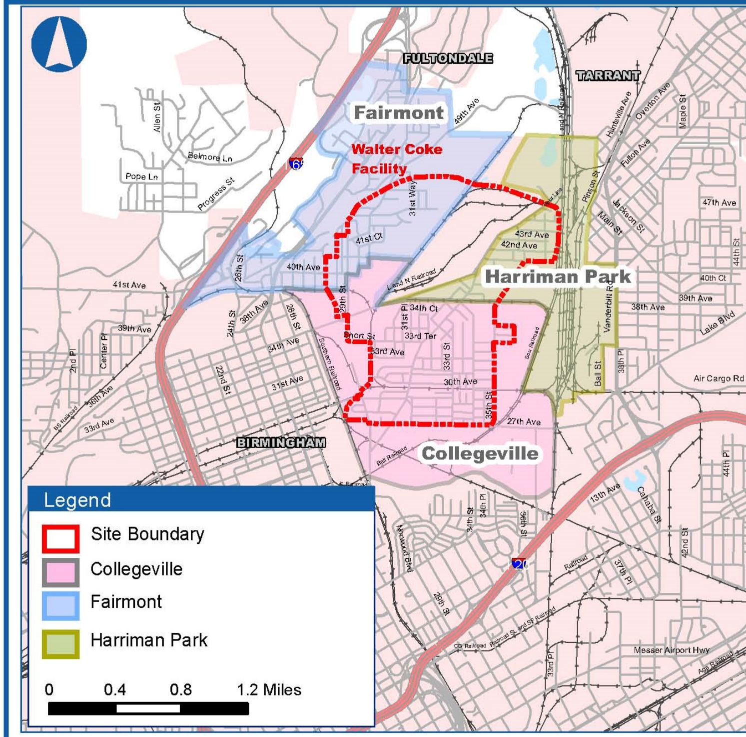


Figure 2A. Demographic Statistics for the 35th Avenue Site, Birmingham, AL



Site Location : Jefferson County, AL

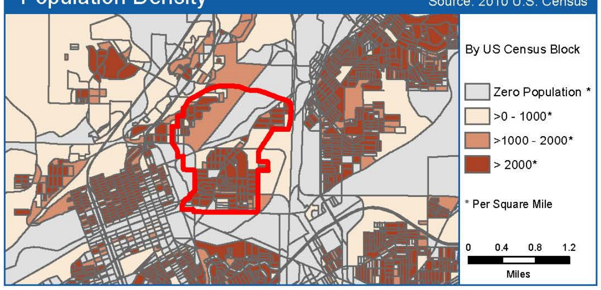
Demographic Statistics
Within Site Boundary*

Total Population	3,585
White Alone	24
Black Alone	3,520
Am. Indian & Alaska Native Alone	4
Asian Alone	1
Native Hawaiian & Other Pacific Islander Alone	0
Some Other Race Alone	16
Two or More Races	21
Hispanic or Latino**	22
Children Aged 6 and Younger	589
Adults Aged 65 and Older	456
Females Aged 15 to 44	780
Total Housing Units	1,637

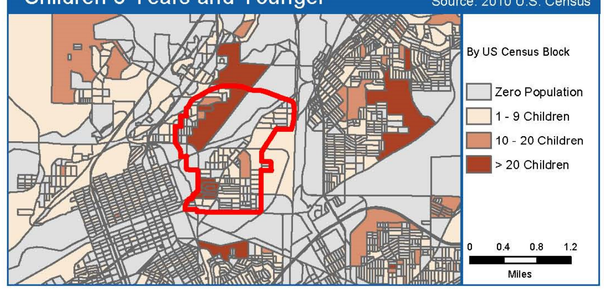
Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels) : NAD_1983_StatePlane_Alabama_West_FIPS_0102_Feet

Demographics Statistics Source: 2010 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

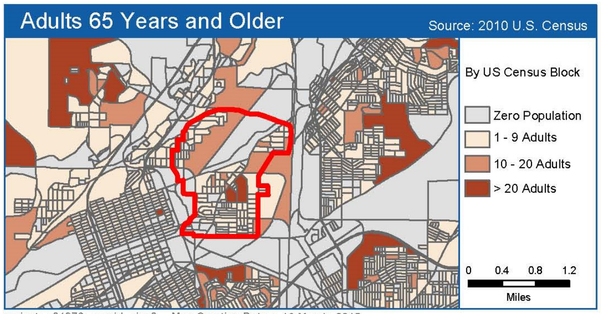
Population Density Source: 2010 U.S. Census



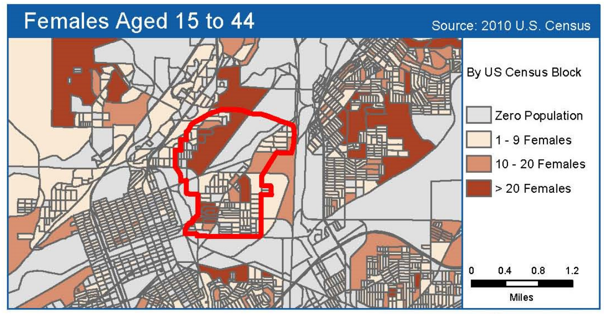
Children 6 Years and Younger Source: 2010 U.S. Census



Adults 65 Years and Older Source: 2010 U.S. Census



Females Aged 15 to 44 Source: 2010 U.S. Census



project = 04276 , userid = jxa0 , Map Creation Date = 16 March, 2015

GRASP

CDC ATSDR
Centers for Disease Control and Prevention
Agency for Toxic Substances and Disease Registry
Geospatial Research, Analysis & Services Program

Appendix B. Tables

Table 1B. Definition of Statistical Terms*

Term	Definition
Minimum	The minimum is the lowest value in the data set.
Maximum	The maximum is the highest value in the data set.
Mean	The mean, also called the average, is a measure of the center of the data. The mean is obtained by adding all of the data values together and dividing the total by the number of data values.
Median	The median, also known as the 50th percentile, is another measure of the center of the data. If the data are ordered from highest to lowest, the median is the value that is in the middle of the data. For any given data set, 50% of the data will be above the median and 50% of the data will be below the median. Because the median is less affected by extreme values in the data, it can be a better–or more robust–central measure than the average.
25th percentile	The 25th percentile is the value that delineates the lowest 25% of the data values from the upper 75% of the data values.
75th percentile	The 75th percentile is the value that delineates the highest 25% of the data values from the lowest 75% of the data values.
Interquartile range	The interquartile range (IQR) is the range between the first and third quartiles (Q3-Q1), which corresponds to the data within the 25th and 75th percentiles. The range represents 50% of the data.
Confidence interval	A confidence interval is a range of values that will likely contain the value of the parameter of interest–the mean for example. A confidence interval typically has a percentage level associated with it that indicates how often the interval will contain the true value of the parameter of interest. Common levels for the confidence interval are 90%, 95%, and 99%.

* Reference Tables 2B–5B for application of these terms to the site-related soil data.

Table 2B. Descriptive Statistics for Arsenic in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of samples		6,416	770	5,646
Concentration (ppm)	Maximum	1,336	1,336	1,000
	75th percentile	28	41	27
	Median	20	29	19
	25th percentile	13	20	12
	Minimum	2.2	4.5	2.2
	Interquartile range	15	21	15
	Mean§	23.6	39.1	21.5
	95% confidence interval on the mean§	22.9 – 24.3	35.0 – 44.5	21.0 – 22.0
Number of samples > 15 ppm (ATSDR chronic child EMEG)		4,368	687	3,681

Data Source: USEPA 2016a, ATSDR 2013.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil samples for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

‡ The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil samples following Phase 1, 2, and 3 removal activities; these statistics are for surface soil sampling areas that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site, including statistics for samples from Phase 4 properties).

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ATSDR Agency for Toxic Substances and Disease Registry
EMEG environmental media evaluation guide
ppm part per million
TCRA Time Critical Removal Action
US EPA U.S. Environmental Protection Agency

Table 3B. Descriptive Statistics for Lead in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of samples		6,416	770	5,646
Concentration (ppm)	Maximum	28,000	27,000	28,000¶
	75th percentile	282	522	254
	Median	157	330	145
	25th percentile	90	171	86
	Minimum	2	14	2
	Interquartile range	192	351	168
	Mean§	270	737	206
	95% confidence interval on the mean§	251 – 291	603 – 891	196 – 220

Data Source: USEPA 2016a.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil samples prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil samples for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

‡ The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil samples following Phase 1, 2, and 3 removal activities; these statistics are for surface soil sampling data for areas that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site, including statistics for samples from Phase 4 properties).

¶ The 28,000 ppm maximum lead concentration was from an unsieved, laboratory sample collected from a vacant lot in December 2015. In that area, US EPA intends to clean up a cluster of adjacent properties sequentially as a part of Phase 4.

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ppm part per million
TCRA Time Critical Removal Action
US EPA U.S. Environmental Protection Agency

Table 4B. Descriptive Statistics for BaP TE in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of samples		4,004	406	3,598
Concentration (ppm)	Maximum	347	344	347
	75th percentile	0.90	7.2	0.68
	Median	0.33	2.5	0.29
	25th percentile	0.14	0.84	0.13
	Minimum	0.0045	0.055	0.0045
	Interquartile range	0.76	6.4	0.55
	Mean§	2.9	18	1.2
	95% confidence interval on the mean§	2.4 – 3.5	13 – 23	1.0 – 1.5
Number of samples > 0.096 ppm (ATSDR BaP CREG)		3,416	400	3,016

Data Source: USEPA 2016a, ATSDR 2013.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phases 1, 2 and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

‡ The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil following Phase 1, 2, and 3 removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site, including statistics for samples from Phase 4 properties).

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ATSDR	Agency for Toxic Substances and Disease Registry
BaP	benzo(a)pyrene
BaP TE	benzo(a)pyrene toxic equivalent
CREG	cancer risk evaluation guide
ppm	part per million
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 5B. Descriptive Statistics for Dibenz(ah)anthracene in Surface Soil, Birmingham, AL

Descriptive Statistics		Past Exposure Scenario*	Removal Action Areas†	Current Exposure Scenario‡
Number of samples		4,002	406	3,596
Concentration (ppm)	Maximum	47	31	47
	75^{th} percentile	0.12	0.45	0.11
	Median	0.057	0.15	0.053
	25^{th} percentile	0.027	0.053	0.027
	Minimum	0.0025	0.0036	0.0025
	Interquartile range	0.093	0.39	0.083
	Mean§	0.22	0.96	0.14
	95% confidence interval on the mean§	0.18 – 0.27	0.66 – 1.3	0.11 – 0.18

Data Source: USEPA 2016a.

* The "Past Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil prior to TCRA activities; these statistics are for all available surface soil data for the site.

† The "Removal Action Areas" column provides descriptive statistics for chemical levels found in surface soil for grids/properties that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center).

‡ The "Current Exposure Scenario" column provides descriptive statistics for chemical levels found in surface soil following Phase 1, 2, and 3 removal activities; these statistics are for surface soil data of grids/properties that did not undergo removal actions (i.e., statistics for the chemical levels that remain at the site, including statistics for samples from Phase 4 properties).

§ Estimates for the mean and 95% confidence interval for the mean were obtained using bootstrap methods.

ppm part per million
TCRA Time Critical Removal Action
US EPA U.S. Environmental Protection Agency

Table 6B. Estimated Doses, Number of Grids, and Number of Properties within Various Arsenic Concentration Ranges for both Laboratory and XRF Sampling Data Combined, Birmingham, AL

Arsenic Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND to <30	NA to <0.0003	NA to <0.003	ND to <0.00002	2,558	61	2,497	750	25	725
30 to <61	0.0003 to <0.0006	0.003 to <0.007	0.00002 to <0.00005	645	100	545	404	59	345
61 to <90	0.0006 to <0.0009	0.007 to <0.01	0.00005 to <0.00007	59	24	35	49	18	31
90 to <150	0.0009 to <0.002	0.01 to <0.02	0.00007 to <0.0001	19	12	7	18	11	7
150 to <300	0.002 to <0.003	0.02 to <0.03	0.0001 to <0.0002	8	4	4	7	3	4
300 to <600	0.003 to <0.006	0.03 to <0.07	0.0002 to <0.0005	4	3	1	4	4	0
600 to 1,336	0.006 – 0.01	0.07 – 0.2	0.0005 – 0.001	2	1	1	2	1	1

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of arsenic. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	time critical removal action
US EPA	U.S. Environmental Protection Agency
XRF	X-ray fluorescence spectrometer

Table 7B. Estimated Doses, Number of Grids, and Number of Properties within Various Arsenic Concentration Ranges for only Laboratory Sampling Data, Birmingham, AL

Arsenic Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND to <30	NA to <0.0003	NA to <0.003	ND to <0.00002	571	88	483	266	46	220
30 to <61	0.0003 to <0.0006	0.003 to <0.007	0.00002 to <0.00005	336	95	241	241	59	182
61 to <90	0.0006 to <0.0009	0.007 to <0.01	0.00005 to <0.00007	23	8	15	21	9	12
90 to <150	0.0009 to <0.002	0.01 to <0.02	0.00007 to <0.0001	9	3	6	9	3	6
150 to <300	0.002 to <0.003	0.02 to <0.03	0.0001 to <0.0002	4	1	3	4	1	3
300 to <600	0.003 to <0.006	0.03 to <0.07	0.0002 to <0.0005	1	1	0	1	1	0
600 to 1,336	0.006 to 0.01	0.07 to 0.2	0.0005 to 0.001	1	0	1	1	0	1

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of arsenic. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	time critical removal action
US EPA	U.S. Environmental Protection Agency
XRF	X-ray fluorescence spectrometer

Table 8B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges for both Laboratory and XRF Sampling Data Combined, Birmingham, AL (page 1 of 2)

Lead Concentration Range (ppm)	Estimated Probability (%) of exceeding a BLL of 5 µg/dL	Estimated Geometric Mean BLL (µg/dL)	Number of Grids*			Number of Properties*		
			Past Exposure Scenario†	Removal Action Areas‡	Current Exposure Scenario§	Past Exposure Scenario†	Removal Action Areas‡	Current Exposure Scenario§
ND to <100	NA to <1.5	NA to <1.8	1,079	13	1,066	179	4	175
100 to <200	1.5 to <10¶	1.8 to <2.7	1,176	39	1,137	421	13	408
200 to <300	10 to <25	2.7 to <3.6	423	27	396	205	17	188
300 to <400	25 to <40	3.6 to <4.5	218	7	211	139	9	130
400 to <600	41 to <66	4.5 to <6.1	199	48	151	127	26	101
600 to <800	66 to <81	6.1 to <7.6	85	9	76	73	7	66
800 to <1,000	81 to <89	7.6 to <8.9	25	6	19	19	2	17
1,000 to <2,000	89 to <99	8.9 to <15	52	27	25	39	19	20
2,000 to <3,000	99 to <100	15 to <19	21	14	7	17	11	6
3,000 to 28,000	100 to NA**	19 to NA**	17	15	2	15	13	2

* ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of lead. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it choose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are indicated in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

† The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

‡ The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

§ The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

¶ For example, the value of 10 means 10% of the BLLs are estimated to be ≥ 5 µg/dL.

** At elevated soil lead concentrations, the IEUBK model provides a warning that the predicted blood lead levels (> 30 µg/dL) are above the range of values that were used in the calibration and empirical validation of the model [USEPA 2002a]. Therefore, US EPA states the model should not be relied upon to predict BLLs above 30 µg/dL [USEPA 2002a, 2002b].

BLL blood lead level
IEUBK Integrated Exposure Uptake Biokinetic Model for Lead in Children
µg/dL micrograms per deciliter

Table 8B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges, Birmingham for both Laboratory and XRF Sampling Data Combined, AL (page 2 of 2)

NA	not applicable
ND	not detected
ppm	parts per million
US EPA	U.S. Environmental Protection Agency
XRF	X-ray fluorescence spectrometer

Table 9B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges for only Laboratory Sampling Data, Birmingham, AL (page 1 of 2)

Lead Concentration Range (ppm)	Estimated Probability (%) of exceeding a BLL of 5 µg/dL	Estimated Geometric Mean BLL (µg/dL)	Number of Grids*			Number of Properties*		
			Past Exposure Scenario†	Removal Action Areas‡	Current Exposure Scenario§	Past Exposure Scenario†	Removal Action Areas‡	Current Exposure Scenario§
ND to <100	NA to <1.5	NA to <1.8	158	25	133	56	10	46
100 to <200	1.5 to <10¶	1.8 to <2.7	220	39	181	99	20	79
200 to <300	10 to <25	2.7 to <3.6	170	26	144	85	13	72
300 to <400	25 to <40	3.6 to <4.5	114	11	103	78	9	69
400 to <600	41 to <66	4.5 to <6.1	149	38	111	115	25	90
600 to <800	66 to <81	6.1 to <7.6	50	11	39	43	6	37
800 to <1,000	81 to <89	7.6 to <8.9	14	4	10	10	1	9
1,000 to <2,000	89 to <99	8.9 to <15	37	18	19	27	13	14
2,000 to <3,000	99 to <100	15 to <19	18	11	7	16	10	6
3,000 to 28,000	100 to NA**	19 to NA**	15	13	2	14	12	2

* ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated levels of lead. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it choose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are indicated in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

† The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

‡ The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

§ The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

¶ For example, the value of 10 means 10% of the BLLs are estimated to be ≥ 5 µg/dL.

** At elevated soil lead concentrations, the IEUBK model provides a warning that the predicted blood lead levels (> 30 µg/dL) are above the range of values that were used in the calibration and empirical validation of the model [USEPA 2002a]. Therefore, US EPA states the model should not be relied upon to predict BLLs above 30 µg/dL [USEPA 2002a, 2002b].

BLL blood lead level
IEUBK Integrated Exposure Uptake Biokinetic Model for Lead in Children
µg/dL micrograms per deciliter

Table 9B. IEUBK Estimated Probabilities, Estimated Geometric Mean BLLs, Number of Grids, and Number of Properties with Mean Soil Lead Levels at Various Lead Concentration Ranges for only Laboratory Sampling Data, Birmingham, AL (page 2 of 2)

NA	not applicable
ND	not detected
ppm	parts per million
US EPA	U.S. Environmental Protection Agency

Table 10B. Estimated Doses, Number of Grids, and Number of Properties within Various BaP TE Concentration Ranges, Birmingham, AL

BaP TE Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND to <0.5	NA to <9E-06	NA to <9E-05	NA to <7E-07	2,320	46	2,274	696	22	674
0.5 to <1.0	9E-06 to <2E-05	9E-05 to <2E-04	7E-07 to <1E-06	479	37	442	231	18	213
1.0 to <1.8	2E-05 to <3E-05	2E-04 to <3E-04	1E-06 to <2E-06	211	21	190	126	16	110
1.8 to <3.5	3E-05 to <6E-05	3E-04 to <7E-04	2E-06 to <5E-06	126	28	98	71	10	61
3.5 to <5.0	6E-05 to <9E-05	7E-04 to <9E-04	5E-06 to <7E-06	41	14	27	25	8	17
5.0 to <7.5	9E-05 to <1E-04	9E-04 to <1E-03	7E-06 to <1E-05	33	17	16	28	15	13
7.5 to 347	1E-04 to 6E-03	1E-03 to 7E-02	1E-05 to 5E-04	81	40	41	57	32	25

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated BaP TE levels. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

BaP TE	benzo(a)pyrene toxic equivalent
mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 11B. Estimated Doses, Number of Grids, and Number of Properties within Various Dibenz(ah)anthracene Concentration Ranges, Birmingham, AL

Dibenz(ah)-anthracene Concentration Range (ppm)	Child Dose Range* (mg/kg/day)	Child who Intentionally Eats Soil Dose Range† (mg/kg/day)	Adult Dose Range‡ (mg/kg/day)	Number of Grids§			Number of Properties§		
				Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††	Past Exposure Scenario¶	Removal Action Areas**	Current Exposure Scenario††
ND to <0.5	NA to <9E-06	NA to <9E-05	NA to <7E-07	3,159	144	3,015	1,138	70	1,068
0.5 to <1.0	9E-06 to <2E-05	9E-05 to <2E-04	7E-07 to <1E-06	63	23	40	46	21	25
1.0 to <1.8	2E-05 to <3E-05	2E-04 to <3E-04	1E-06 to <2E-06	31	16	15	22	15	7
1.8 to <3.5	3E-05 to <6E-05	3E-04 to <7E-04	2E-06 to <5E-06	16	4	12	12	2	10
3.5 to <5.0	6E-05 to <9E-05	7E-04 to <9E-04	5E-06 to <7E-06	3	3	0	3	3	0
5.0 to <7.5	9E-05 to <1E-04	9E-04 to <1E-03	7E-06 to <1E-05	6	3	3	4	3	1
7.5 to 47	1E-04 to 8E-04	1E-03 to 9E-03	1E-05 to 6E-05	13	10	3	9	7	2

* The child doses provided are for the most highly exposed group, i.e., RME for children aged 1 to > 2 years of age who are considered to have the highest ingestion rate of soil per body weight.

† The child doses provided use 5,000 milligrams/event for the amount of soil ingested and a frequency of 3 days a week. Note that 5,000 milligrams/event probably represents the central tendency intake; no reliable upper percentile intake rate is available [ATSDR 2014].

‡ The adult doses provided are for the most highly exposed group, i.e., RME for women ≥ 21 years of age.

§ ATSDR notes that not all property owners allowed access for sampling activities, and these untested properties may have elevated dibenz(ah)anthracene levels. Also, some property owners allowed access for sampling activities, but then denied access for removal activities. For each property listed in the "Number of Properties" columns, ATSDR notes it chose the grid with the maximum detected concentration to represent that property. In addition, when grids/properties are listed in the "Removal Action Areas" column in the lower concentration ranges, this is because in some cases removal activities for a grid/property were completed based on another chemical's level in surface soil.

¶ The "Past Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range prior to TCRA activities.

** The "Removal Action Areas" column provides the number of grids or properties that fall within the row's concentration range for areas that were cleaned up during Phases 1, 2, and 3, or will be during the future effort at the former Carver School where US EPA set up its command center.

†† The "Current Exposure Scenario" column provides the number of grids or properties that fall within the row's concentration range following Phase 1, 2, and 3 removal activities.

mg/kg/day	milligrams per kilogram per day
NA	not applicable
ND	not detected
ppm	parts per million
RME	reasonable maximum exposure
TCRA	Time Critical Removal Action
US EPA	U.S. Environmental Protection Agency

Table 12B. Default Exposure Assumptions

Group	Soil Intake (mg/day)		Exposure Frequency	Body Weight (kg)	Exposure Duration for Cancer Risk (years)
	RME	CTE			
Child 6 weeks to < 1 year	100	60	1	9.2	0.88
Child 1 to < 2 years	200	100	1	11.4	1
Child 2 to < 6 years	200	100	1	17.4	4
Child 6 to < 11 years	200	100	1	31.8	5
Child 11 to <16 years	200	100	1	56.8	5
Child 16 to <21 years	200	100	1	71.6	5
Child (who intentionally eats soil) 1 < 2 years	NA	5,000	0.429*	11.4	NA
Child (who intentionally eats soil) 2 < 6 years	NA	5,000	0.429*	17.4	NA
Adults ≥ 21 years	100	50	1	80	33
Men ≥ 21 years	100	50	1	85	54
Women ≥ 21 years	100	50	1	75	59
Gardener ≥ 21 years	NA	100	1	80	33

Source: ATSDR 2014.

* Assumes a frequency of 3 days a week.

CTE central tendency exposure
kg kilogram
mg milligram
NA not applicable
RME reasonable maximum exposure

Table 13B. Possible Sources of Lead Exposures

Place	Source
Indoors	**Paint** – Ingesting paint chips primarily found in homes built prior to 1978 and on older toys and furniture.
	Dust – Ingesting dust (from hand-to-mouth activity) found in older homes (built prior to 1978) or tracked in from contaminated soil.
	Water – Drinking water containing lead that comes from corrosion of older fixtures, from the solder that connects pipes, or from wells where lead contamination has affected the groundwater.
	Tableware – Eating foods from imported, old, handmade, or poorly glazed ceramic dishes and pottery that contains lead. Lead may also be found in leaded crystal, pewter, and brass dishware.
	Candy – Eating consumer candies imported from Mexico. Certain candy ingredients such as chili powder and tamarind may be a source of lead exposure. Candy wrappers have also been shown to contain some lead.
	Toy Jewelry – Swallowing or putting in the mouth toy jewelry that contains lead. This inexpensive children's jewelry is generally sold in vending machines and large volume discount stores across the country.
	Traditional (folk) Medicines –Ingesting some traditional (folk) medicines used by India, Middle Eastern, West Asian, and Hispanic cultures. Lead and other heavy metals are put into certain folk medicines on purpose because these metals are thought to be useful in treating some ailments. Sometimes lead accidentally gets into the folk medicine during grinding, coloring, or other methods of preparation.
Outdoors	**Outdoor Air** – Breathing lead particles in outdoor air that comes from the residues of leaded gasoline or industrial operations.
	Soil – Ingesting dirt contaminated with lead that comes from the residues of leaded gasoline, industrial operations, or lead-based paint.
Other	**Hobbies** – Ingesting lead from hobbies using lead such as welding, auto or boat repair, the making of ceramics, stained glass, bullets, and fishing weights. Other hobbies that might involve lead include furniture refinishing, home remodeling, painting and target shooting at firing ranges.
	Workplace – Ingesting lead found at the workplace. Jobs with the potential for lead exposure include building demolition, painting, remodeling/renovation, construction, battery recycling, radiator repair, and bridge construction. People who work in a lead environment may bring lead dust into their car or home on their clothes and bodies exposing family members.

Sources: CDC 2009; NYDOH 2010.

Table 14B. Descriptive Statistics for 35th Avenue Blood Lead Testing (July 2013), Birmingham, AL

Descriptive Statistics*		Children 1–5 years of age	Children 6–11 years of age	Children 12–19 years of age	20 years of age and older
Number of people		13	23	6	2
Blood Lead Level (µg/dL)	Maximum	3	3	1	1
	75th percentile	2	1	1	1
	Median	1	1	1	1
	25th percentile	1	1	1	1
	Minimum	1	0	0	1
	Interquartile range	1	0	0	0
	Geometric Mean†	1.4	0.64	0.32	1
	95% confidence interval on the geometric mean†	1.1 – 1.9	0.27 – 1.5	0.032 – 3.0	1 – 1

Data Source: JCDH 2013.

* The blood lead level data provided to ATSDR were integer values.

† The geometric means and associated confidence intervals are approximations when an age group contains minimum BLL values of zero.

BLL blood lead level
µg/dL micrograms per deciliter

Table 15B. Descriptive Statistics for 2010–2014 BLL data for children ≤ 21 years of age in ZIP code 35207, Birmingham, AL

Descriptive Statistics*		Children 1–5 years of age	Children 6–11 years of age	Children 12–19 years of age	Children 20–21 years of age
Number of children		329	214	16	1
Blood Lead Level (µg/dL)	Maximum	16	10	4	3
	75th percentile	3	3	3	3
	Median	2	2	3	3
	25th percentile	1	1	2	3
	Minimum	0	1	1	3
	Interquartile range	2	2	1	0
	Geometric Mean†	1.7	1.9	2.4	3
	95% confidence interval on the geometric mean†	1.6 – 1.9	1.7 – 2.0	2.0 – 2.9	NA
Number children with BLL ≥ 5 µg/dL (reference level‡)		16	9	0	0

Data Source: ATSDR 2015.

* The blood lead level data provided to ATSDR were integer values.

† The geometric means and associated confidence intervals are approximations when an age group contains minimum BLL values of zero.

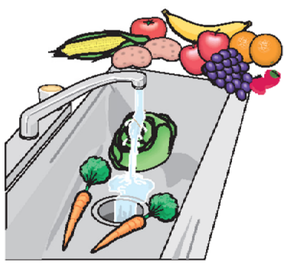
‡ The reference level is based on the highest 2.5% of the U.S. population of children 1-5 years of age. This level is currently 5 µg/dL and based on the 2009-2010 National Health and Nutrition Examination Survey.

BLL blood lead level
µg/dL micrograms per deciliter
NA not applicable

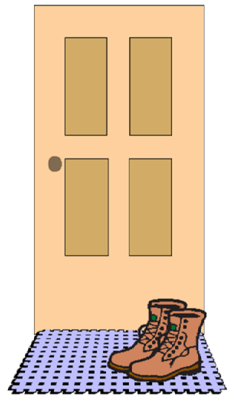
Appendix C. Ways to Protect your Health

Ways to protect your health

By keeping dirt from getting into your house and into your body



Wash and peel all fruits, vegetables, and root crops



Wipe shoes on doormat or remove shoes

Don't eat food, chew gum, or smoke when working in the yard

Damp mop floors and damp dust counters and furniture regularly

Wash dogs regularly

Wash children's toys regularly

Wash children's hands and feet after they have been playing outside

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Appendix D. Ways to Prevent High Levels of Lead in Blood

Children and the developing fetus of pregnant women are at higher risk of developing health effects caused by exposure to high levels of lead than adults. When too much lead builds up in a child's body, it can cause learning, hearing, and behavioral problems and can harm your child's brain, kidneys, and other organs. Some of these health effects can last a lifetime. Tests are available to let people know how much lead is in their blood.

Ways to prevent high levels of lead in blood include

✔ **Eating 3 healthy meals a day and at least 2 healthy snacks.**

Eating healthy meals can help lower, but not eliminate, the risk of getting high levels of lead in blood. People with empty stomachs get more lead into their bodies than people with full stomachs.

✔ **Eating a balanced diet.**

People's bodies are less likely to absorb lead when their diet is rich in nutrients and vitamins.

- Eat iron-rich foods like
  - Lean red meats, fish or chicken
  - Cereals high in iron
  - Dried fruits such as raisins or prunes
- Eat calcium-rich foods like
  - Milk, yogurt, cheese
  - Green leafy vegetables (spinach, kale, collard greens)
- Eat foods high in Vitamin C like
  - Oranges or orange juice and grapefruits or grapefruit juice
  - Tomatoes, tomato juice
  - Green peppers

✔ **Eating less high fat and fried foods.**

People's bodies are more likely to absorb lead when they eat high fat and fried foods.

- Avoid foods like hot dogs, French fries, and potato chips

✔ **Washing your hands before fixing food and washing and peeling produce before eating it.**

Lead particles that stick to people's hands after gardening and to the surface of garden produce can be washed away before the lead enters a person's body.

✔ **Using only cold water from the tap for drinking, cooking, and for making baby formula.**

Hot water is more likely to contain lead. Run cold water 30 to 60 seconds before using it.

Appendix E. How to Prevent Lead Exposure at Home

How to Prevent Lead Exposure at Home

Parents can take simple steps to make their homes more lead-safe.

Lead can be found in a variety of sources.

These include:

- paint in homes built before 1978
- water pumped through leaded pipes
- imported items including clay pots.
- certain consumer products such as candies, make -up and jewelry
- certain imported home remedies

- Talk to your local health department about testing paint and dust in your home for lead if you live in a home built before 1978.
- Common home renovation activities like sanding, cutting, and demolition can create hazardous lead dust and chips by disturbing lead-based paint. These can be harmful to adults and children.
- Renovation activities should be performed by certified renovators who are trained by U.S. Environmental Protection Agency (US EPA)-approved training providers to follow lead-safe work practices.
- Learn more at US EPA's Renovation, Repair, and Painting rule Web page: http://www.epa.gov/lead/pubs/renovation.htm.
- If you see paint chips or dust in windowsills or on floors because of peeling paint, clean these areas regularly with a wet mop.
- Wipe your feet on mats before entering the home, especially if you work in occupations where lead is used. Removing your shoes when you are entering the home is a good practice to control lead.
- Use only cold water from the tap for drinking, cooking, and for making baby formula. Hot water is more likely to contain lead. Run cold water 30 to 60 seconds before using it.
- Remove recalled toys and toy jewelry from children. Stay up-to-date on current recalls by visiting the Consumer Product Safety Commission’s Web site: http://www.cpsc.gov/.

Appendix F. Derivation and Intended Use of Comparison Values

The Agency for Toxic Substances and Disease Registry (ATSDR) has developed health and environmental guidelines to use when conducting the screening analysis and evaluating exposures to substances found at sites under investigation. The information provided in this appendix was compiled directly from ATSDR's Public Health Assessment Guidance Manual [ATSDR 2005]. The purpose of this appendix is to provide information about those health and environmental guidelines used for screening purposes in the 35th Avenue Public Health Consultation. For further information on ATSDR's public health assessment process and comparison values, please refer to the ATSDR guidance manual available at http://www.atsdr.cdc.gov/hac/PHAManual/toc.html.

ATSDR, in cooperation with the U.S. Environmental Protection Agency (US EPA), has developed a priority list of hazardous substances found at hazardous waste sites, as directed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendment and Reauthorization Act of 1986 (SARA). For those substances most commonly found, ATSDR has prepared Toxicological Profiles that include an examination, summary, and interpretation of available toxicologic and epidemiologic data. Using those data, ATSDR has derived health and environmental guidelines.

- ATSDR ***health guidelines*** are substance-specific doses or concentrations derived using toxicologic information. Where adequate dose-response data exist, health guidelines are derived for both the ingestion or inhalation routes of exposure. Health guidelines include ATSDR's minimal risk levels (MRLs). No health guidelines have been developed by ATSDR for dermal exposures.
- ATSDR ***environmental guidelines*** are media-specific substance concentrations derived from health guidelines using default exposure assumptions. ATSDR environmental guidelines include environmental media evaluation guides (EMEGs) and cancer risk evaluation guides (CREGs) that are available for contact with substances in water, soil, and air. No environmental guidelines have been developed by ATSDR for contact with contaminants in food or biota.

ATSDR health and environmental guidelines discussed in this appendix are MRLs, EMEGs, and CREGs. For each guideline discussed, a definition and description of the derivation and applicability or intended use are provided.

1F. Minimal Risk Levels (MRLs)

ATSDR's minimal risk levels (MRLs) are an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse health effects during a specified duration of exposure. MRLs are based only on noncarcinogenic effects. MRLs are screening values only and are not indicators of health effects. Exposures to substances at doses above MRLs will not necessarily cause adverse health effects and should be further evaluated.

ATSDR derives MRLs when reliable and sufficient data can identify the target organ(s) of effect or the most sensitive health effects(s) for a specific duration for a given route of exposure. MRLs are set below levels that might cause adverse health effects in most people, including sensitive populations. MRLs are derived for acute (1–14 days), intermediate (15–364 days), and chronic (365 days and longer) durations. MRLs are generally based on the most sensitive chemical-induced endpoint considered relevant to humans. ATSDR does not use serious health endpoints (e.g., irreparable damage to the liver or kidneys, birth defects) as bases for establishing MRLs.

ATSDR derives MRLs for substances by factoring the most relevant documented no-observed-adverse-effects level (NOAEL) or lowest-observed-adverse-effects level (LOAEL) and an uncertainty factor. The specific approach used to derive MRLs for individual substances are detailed in ATSDR's Toxicological Profile for each substance available at http://www.atsdr.cdc.gov/toxprofiles/index.asp.

MRL Derivation

MRL = NOAEL (or LOAEL) / UF

where,

MRL	=	minimal risk level (mg/kg/day)
NOAEL	=	no-observed-adverse-effect level (mg/kg/day)
LOAEL	=	lowest-observed-adverse-effect level (mg/kg/day)
UF	=	uncertainty factor (unitless)

Most MRLs contain a degree of uncertainty because of the lack of precise toxicologic information about the people who might be most sensitive to the effects of environmental contamination (e.g., children, elderly, those with pre-existing illnesses). ATSDR uses a conservative (i.e., protective) approach to address this uncertainty. This approach is consistent with the public health principle of prevention.

Although human data are preferred, when relevant human studies are unavailable, ATSDR bases MRLs on animal studies. In the absence of evidence to the contrary, ATSDR assumes that humans are more sensitive to the effects of hazardous substances than are animals and that certain persons might be particularly sensitive. Uncertainties are taken into account by applying “uncertainty factors” to the NOAEL. For example, an uncertainty factor of between 1 and 10 might apply for extrapolation from animal doses to human doses or to account for sensitive persons. When more than one uncertainty factor is applied, the uncertainty factors are multiplied. For example, the combined uncertainty factor of 100 could be accounted for by an uncertainty factor of 10 for the extrapolation of animals to humans and another factor of 10 to account for sensitive persons.

ATSDR derives MRLs on the assumption that exposures occur to a single substance and that only noncarcinogenic health effects might result. But hazardous waste sites might expose people to a mixture of substances. MRLs are intended to serve only as a screening tool to help ATSDR staff decide whether to evaluate more closely exposures to a substance found at a site. MRLs are not intended to define cleanup or action levels. And exposure doses above the MRL do not necessarily mean that adverse health effects will occur.

2F. Environmental Media Evaluation Guides (EMEGs)

ATSDR’s environmental media evaluation guides (EMEGs) represent concentrations of substances in water, soil, and air to which humans might be exposed during a specified period of time (acute, intermediate, or chronic) without experiencing adverse health effects. EMEGs have been calculated for substances for which ATSDR has developed Toxicological Profiles. ATSDR uses information about the substance toxicity (MRLs) and default exposure assumptions.

ATSDR uses EMEGs during a screening analysis, particularly when conducting an environmental guideline comparison. Substances found at concentrations below EMEGs are not expected to pose public health hazards. Substances found at concentrations above EMEGs require further evaluation before arriving at a public health conclusion. EMEGs are screening values only—they are not indicators of adverse public health effects. Substances found at concentrations above EMEGs will not necessarily cause adverse health effects, but will require further evaluation.

ATSDR makes three assumptions when deriving EMEGs: 1) exposures occur through contact with a single medium (e.g., water or soil) via a single route (e.g., ingestion or inhalation), 2) exposures involve a single substance, and 3) from the exposure, only noncarcinogenic health effects might result.

EMEGs are based on toxicity information (MRLs), which consider noncarcinogenic toxic effects of chemicals, including their developmental and reproductive toxicity. MRLs do not consider potential genotoxic or carcinogenic effects of a substance. Because some substances have both noncarcinogenic and carcinogenic effects, ATSDR has derived cancer risk evaluation guides (CREGs) to consider potential carcinogenic effects of a substance.

To derive the soil EMEGs, ATSDR uses the chronic oral MRLs from its Toxicological Profiles. Many chemicals bind tightly to organic matter or silicates in the soil. Therefore, the bioavailability of a chemical is dependent on the media in which it is administered. Ideally, an MRL for deriving a soil EMEG should be based on an experiment in which the chemical was administered in soil. However, data from this type of study is seldom available. Therefore, often ATSDR derives soil EMEGs from MRLs based on studies in which the chemical was administered in drinking water, food, or by gavage using oil or water as the vehicle. The Toxicological Profiles for individual substances provide detailed information about the MRL and the experiment on which it was based.

Children are usually assumed to be the most highly exposed segment of the population because their soil ingestion rate is greater than adults' rate. Experimental studies have reported soil ingestion rates for children ranging from approximately 40 to 270 milligrams per day (mg/day), with 100 mg/day representing the best estimate of the average intake rate. ATSDR calculates an EMEG for a child using a daily soil ingestion rate of 200 mg/day for a 10-kg child [ATSDR 2005, 2013].

For sites where the only receptors for soil ingestion are adults, an EMEG is calculated using an adult body weight of 70 kilograms and an assumed daily soil ingestion rate of 100 mg/day [ATSDR 2005, 2013]. There are very few data on soil ingestion by adults, but limited experimental studies suggest a soil ingestion rate in adults of up to 100 mg/day, with an average intake of 50 mg/kg. Concentrations of substances in soil are expressed as milligrams per kilogram (mg/kg) or ppm.

3F. Cancer Risk Evaluation Guides (CREGs)

ATSDR’s cancer risk evaluation guides (CREGs) are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in an increase of cancer rates in an exposed population. ATSDR develops CREGs using US EPA's cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents a possible risk of one excess cancer case in a population of one million. CREGs are only available for adult exposures—no CREGs specific to childhood exposures are available.

To derive soil CREGs, ATSDR uses CSFs developed by US EPA and reported in the Integrated Risk Information System (IRIS). The IRIS summaries, available at http://www.epa.gov/iris/ , provide detailed information about the derivation and basis of the CSFs for individual substances. ATSDR derives CREGs for lifetime exposures, and therefore uses exposure parameters that represent exposures as an adult [ATSDR 2005, 2013]. An adult is assumed to ingest 100 mg/day of soil and weigh 70 kg . [ATSDR 2005, 2013].

In developing the CREGs, ATSDR assumes that 1) exposures occur through contact to a single medium, (2) exposures occur to a single substance, and 3) from the exposure only cancer health effects will result. CREGs serve as a screening tool for evaluating concentrations of carcinogens during an environmental guideline comparison. CREGs are based on possible estimates of cancer risk. Therefore, CREGs should serve only as a screening tool and not that cancer is indicated, expected, or predicted.

4F. References

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005. Public health assessment guidance manual (update). Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2013. Updated comparison value tables - March 2013. Email containing comparison value spreadsheets from Annemarie DePasquale, ATSDR, to agency staff on March 8, 2013. Atlanta: US Department of Health and Human Services.

Appendix G. Public Comments

From July 22, 2015, through September 30, 2015, the Agency for Toxic Substances and Disease Registry (ATSDR) released this public health consultation (PHC) for public review and comment. Four reviewers provided comments on the report. Each written comment received was logged and became part of the administrative record.

Within their comments, reviewers referred to several ATSDR documents on this site in a variety of ways. For consistency in this appendix,

1. the 2015 PHC on soil and garden produce exposures is called "this report",
2. the previous 2013 PHC on soil exposures is called "2013 ATSDR soil report", and
3. the 2015 public health assessment (PHA) on air exposures is called "2015 ATSDR air report".

The comments are grouped into seven categories: background, pathway analyses, data quality, data analyses, cancer risk, conclusions, and recommendations. This appendix contains both the written comments[21] received during the public comment period and ATSDR's response to those comments.

Reviewer	***Reviewer Comment***	***ATSDR Response***
Background		
1	The 35th Avenue site is a mixed industrial and residential area of Birmingham, Alabama. "Since 1886 the area has been home to 20 foundries and kilns; seven coal, coke or byproducts facilities […] By 1981, 20[%] of the land area was devoted to large industrial plants."[22] Five facilities are identified as possible or likely contributors to the lead, arsenic and/or benzo(a)pyrene (BaP) contamination found in the area of observed contamination: Walter Coke, ABC Coke, U.S. Pipe, KMAC and Alabama Gas Corporation (Alagasco).[23] Coke is the residue from the destructive distillation of coal. The 35th Avenue site and the surrounding area include two coke oven plants: Walter Coke and ABC Coke. "The coal used in the coke plants in the site area was generally obtained from mines in the Birmingham area until the late 1950's."[24] "Coal	In Section 3.1 of this report, ATSDR provides general background information about the site area. The information cited by Reviewer #1 is from U.S. Environmental Protection Agency (US EPA) records. Unlike US EPA, we are not focusing our evaluation of the 35th Avenue site on determining sources of contamination from specific facilities in the area. Instead, we only state in general what types of industries and other sources of potential contamination are in a site's area. For this site, we did this to show how soil might be impacted, such as from aerial deposition, flooding, leaded paint, and homeowners using leftover product as soil fill material in residential yards (see also Section 4, Exposure Pathways Evaluation). The information currently provided in Section 3.1 (Background, Site Description) is considered sufficient for our public health evaluation.

[21] We tried not to include very similar comments on the same topic from different reviewers in this appendix to avoid duplication.
[22] US EPA HRS Documentation Record, see http://www.epa.gov/superfund/sites/docrec/pdoc1897.pdf.
[23] US EPA HRS Documentation Record.
[24] US EPA HRS Documentation Record.

Reviewer	Reviewer Comment	ATSDR Response
	mines in the Birmingham area […] [are] known to have arsenic levels as high as 1,500 [mg/kg]. BaP is a known contaminant from coke ovens and foundries […]; lead is a known contaminant from foundries and other industrial plants.”[25]	
2	This report should refrain from appearing to identify Walter Coke as the sole presumed source of concentrations found in the community. Walter Coke has repeatedly offered US EPA technical information showing that the concentrations of substances identified in the community are inconsistent with Walter Coke’s operations. US EPA has never rebutted that information.	We focused our evaluation at this site on determining the potential for harmful health effects from exposures to arsenic, lead, and polycyclic aromatic hydrocarbons (PAHs) in surface soil and garden produce. This report does not try to determine whether past or ongoing operations by specific facilities in the area, including Walter Coke, are the source of these compounds.
2	As ATSDR correctly notes, the relevant area has a history of heavy industry, and US EPA is privy to information showing a number of other industrial facilities in the vicinity having operations far more consistent with the contaminants observed. One type of such facilities deserves note: this report (Section 3.1) states that industry in the area is associated with coke and chemical manufacturing. In fact, both now and in the past, iron foundries were prevalent in and immediately nearby the North Birmingham area, which this report seems to ignore. Indeed, Walter Coke has pointed out to US EPA, the ACIPCO facility nearby alone is the source of thousands of tons of lead emitted to the environment, whereas Walter Coke’s operations are not consistent with any significant lead emissions at all. This area was dominated over the years by iron pipe manufacturing at a number of facilities, of which ACIPCO is only one.	As stated in previous responses, this report is not focused on determining whether specific facilities are sources of contamination in the area. However, we do agree that the background section should include iron foundries and pipe manufacturing as part of the history of heavy industry in the site area. This information was added to the main text in Section 3.1.
2	The record related to the Site is replete with significant evidence of sources at discrete locations having nothing to do with industry—residents’ disposal of asphalt shingles in their yards, burning of coal for home heating, and use of roofing tar are just a few examples.	Sections 3 and 4 of this report list a few potential sources of contamination including aerial deposition, flooding, leaded paint, and homeowners using leftover product as soil fill material in residential yards. This report is not intended to list every source of potential contamination in the site area. The information currently in the main text of this document is considered suitable for the purpose of our public health evaluation.
2	Walter Coke is the only private entity mentioned in this report. Similarly, Figure A calls out Walter Coke but fails to note a number of other industries and potential contaminant sources in the area. Thus, whether intentionally or not, this report appears to communicate an ATSDR view or presumption about Walter Coke’s responsibility for the conditions discussed in the report.	The Walter Coke facility is on Figure A, Appendix A, because this facility is within the site boundary. And, similar to the three communities also noted on the figure (Collegeville, Fairmont, and Harriman Park), the Walter Coke facility takes up a large portion of the site area. Therefore, the Walter Coke facility is noted on the map. In response to this comment, in Section 3.2, we added this footnote:

[25] US EPA HRS Documentation Record.

Reviewer	Reviewer Comment	ATSDR Response
		Note that the Walter Coke facility is mentioned in this section because a large portion of the facility is within the site boundary. However, in this document, ATSDR does not attempt to determine contaminant sources and notes there are many facilities in the surrounding area.
Pathway Analyses		
1	We are especially concerned about the air migration pathways that results in arsenic, lead and PAHs being found in the soil. Although this report evaluates only residential surface soil and homegrown garden produce, the 2015 ATSDR air report is referenced in the Site Activities and the Exposure Pathways Evaluation sections of this report. Accordingly, the pathways analysis in the 2015 ATSDR air report is highly relevant to the conclusions and recommendations in this report.	In Section 4 of this document, ATSDR acknowledged that soil could be impacted by aerial deposition from facility emissions in the area, as well as by other sources. However, our conclusions are based on an evaluation of people's exposure to the chemical levels found in soil and garden produce, and our recommendations provide ways to reduce or eliminate potentially harmful exposures to these environmental media.
1	ATSDR acknowledges that contaminants can move through the air in the 2015 ATSDR air report. The 2015 ATSDR air report also asserts that "[a] resident living in North Birmingham[,] Collegeville, Harriman Park and Fairmont communities *could be exposed to air contaminants from nearby facilities*. *Exposure occurred in the past, is occurring now, and will likely occur in the future.*" In this report, ATSDR asserts that "[s]urface soil [and homegrown garden produce] at the 35th Avenue site *could be impacted by aerial deposition from facility emissions* in the area." Accordingly, where the 2015 ATSDR air report was relevant to this report, there should have been some further discussion in this report regarding the exposure pathway discussed in the 2015 ATSDR air report. For example, where residents within the 35th Avenue site can and do breathe in aerosolized surface soil material, this pathway should have also been assessed. Furthermore, the air migration pathway for the contaminants is highly relevant when offering recommendations to accompany the strong conclusions in this report. Although this report's purpose is to evaluate the public health significance of exposures to contaminants in residential surface soil and homegrown garden produce, the air migration pathway is highly relevant to the recommendations made by ATSDR.	We agree contaminants can move through the air. Our 2015 ATSDR air report evaluated over 100 contaminants in outdoor air including arsenic, lead, and PAHs. In that 2015 ATSDR air report, we found that breathing the levels of arsenic, lead, and PAHs found in outdoor air is not likely to result in harmful health effects. Although these compounds are not of health concern in outdoor air, we acknowledged in this report that soil in the site area could be impacted by aerial deposition, which includes arsenic, lead, and PAHs. We also acknowledged other potential sources of soil contamination, such as lead-based paint. In reaching conclusions about the levels of these compounds found in soil, we considered both the intentional eating of soil and the unintentional swallowing of soil. These routes of exposure would lead to more contaminated soil in a person's body than breathing dust and aerosolized surface soil material when the soil is agitated. Therefore, we consider our conclusions and recommendations about the soil exposure pathway to be protective of public health.
4	In this report, both past *and* current exposures were evaluated in assessing the impact on public health, which is unlike prior ATSDR reports and contrary to ATSDR guidance.	Evaluating whether both past and current exposures may be of health concern is not contrary to prior ATSDR documents on this site and ATSDR's current guidance manual. The Summary sections in our other reports on this site explicitly state (underline emphasis added)

Reviewer	Reviewer Comment	ATSDR Response
		• **2013 ATSDR soil report:** *The purpose of this public health consultation (PHC) is to determine if past, present, and future exposures to soils in Collegeville, Harriman Park, and Fairmont communities are a public health hazard for people who live or work in the area.* • **2015 ATSDR air report:** *ATSDR has evaluated the past and current exposures to air contaminants in the communities in the vicinity of the 35th Avenue Site.* Furthermore, our 2005 guidance manual [ATSDR 2005] states (underline emphasis added) • **Section 2.1.3:** *The public health assessment is used by ATSDR to identify possible harmful exposures and to recommend actions needed to protect public health…It considers past exposures in addition to current and potential future exposures.* • **Section 6.1:** *Past, current, and future exposure conditions need to be considered because the elements of an exposure pathway typically change with time.*
4	ATSDR develops its public health reports by conducting a scientific review of toxicological, health, peer-reviewed science, and other reliable sources of information to evaluate the impact of hazardous contaminants on public health. ATSDR bases its findings on site-specific factors including demographics, realistic land use, realistic pathway analysis, and other pertinent data related to a site. As defined, the ATSDR health assessment is the evaluation of data and information on the release of hazardous substances into the environment in order to assess any current or future impact on public health, develop health advisories or other recommendations, and identify studies or actions needed to evaluate and mitigate or prevent human health effects (55 Federal Register 5136, February 13, 1990, as codified at Title 42 Code of Federal Regulations Part 90). Contrary to ATSDR's own 2005 Guidance Manual, this report includes data and conclusions regarding past surface soil exposures—prior to US EPA removal activities—which increases the number of parcels with contaminant levels above the removal action level and thereby overestimates the current risk at the Site. This inclusion of past exposures is misleading since they are no longer applicable due to the fact that these properties have been remediated to US EPA standards. Including past exposures in this report reflects an obvious attempt by ATSDR to justify the earlier US EPA removal actions and to provide the foundation for recommending additional removal	Please refer to the previous response that directly cites our guidance manual. It is not contrary to our guidance manual to evaluate past exposures. We evaluate past exposures that may not be occurring currently for several reasons. One reason is because exposure to higher levels in the past could have a current or future impact on health. For example, lead moves into bones and teeth and can stay there for decades; then, many years later, some of this lead can leave bones and reenter the blood and organs under certain circumstances like after a bone is broken. Another example is that there may be the potential for health effects like certain cancers resulting from long-term exposure to higher chemical exposure levels in the past. Overall, we recognize that US EPA has cleaned up many residential yards at this site. Therefore, when presenting information in this report for arsenic and PAHs, we noted the number of yards in the past and number of yards currently that are of potential health concern. By presenting the information this way in our conclusions and data tables, we ensure our conclusions are not misleading with regard to the levels of past and current chemical exposures and the number of yards for each exposure scenario.

Reviewer	Reviewer Comment	ATSDR Response
	activities. In fact, this report devotes a similar level of effort to evaluating past exposure levels as it does to assessing current exposure levels, which is inappropriate and contrary to ATSDR's Guidance Manual, which instructs ATSDR to consider current and future impacts on public health.	
4	The "current" state of the Site should have been the basis for this report in order to determine what, if any, health risks were based on current or future conditions. ATSDR's use of data from soils that have already been removed to reach its revised conclusions is inappropriate, especially considering the questionable validity of the XRF data that was used.	See previous responses. According to our 2005 guidance manual, it is appropriate for the agency to evaluate both past and current exposures. Data quality questions related to XRF (i.e., X-ray fluorescence spectrometer) results are addressed in the next set of responses (i.e., in the "Data Quality" category).
Data Quality		
2	We applaud ATSDR's effort to address perceived health threats in the North Birmingham area. Critical to that effort is ensuring the use of sound science and transparency in evaluations and decision-making. While this submission contains a number of comments, the most significant relates to serious, demonstrable flaws in much of the data US EPA provided to ATSDR. That inaccurate and unreliable data in turn has adversely infected ATSDR's analyses. Consequently, as discussed below, we call on ATSDR to withdraw this current draft report and conduct its evaluation relying only on available **reliable** data. ATSDR should then reissue this report in draft form for further public comment. Other alternatives are also identified below. Contemporaneously with the submission of these comments, we are instituting a formal proceeding under the federal Information Quality Act (IQA) seeking US EPA's retraction of the unreliable data at issue. A copy of the Petition is attached as Exhibit "A"[26] and incorporated into these comments by reference. The core and indisputable problem relates to an US EPA contractor's erroneous use of a particular sampling methodology at the properties tested within the 35th Avenue Site. That methodology—known as x-ray florescence (XRF)—created large quantities of grossly unreliable data, particularly for arsenic, and also for lead. As is explained below, the XRF misuse resulted in substantially artificially-inflated concentrations reported at properties within the Site. It is clear that the data at issue fails to even approach US EPA's own	X-ray fluorescence spectrometer (or XRF) is one of the most widely used field methods for analysis of large soil sample data sets because of its relative ease of use and reliability. XRF measurements provide a fast and cost-effective way of screening metals in soil. However, this field method does have limitations, such as that arsenic concentrations may be masked by high lead concentrations. To confirm field XRF results, US EPA typically analyzes 10% of the soil samples in the laboratory. No chemical measurement has value for decision-making unless its accuracy is known and understood. Although variations in sample collection, sample handling, sample preparation (including aliquot collection and homogenization), and analysis can affect measurements, the laboratory confirmatory method should match the field XRF method as well as possible. In preparing the public comment version of this report, US EPA shared with us its February 2013 memorandum on recommendations for use of XRF and sieving of soils at the 35th Avenue site [USEPA 2013]. The 2013 US EPA memorandum found a positive correlation (r = 0.74) between the laboratory and XRF data within +/- 200 mg/kg of the lead RML, and a similarly strong correlation between the sieved and unsieved data (r = 0.74) [USEPA 2013]. This memorandum also provided recommendations for procedures that would provide a higher level of confidence in the arsenic and lead data used for decision making [USEPA 2013]. Based on the positive correlations reported in the 2013 US EPA memorandum, ATSDR gave the same weight to the reported XRF concentration data and unsieved data as we did the reported laboratory

[26] ATSDR did not include the commenter's Exhibit A, which is in regard to a letter sent to US EPA, in this report.

Reviewer	Reviewer Comment	ATSDR Response
	standards for use of XRF results; it also utterly fails any scientific standard for data reliability. The extent of these data problems is nontrivial—the XRF method is the sole source of available Site data for about 86% of the properties sampled (and the source of reported data for an even higher percentage of properties). These problems have in turn corrupted the calculations in this report, leading to conclusions that are scientifically unsupportable and that substantially overstate the potential health risks in the community. In light of the seriousness of the data problem documented in these comments and in the IQA Petition, we strongly urge that ATSDR withdraw this draft report and that it prepare a new version relying only on US EPA laboratory data (and excluding XRF results). Given the significance of this change, such a redraft should be then released for public comment prior to finalization. Alternatively, ATSDR could defer a decision on whether to rely on the disputed data pending resolution of the IQA petition. If that course is followed, we request that ATSDR provide a public notice that this draft report is being withdrawn pending resolution of these data issues. Finally, while we strongly recommend against doing so, should ATSDR elect to move forward to finalize this report despite these requests, we request that the disputed data issues be highlighted in such final report in an appropriately prominent way.[27]	concentration data and sieved data in the public comment release version of this report. Based on concerns regarding the XRF concentration data, we analyzed the correlations in the complete data set ourselves and agree the data do not show strong positive correlations between XRF and laboratory measurements. However, this does not necessarily mean that the XRF measurements are unreliable and provide artificially-inflated concentrations that would lead to our overstating the potential health risk in the community. To determine whether our health conclusions would change if we excluded the XRF data, we compiled just the laboratory data in two new tables (i.e., Tables 7B and 9B, Appendix B). These two new tables present grids and properties falling within certain arsenic and lead concentration ranges for just the laboratory sampling data. Consistent with the public comment version of this report, Tables 6B and 8B, Appendix B, present the grids and properties falling within certain arsenic and lead concentration ranges for the laboratory and XRF sampling data combined. Regardless of whether we base our conclusions on the laboratory and XRF data combined or on just the laboratory data alone, these tables show the arsenic and lead health conclusions do not change. Overall, a small percentage of properties are of health concern. For example, we previously reported that for children, arsenic surface soil levels ≥61 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. Table 6 B, Appendix B, shows for the laboratory and XRF data combined for past soil arsenic exposures, about 6.5% of the properties (80 of the 1,234 total properties) were ≥ 61 ppm and Table 7B, Appendix B, shows for just the laboratory data the percentage of properties was about the same (6.6%, or 36 of the 543 total properties). For current soil arsenic exposures, these tables show the laboratory data alone actually has a higher percentage of properties that are ≥ 61 ppm at 5.2% (22 of the 424 total properties) than the laboratory and XRF data combined at 3.9% (43 of the 1,113 total properties).

[27] Under applicable ATSDR IQA procedures, an IQA Complaint directed to ATSDR would not be ripe unless ATSDR were to finalize the petition using the flawed data. See GUIDELINES FOR ENSURING THE QUALITY OF INFORMATION DISSEMINATED TO THE PUBLIC, CENTERS FOR DISEASE CONTROL AND PREVENTION AND AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY (2005), http://www.cdc.gov/maso/Policy/ReleasingData.pdf. Should that occur, we would expect to file such a Complaint at that time.

Reviewer	Reviewer Comment	ATSDR Response
		Therefore, regardless of whether we base our conclusions on the laboratory and XRF data combined or on just the laboratory data alone, our health conclusion that a small percentage of properties are of health concern remains the same. ATSDR also notes that US EPA responded in a letter to Reviewer #2 regarding the IQA petition seeking US EPA's retraction of the XRF data. US EPA defended its removal decisions for the site and did not retract the XRF data [USEPA 2016]. And as requested, we added Section 5.1.1 to discuss the soil data quality. We also included both tables and text throughout the report, including the Summary, showing the results of the laboratory and XRF data combined and laboratory data alone.
2	This report relies on arsenic data that is demonstrably unreliable and invalid and that significantly overstates the concentrations actually present. Lead data is also questionable and should not be used. The vast majority arsenic data results reported to ATSDR by US EPA were collected by US EPA's contractor using an XRF device. XRF is a technology that can report reliable metals data in the field nearly instantly. It can therefore be a great time and cost saver by, in effect, predicting laboratory results. Crucially, however, valid XRF use **requires** that it be checked to ensure that it correlates appropriately to laboratory results. In this case, the contractor was required to analyze at least 10% of all collected samples by **both** a laboratory and the XRF. The purpose of this procedure was to provide laboratory results against which the XRF results could be compared to ensure the XRF was generating reliable results. Such corresponding laboratory data was collected (in fact ultimately for about 14% of the samples) but inexplicably was not used to ensure an appropriate level of reliability. That laboratory data remains available, however, to judge how the XRF performed and shows that it performed abysmally. US EPA guidelines make clear that the correlation coefficient (the "r" value) between the laboratory sample set and the corresponding XRF sample set must be 0.9 or greater for the data to be usable for decision making. Even for the lesser function of "screening" data (i.e., identifying data that warrants	Unlike US EPA, ATSDR does not have guidance on a specific correlation coefficient (r value) between XRF and laboratory data that we believe is needed for the XRF data to be considered appropriate for use in our reports. As stated previously, based on the positive correlations ($r = 0.74$) between the laboratory and XRF data reported in a 2013 US EPA memorandum [USEPA 2013], we gave the same weight to the reported XRF data as we gave to the reported laboratory data for all of the analyses in the public comment release version of this report. Overall, ATSDR considers the XRF measurements to provide a reliable indication of the possible concentration of the chemical in soil, but with less accuracy in the reported concentrations (i.e., the true concentration of the chemical in soil may be lower or higher than the reported XRF concentration). The reported laboratory concentrations are more accurate and are more likely to represent the true concentration of the chemical in soil compared with the reported XRF concentrations. Of most importance though, our conclusions have not changed from the public comment version of this report to this final version. In fact, the laboratory data alone indicates exposures to arsenic and lead found in surface soil of some residential yards could harm people's health (see previous response).

Reviewer	Reviewer Comment	ATSDR Response
	some type of further evaluation), the r value must be above 0.7.[28] Data having a lower coefficient is normally deemed unusable by US EPA.	
2	The r value for the arsenic data—from 650 paired laboratory and XRF analyses—was only 0.399. The point of using an XRF device is to generate a result that is reliably predictive of what a laboratory result would be so that the XRF data can be used in lieu of lab data. Here, no such predictive value exists. Thus, where XRF was used but no corresponding lab result was generated (again, in about 86% of the total results reported), no valid arsenic data exists at all.	US EPA is following the sampling methodology described in its quality assurance project plan (QAPP) for this site, which indicates 10% of the field screened samples be sent to the laboratory. Further, US EPA's Technical Services Section (TSS) analyzed the need for laboratory analysis for all arsenic and lead samples. According to US EPA, TSS recommended any arsenic XRF reading above 40 mg/kg be sent to the laboratory for analysis, with the exception being when the sample also has an XRF reading for lead exceeding 600 mg/kg because the lead sample alone would warrant a removal action at the property [USEPA 2016]. For arsenic removal actions, US EPA reported there has been only one time when the QAPP and TSS recommendations were not followed. In that instance, the XRF measurement at the property was 61 ppm, while the laboratory analysis showed a value (i.e., 44 ppm) below the removal action level. Based on the data combined with the presence of young children residing at the property, US EPA determined that a removal action was necessary to protect children's health and was not inconsistent with the National Contingency Plan [USEPA 2016].
2	US EPA further compounded these errors by reporting, for those samples having both an XRF and laboratory result, only the higher of the two (usually, the XRF result). US EPA's own guidelines make clear that where laboratory data is more reliable than XRF data. See generally US EPA Method 6200. Yet US EPA routinely distributed invalid XRF results (and only the XRF result) even in the face of far more reliable lab data showing lower (and in many cases, much lower) concentrations.	US EPA provided to ATSDR the full data set to us, including both the laboratory and XRF results for all samples.

[28] Under EPA's guidance for the use of XRF (USEPA XRF Method 6200), a statistical regression analysis is to be conducted to generate a Pearson's Correlation (an "r" value). The r value quantifies the extent to which an XRF measurement is a scientifically acceptable predictor or surrogate measurement as compared to a standard laboratory measurement. EPA's guidance provides:

> The correlation coefficient (r) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

See USEPA SW-846 Method 6200, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment (February 2007), page 15.

Reviewer	*Reviewer Comment*	*ATSDR Response*
2	The resulting overstatement of concentrations in the community is significant. The XRF values ranged **up to 1,825 percent higher** than corresponding lab results. Consider, as an example, the XRF result that was 1825 percent higher than its corresponding lab value: US EPA provided the XRF value to the public—**but withheld the laboratory result**—despite the fact that both US EPA guidance and elementary scientific principles are clear that the laboratory result is the reliable result. US EPA seemingly also failed to inform ATSDR about the laboratory result (or masked it in data summaries). Of course, ATSDR's evaluation methodology is particularly sensitive to higher-concentration results. ATSDR has thus regrettably been put in the position of using artificially high, invalid values as the lynchpin of certain of its conclusions.	Please see previous responses about the accuracy of the XRF data and note that US EPA provided the full data set to ATSDR, including both the laboratory and XRF results. No data were withheld or masked in data summaries with regard to the soil data shared by US EPA. Further, the laboratory data alone indicates exposures to arsenic and lead found in surface soil of some residential yards could harm people's health (see previous responses).
2	At sample location CV0823, the XRF report for arsenic was 384.84 ppm (much higher than ATSDR's "of concern" level), whereas the valid lab result was only 20 ppm. The data files are replete with large such discrepancies; we highlight this one as the largest discrepancy percentage-wise. Among other things, ATSDR's Conclusion 1 about arsenic would warrant substantial revision if such invalid arsenic data was excluded.	Property CV0823 has two grids (one being the front yard and one being the back yard). US EPA collected 10 samples from this property. Of the 10 samples, the 4 XRF samples ranged from 21.38–384.84 ppm and the 6 laboratory samples ranged from 20–93 ppm. Based on these data, our cancer risk conclusion for children regarding this property remains the same regardless of whether we use the maximum XRF arsenic result (384.84 ppm) or maximum laboratory arsenic result (93 ppm) because both values are above 61 ppm. Overall, the laboratory data alone indicates exposures to arsenic and lead found in surface soil of some residential yards could harm people's health (see previous responses).
2	The absurdity of using of this XRF data is demonstrated by another correlation example. We have calculated the correlation coefficient value as between Alabama's annual daily rainfall average and the losing Super Bowl team score. The result—an r value of 0.424—is slightly stronger than the correlation applicable to US EPA's XRF and lab sample results. This example highlights how profound US EPA's error was in publishing the XRF results as real data. The XRF results are junk science at its worst and should not be allowed to taint ATSDR's evaluation. Worse still, US EPA's error has an even more pronounced effect at the upper end of the concentration spectrum, which as noted above is the range of concentrations most critical to ATSDR's analyses. Specifically, the correlation coefficient for arsenic levels that ATSDR labels as "of concern" (i.e., data with results exceeding 61 ppm) is even lower than for the overall data set. For that	We consider the most important question to be whether we would change our health conclusions if this report was solely based on laboratory data, not whether there are good correlation coefficients. As stated in previous responses, the laboratory data alone indicates exposures to arsenic and lead found in surface soil of some residential yards could harm people's health. In fact, for current soil arsenic exposures, Tables 6B and 7B, Appendix B, show the laboratory data alone actually has a higher percentage of properties for current arsenic exposures that were ≥61 ppm at 5.2% (22 of the 424 total properties) than the laboratory and XRF data combined at 3.9% (43 of the 1,113 total properties).

Reviewer	Reviewer Comment	ATSDR Response
	data subset (a total of 44 of the 650 paired samples), **the r value is only 0.25.**	
2	The r value for lead was 0.67, also falling short of US EPA's own standards for either screening or decision making. Similarly to the arsenic situation, the difference between the XRF lead results and the corresponding lab results ranged from 0 to 884 percent, a clear indicator of a reliability problem. In short, the XRF data was generated in a manner grossly inconsistent with US EPA's own internal guidance, rendering it worthless as a scientific matter. Indeed, US EPA would reject out of hand the submission of such data by a private party.	As stated in the last response, we consider the most important question to be whether we would change our health conclusions if this report was solely based on laboratory data, not whether there are good correlation coefficients. The laboratory data alone indicates exposures to arsenic and lead found in surface soil of some residential yards could harm people's health (see previous responses).
2	One aspect of the XRF data problem warrants particular added emphasis. Early on in US EPA's sampling, the agency's Technical Services Section ("TSS") recognized the correlation problem and recommended corrective measures to achieve some modicum of data quality for lead and arsenic, but US EPA failed to implement TSS's recommendations. A consultant for industry was told by US EPA personnel that this failure was due to US EPA's lack of funds. Lack of funds, or any other excuse, is not a valid reason to generate and distribute grossly unreliable data. In short, the XRF data should be excluded from any use, particularly something as sensitive as an ATSDR Health Consultation. ATSDR should not be put in the position of further propagating clearly flawed data it was not involved in generating. Nor should the public be presented important health-based conclusions that are based on such unreliable data.	According to US EPA, "for all but two properties that have been remediated by the EPA to date at the Site, laboratory data and/or the recommendations in the TSS Memo were used to support the need for removal actions" [USEPA 2016]. For one of those properties, where the laboratory value was below the arsenic clean up level while the XRF was at or above that level, the decision to remediate was because of the presence of young children residing at the property. For the other property, lead was detected by XRF above the clean up value, but no laboratory analysis was performed. ATSDR has not propagated flawed data in our report. In response to comments about the XRF data, we have included both tables and text throughout the report, including the Summary, showing the results of the laboratory data separately. As stated in previous responses, our health conclusion that some properties are of health concern did not change.
4	ATSDR relied on data obtained from US EPA's 2012 and 2015 sampling activities, much of which was inconsistent with US EPA guidelines and industry best practices for scientific reliability, such as the use of unreliable XRF data to show conclusive results.	See previous responses.
4	In addition to ATSDR's apparent attempt to manipulate the data to reach a predetermined outcome, another significant issue associated with this report is its reliance on US EPA's samples from its November 2012 through January 2015 sampling activities (that are not provided for full examination). Specifically, in obtaining these soil samples, US EPA used X-Ray Fluorescence (XRF) as a field sampling technique to generate the results. All soil samples were indicated to be field screened using XRF, but only about 10% of the soil samples were split and submitted to the laboratory for RCRA-8 metals analysis. Without an adequate correlation between laboratory data	See previous responses.

Reviewer	Reviewer Comment	ATSDR Response
	and XRF results and without appropriate confirmation of XRF data, the sampling results for lead and arsenic in this report are likely overstated.	
4	US EPA's Operating Procedure for XRF measurements presents several limitations associated with this field screening technique. Specifically, the Operating Procedures identify "sources of interference in XRF analysis which may impact data quality," including: sample preparation errors, spectral interferences, soil moisture, chemical matrix interferences especially associated with arsenic and lead, and a lack of sensitivity with respect to certain analytes. Because of these limitations, US EPA's Operating Procedure includes detailed Quality Assurance/Quality Control and documentation procedures that must be followed. According to US EPA's Operating Procedure, "[i]f at any time during a field investigation, it appears that the environmental conditions could jeopardize the quality of the measurement results, the measurements will be stopped."[29] ATSDR should only use data that it can validate as accurate and precise in determining possible public health risks. The XRF data used by ATSDR to draw conclusions in this report of possible health risks associated with the Site are suspect at best and may be contributing to false conclusions by ATSDR.	Overall, ATSDR considers the XRF measurements to be reliable data, but with less accuracy in the reported concentrations (i.e., the true concentration of the chemical in soil may be lower or higher than the reported XRF concentration). As stated previously, we reported the laboratory results separately in response to comments on this report. Note that our conclusions remain the same in that a small percentage of properties are of potential health concern (see previous responses).
4	Past experience has shown that good correlation curves are needed to substitute XRF analysis for laboratory analysis. For example, in the lead cleanup performed in Anniston, Alabama, all residential properties had soil samples analyzed in the laboratory before USEPA made its remediation determinations for the properties. XRF was used primarily to confirm the bottom of excavation concentrations—not for determining areas requiring remediation. USEPA's practice of relying primarily on XRF field screening data at the 35th Avenue Site has been questioned in the past,[30] and with good reason. In fact, ATSDR's own Public Health Assessment Guidance Manual (2005 Update) cautions against using sample results obtained with field screening techniques such as XRF. Specifically, Section 5.1.1 of ATSDR's Guidance Manual states that "you should rely on data generated by field screening techniques only when data from more advanced sampling	Questions about decisions US EPA made regarding remediation determinations for properties at this site should be expressed to that agency. Regarding ATSDR's Public Health Assessment Guidance Manual [ATSDR 2005], Section 5.1.1 of the manual specifically states: **Field Screening Techniques**. Sampling teams usually rely on field screening techniques to obtain real-time indications of levels of contamination. This is typically done during the preliminary site investigations of hazardous waste sites. Examples of field screening techniques include chemical test kits, organic vapor analyzers, Drager tubes, ion-specific probes, and other portable monitoring equipment. These techniques help field personnel quickly identify the presence of certain contaminants and maybe even areas of relatively high and

[29] USEPA, SESDPROC-107-R2, December 2011, Field X-Ray Fluorescence Measurement Operating Procedure, Pages 6, 7, & 8.

[30] See Walter Energy letter from Carol Farrell to USEPA's Heather McTeer Toney dated February 28, 2014 and Kazmarek Mowrey Cloud Laseter LLP letter from Robert D. Mowrey to USEPA's Marianne Lodin dated February 26, 2014.

Reviewer	Reviewer Comment	ATSDR Response
	approaches are not available. In such cases, recommending additional sampling may be appropriate", and even then, the outputs of field screening techniques "often are of limited quality and reliability in terms of precise quantification and specificity...."[31] Considering the limitations set forth in USEPA's Operating Procedure for Field XRay Fluorescence Measurement and cautions from ATSDR's own Guidance Manual regarding the validity of field screening techniques, such as the lead and arsenic XRF data for the Site, it is more than troubling that these results were still considered valid and used to justify the conclusions in this report.	relatively low contamination. Their outputs, however, often are of limited quality and reliability in terms of precise quantitation and specificity, as the following examples show: Certain surveying devices report measured concentrations as ranges (e.g., "between 50 and 100 [parts per billion]"), rather than reporting actual concentration; other devices report concentrations of groups of substances, rather than for individual compounds (e.g., "total VOCs in air at 2.0 ppm [parts per million]"); and other techniques have relatively high detection limits (see text box below), which often limits their utility in environmental public health evaluations. Unlike the field screening techniques mentioned in our guidance manual (i.e., those reporting concentration ranges not actual concentrations, those reporting concentrations for groups of substances, or those with relatively high detection limits), the field XRF method reports chemical-specific concentrations at levels low enough for public health evaluation. Furthermore, as stated previously, our public health analyses (i.e., conclusions) would not change even if we had excluded the XRF data.
4	US EPA's SW-846 Method 6200[32] notes that XRF is a rapid field screening procedure that is to be used for screening – not characterization – and provides several reasons why, including the following: 1) lower detection limits than the XRF instrument is capable of reading are generally needed; 2) experience and qualifications of the instrument user is subjective; 3) measurement times are user-selectable and subjective; 4) matrix variations (particle size, uniformity, surface condition) affect the results; 5) moisture content affects the accuracy of the analysis; 6) inconsistent positioning of samples in front of the probe window is a potential source of error; and 7) chemical matrix effects common in soils contaminated with heavy metals (including arsenic and lead) that may skew the results. Accordingly, techniques other than XRF are intended to be used for confirmatory sampling and there is simply no justification or reason to use any XRF data for characterization of arsenic or lead. Further, any remedial decisions or actions taken based on XRF results will be invalid.	Questions about decisions US EPA made regarding the use of XRF and remedial determinations at this site should be expressed to that agency.

[31] ATSDR, Public Health Assessment Guidance Manual (Update), January 2005.

[32] SW-846, Rev. 0, February 2007, Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment.

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4	This report notes that about 60 percent of the samples were sieved using a 2 millimeter sieve. This is contrary to recommended sampling practices and guidance and should not have been allowed. Specifically, the US EPA Technical Review Workgroup and the American Society for Testing and Materials have issued guidance on sieving, which recommends the use of a 250 µm sieve.[33] By using a larger sieve with the soil samples for the 35th Avenue Site, it is likely that US EPA improperly included larger particle size materials that would not be bioavailable in terms of health risk, thereby again overstating any health risk associated with the Site in yet another way.	ATSDR primarily relies on environmental data collected by other agencies. For this site, we relied on data provided by the US EPA. ATSDR did not have any input into the sieve size chosen by US EPA. We agree that soil particle size can play a role in the determination of contaminant bioavailability and therefore exposure assessment. Soil particle size can also play a role in contaminant concentrations. For example, one study found areas contaminated by lead show that soil lead concentrations increased with decreasing soil particle size [Juhasz et al. 2011]. Overall though, without site-specific data, ATSDR cannot say how soil particle size impacts bioavailability and the measured concentrations of contaminants at the 35th Avenue site. However, we did recommend US EPA test the bioavailability of metals (arsenic and lead) in the soil (see Section 9, Recommendations).
Data Analyses		
2	The final version of this report should be clearer that samples at levels of concern were found in only a small fraction of the residential properties tested. The public comment version of this report may create a false impression that sampling reflects a community wide problem, when the data (even before excluding the deeply flawed XRF data) actually indicates that a tiny fraction of the total number of residential properties tested exhibit concentrations of potential concern. The ultimate final version of this report should be drafted to make that point more clear by placing an appropriate degree of emphasis on the fact that the very large majority of properties sampled do not pose the health risks discussed in the report. Exhibit "B" reflects proposed edits to address this perception problem.	The current language about the properties of potential health concern is clear and adequate for this report's purpose. For example, we explicitly state the number of yards impacted in our report. However, in response to this comment, we added percentages to these statements such as in the Summary (Section 1): "*Based on the laboratory and XRF data combined, 31 of 1,234 (2.5%) tested properties in the past and 12 of 1,113 (1.1%) properties currently have soil arsenic levels of public health concern for children who intentionally eat soil (which leads to a higher than normal soil intake) for acute (short-term) exposures. Based on the laboratory data alone, 15 of 543 (2.8%) tested properties in the past and 10 of 424 (2.4%) properties currently are of public health concern for children who intentionally eat soil.*" Exhibit B suggested edits to include community-wide conclusion statements in this document. These proposed edits were not made because 45% of the site area has not been tested and we cannot reach conclusions regarding those untested properties.
3	ATSDR fails to evaluate the risks of exposure to lead found throughout the neighborhood. ATSDR claims that there is no health based comparison value for assessing the risks to lead in soil, so they fail to make any comparisons at all. The agency rightly states that "there is no clear threshold for some of the	Reviewer #3 is correct in stating that we do not have a health-based comparison value for lead and that there is no clear threshold for harmful effects. However, that does not mean we ignored the risks posed by exposure to lead at this site. In fact, page 2 of this report contains our Conclusion 2, which specifically

[33] See Superfund Lead-Contaminated Residential Sites Handbook, OSWER Directive 9285.7-50 (Aug. 2003) page 27.

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	more sensitive health effects associated with lead exposure" on page 2 of this report. This means that virtually any exposure will likely lead to some adverse health effects. This fact should not, however, be the basis for not including the risks posed by lead in the overall assessment of the impact of the contamination on the people who live in this neighborhood. It is a terrible decision by ATSDR to essentially ignore the risks posed by exposure to lead because there is no clear threshold for exposures. Given this recognition, the agency should want to take action to protect the health of the people in this neighborhood, especially the children who are especially sensitive and vulnerable to exposure to lead and recommend action steps that protect against the exposure to lead in soil.	discusses those risks. Tables 8B and 9B, Appendix B, puts various soil lead concentrations into perspective for the residents by providing the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) estimated probability of exceeding a blood lead level (BLL) of 5 µg/dL and the estimated geometric mean BLL for various lead soil ranges. ATSDR, an advisory public health agency, made several recommendations to protect against exposure to lead at this site (see Section 9). US EPA, a regulatory agency, determines clean-up levels for contaminants such as lead. As stated in this report, we support additional efforts by US EPA to reduce lead levels in soil at this site.
3	ATSDR failed to include individual data points in this report. ATSDR only provides summary data in this report, arguing that they need to maintain privacy/confidentiality. This is ridiculous. No one is suggesting that ATSDR provide the name and address of every home/ homeowner that was sampled. It is simple enough however to include all individual data points identified by providing just a sampling number for each individual sampling point without disclosing any personal information, fully protecting the privacy of the individual. As presented, no independent analysis of the data can be made. The lack of individual data points in this report makes it difficult to analyze the results in an independent fashion. Without individual data points, it is impossible to assess the distribution of contaminants in the neighborhood and to compare the results to a different target risk value than that selected by ATSDR. In other words, without the individual data points, it's not possible to accurately determine how many homes should be targeted for cleanup using a different target cancer risk value than that selected by ATSDR. ATSDR does provide summary tables that contain the results of numerous calculations made by ATSDR, but there is no way to link observed concentrations to individual data points. Furthermore, ATSDR does describe some of the limitations for the different equations and models used to summarize the data, but without individual data points, there is no way to independently verify the agency's observations, create an alternate summary of the data or to carry out calculations with different inputs, models, and comparison values. It is very patronizing, perhaps even arrogant, for the agency not to include this basic information. This appears primary to be a ruse to restrict access of	There are several reasons for not providing individual data points. Most important, there are thousands of soil samples and each soil sample has data for several chemicals (i.e., arsenic, lead, and 7 PAHs). Further, soil samples for each chemical may have several levels reported such as a laboratory confirmation level for sieved, laboratory confirmation level for unsieved, XRF level for sieved, XRF level for unsieved, and/or duplicate level. Because the data set is so large, it is not feasible to provide individual data points as a part of this report. ATSDR provided summary statistics instead (see Tables 2B–5B, Appendix B). Also of note, the data are not ATSDR's data, but US EPA's data. If Reviewer #3 would like to conduct an independent review of the data, ATSDR suggests the reviewer contact US EPA to request the data.

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	the public to this information. Why the agency would choose to do this is not clear.	
4	This report was performed using a different framework than earlier ATSDR public health reports and attempts to quantify *any* potential health risks associated with the 35th Avenue Site from both past and current exposures. This is evident from the beginning of this report, which states in the Introduction section that US EPA requested that ATSDR focus its evaluation on arsenic, lead, and PAHs. This approach is contrary to past ATSDR studies in that, in this report, US EPA determined what constituents could present a public health issue rather than presenting all data and asking ATSDR to determine if there are any potential issues. For instance, in the 2013 ATSDR soil report, soil samples were analyzed for a complete suite of contaminants, but only arsenic and PAHs were detected above health screening values, and thus, only those contaminants were analyzed.	Our public health consultations (PHCs) are conducted in response to a specific request made to the agency and can be focused on a health evaluation of a small subset of chemicals of potential concern. Both the 2013 ATSDR soil report and this report were completed in response to requests we received from US EPA. Both documents focused on only a small subset of chemicals requested by US EPA. In neither document did we screen the data for a complete suite of contaminants. However, there were some differences in the requests. The 2013 ATSDR soil report was conducted in response to US EPA requesting we specifically evaluate arsenic and PAHs in soil related to the site-specific Resource Conservation and Recovery Act (RCRA) evaluation of the Walter Coke, Inc. facility. US EPA requested only arsenic and PAHs in soil be evaluated because the agency found these compounds above their screening values in prior soil investigations of the facility. Overall, the US EPA request for the 2013 ATSDR soil report was focused on only arsenic and PAHs in soil that US EPA felt may be originating from the Walter Coke facility and may be present in nearby properties. In contrast, this report was conducted in response to the US EPA requesting we specifically evaluate arsenic, lead, and PAHs found in the larger 35th Avenue site. US EPA requested only arsenic, lead, and PAHs in soil be evaluated because the agency found only these compounds above their screening values in the site area. Overall, the 35th Avenue site encompasses a larger geographic area and includes an evaluation of soil lead data.
4	This report was performed using a different framework than earlier ATSDR public health reports. In the 2015 ATSDR air report, ATSDR compared the contaminant concentrations detected with their respective comparison values (CV) as a screening step to determine the priority contaminants at the Site. ATSDR also notes in the 2015 air report that "[w]hen a contaminant exceeds a health-based comparison value it does not mean that it will cause a health effect, but it does mean that the contaminant needs to be evaluated further for adverse health effects."	ATSDR public health assessments (PHAs) are different than our public health consultations (PHCs) in that PHAs typically encompass a health evaluation of all chemicals found in an environmental medium (like soil, water, and air). They can also encompass several environmental media. The 2015 ATSDR air report (i.e., PHA) for this site screened the levels of all chemicals found in outdoor air against available health-based comparison values (CVs). In contrast, our PHCs are conducted in response to a specific request made to the agency and can be focused on a health evaluation of a small subset of chemicals of potential concern. For this report, US EPA requested we specifically evaluate arsenic, lead, and PAHs. These compounds were screened against available CVs.

Reviewer	*Reviewer Comment*	*ATSDR Response*
		Similar to the 2015 ATSDR air report, this report states in Section 6 that "*Health-based CVs and health guidelines, as well as all other health-based screening criteria, are conservative levels of protection—they are not thresholds of toxicity. Although concentrations at or below a CV represent low or no risk, concentrations above a CV are not necessarily harmful.*" In this report, we retain for public health evaluation those chemicals exceeding CVs as well as those chemicals with no CVs.
4	ATSDR also used a different approach in this report than in the 2013 ATSDR soil report to determine contaminant levels in the surface soil at properties in the Site. This is significant because the reported contaminant levels for the properties form the basis for exposure determinations, and in turn, the assessment of potential health risks. In the 2013 ATSDR soil report, ATSDR averaged front and back yard samples into a single average value to represent the property (see page 4 of that report). In contrast, in this report, ATSDR not only changed its position and used the maximum grid value to represent the entire property (instead of an average), but it also used the maximum sample value (regardless of collection or analysis technique) to represent the grid. Specifically, ATSDR utilized a single sample result with the highest value contaminant level of the already suspect XRF field screening data to represent the contaminant level for an entire property, which is not appropriate for determining chronic (long term) exposures. This is just another example of how ATSDR intentionally manipulated the input of data to reach a predetermined conclusion of a higher potential risk to human health.	Exposure evaluation is an evolving process. Reviewer #4 is correct in stating that we used a different exposure evaluation approach in this report than in the 2013 ATSDR soil report. After the 2013 ATSDR soil report was released, we developed new exposure dose guidance. This new guidance was shared with ATSDR staff in December 2014 [ATSDR 2014]. To ensure the new guidance was being properly followed, staff working on this report met with staff on the exposure dose guidance work group, which included two branch associate directors of science. One topic of discussion revolved around what value to use in the evaluation of the exposure point concentration on which we base our health evaluations and health conclusions. The decision was made to use the grid sample to represent the exposure point concentration instead of a property average for two reasons: 1. Each grid sample already represents an average (i.e., the grid sample is actually a composite sample typically composed of five aliquots taken within the specified grid). 2. Certain areas of the yard, like play areas and gardens, may be visited repeatedly by young children and gardeners. Calculating a property average, instead of using the grid sample concentration, could result in underestimating the exposure point concentration for these sensitive populations.
4	Another example of ATSDR's intentional manipulation of exposure scenarios related to the data is this report's use of questionable assumptions to develop outcome-driven results to show some desired nominal increase in health risks associated with the 35th Avenue Site. Specifically, it appears that different default exposure assumption values were used in this report than were used in the 2013 ATSDR soil report. For example, the pica child soil ingestion rate used in 2013 was 1,000 milligrams per day (mg/day), and this report used an ingestion rate of 5,000 mg/day (see Table 12B in this report and Table B1 in the 2013 ATSDR soil report). This is a five-time increase in the Central Tendency Exposure from the 2013 pica child soil ingestion value without any	As stated in the previous response, we developed new exposure dose guidance in 2014. For a child who intentionally eats soil, this guidance recommends 5,000 mg/event, with a frequency of 3 events per week [ATSDR 2014]. This guidance was finalized after the release of the 2013 ATSDR soil report. This report follows the new guidance, which represents our best science and ATSDR policy.

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	discussion or justification as to why such an increased rate was needed. The 2013 ATSDR soil report referenced the 1,000 mg/day as the “high end” soil ingestion rate value recommended for a pica child from the “General Population Central Tendency” in US EPA’s Exposure Factors Handbook (Table 5-1; USEPA, 2011). It is apparent that in this report, ATSDR intentionally varied its assessment to achieve an adverse health risk by increasing the soil ingestion rate for a pica child.	
4	ATSDR also lowered the comparison values for arsenic and BaP in this report, as compared to the 2013 ATSDR soil report, again in an apparent attempt to increase the number of properties presenting a potential health risk. For example, the BaP cancer risk evaluation guide (CREG) used in this report is 0.096 ppm, and in the 2013 ATSDR soil report, it was 0.1 mg/kg. ATSDR has apparently lowered the CREG in this report in order to identify more properties exceeding the comparison value.	First, please note that our comparison values (CVs) are not used to determine the potential for harmful health effects and therefore, were not used to determine the number of properties presenting a potential health risk. Our CVs are only used for screening the data. We retain for public health evaluation those chemicals exceeding CVs as well as those chemicals with no CVs. Second, we changed our procedures with regard to rounding the results of our CV calculations. When the 2013 ATSDR soil report was written, we rounded to one significant digit when calculating CVs. However, our current guidance rounds CVs to two significant digits. Although our actual CV calculations did not change [ATSDR 2013], displaying the results of the calculations using two significant digits instead of one can lower or raise the CV. The arsenic CV of 15 ppm (two significant digits) used in this report is listed as 20 ppm (one significant digit) in the 2013 ATSDR soil report. The BaP CV of 0.096 ppm (two significant digits) used in this report is listed as 0.1 ppm (one significant digit) in the 2013 ATSDR soil report. Third, even if we had used the former one significant digit CVs, arsenic and BaP levels in this report were high enough that they would have screened into our evaluation regardless.
4	In the 2013 ATSDR soil report, ATSDR concluded that no adverse health effects were expected from arsenic or BaP-TE soil exposures at properties with average concentrations below the proposed cleanup values. In so doing, ATSDR used the following US EPA proposed cleanup values:	In this report, we determined that exposure to lead found in surface soil of some residential yards indicates the potential for elevating BLLs. We also note that other indoor and outdoor sources of lead (e.g., lead paint) may result in elevating BLLs *even further*. Because even low levels of lead in blood have been shown to have harmful effects, we discuss ways to reduce soil lead exposures as well as ways to reduce or eliminate these other lead sources in people’s environments. With regard to the levels of arsenic and PAHs, we did not state anywhere in this report that health risks exist well below the US EPA RMLs reported in the 2013 ATSDR soil report. In fact, the levels of health concern noted in this report are above the 37 mg/kg arsenic RML and 1.5 mg/kg benzo(a)pyrene RML noted in

<table>
<tr><th>Reviewer</th><th>Reviewer Comment</th><th>ATSDR Response</th></tr>
<tr><td></td><td>
<table>
<tr><th>Constituent of Concern</th><th>Removal Management Level (RML) (mg/kg)</th></tr>
<tr><td>Arsenic</td><td>37[1]</td></tr>
<tr><td>Lead</td><td>400[2]</td></tr>
<tr><td>Benzo(a)pyrene</td><td>1.5</td></tr>
</table>
[1] The original RML for arsenic was set as 39 mg/kg. It was then changed publicly by USEPA in August 2013 to 61 mg/kg. ATSDR's 2013 PHC presented the RML for arsenic as 37 mg/kg.
[2] Although lead was not considered in the 2013 PHC, USEPA set the RML for lead at 400 mg/kg.

However, with no justification or discussion as to why, health risks in this report were stated well below the above-noted cleanup values used by ATSDR in the 2013 ATSDR soil report. ATSDR also reversed its 2013 statements regarding adverse health effects primarily by increasing the level of conservative assumptions and cumulative effects from other sources beyond soil sample results (e.g., lead paint) – again, with no justification or discussion as to why.</td><td>this comment by Reviewer #4. Specifically, we report the following levels of health concern in this report (note, mg/kg = ppm):

Arsenic: short-term ≥ 90 ppm (children who intentionally eat soil), short-term at 1,000 ppm and 1,336 ppm (children who incidentally swallow soil), long-term noncancer ≥ 150 ppm (children who incidentally swallow soil), long-term cancer ≥ 61 ppm (children exposed from birth to 21 years of age), and long-term cancer ≥ 120 ppm (adults for 33 years).
BaP-TE: long-term cancer ≥ 1.8 ppm (children exposed from birth to 21 years of age), and long-term cancer ≥ 25 ppm (adults for 33 years).
Dibenz(ah)anthracene: long-term cancer ≥ 3.5 ppm (children exposed from birth to 21 years of age), and long-term cancer ≥ 45 ppm (adults for 33 years).
</td></tr>
<tr><td>4</td><td>In an attempt to at least partially qualify its biased data, ATSDR notes in this report that "the harmful health effects observed in the studies on arsenic ingestion involved daily long-term ingestion of elevated arsenic levels in drinking water" and "[i]t is not likely that ingestion of large amounts of soil would occur 365 days a year for life." ATSDR also notes "Therefore, ATSDR considers arsenic soil exposures at most properties to represent a low cancer risk." Accordingly, ATSDR basically concedes that its conclusions with respect to arsenic in this report are overstated.</td><td>Regarding the first arsenic statements cited by Reviewer #4, we are only trying to convey that drinking water from a kitchen tap every day is more likely to occur than swallowing large amounts of soil every day. For our exposure dose calculations for long-term exposure, however, we assumed incidental ingestion of soil occurs every day, not ingestion of large amounts of soil. Our cancer risk conclusions are not overstated because we did not assume ingestion of large amounts of soil every day.

Per our guidance [ATSDR 2004], risk estimates at and exceeding 1 in 10,000 people represent an increased risk of cancer. Some residential soil levels of arsenic are of concern because they were at and exceeding the 1 in 10,000 cancer risk level. However, as Reviewer #4 notes, most properties represent a low cancer risk because for most tested properties, the arsenic soil levels were below the 1 in 10,000 cancer risk level.</td></tr>
<tr><td>4</td><td>ATSDR also assumes a bioavailability for PAH of 100%, and notes in this report that "it is not likely that ingestion of large amounts of soil would occur 365 days a year for life. Therefore, ATSDR considers PAH soil exposures at most properties to represent a low cancer risk." This is yet another way ATSDR's conclusions in this report are overstated and inaccurate.</td><td>See previous response. For our exposure dose calculations for long-term exposure, we assume incidental ingestion of soil occurs every day, not ingestion of large amounts of soil. Our conclusions are not overstated because we did not assume ingestion of large amounts of soil every day. Similar to arsenic, exposure to PAHs in soil at most properties represents a low cancer risk because the PAH soil levels were below the 1 in 10,000 cancer risk level at most tested properties.</td></tr>
<tr><td>4</td><td>This report notes that "[n]either ATSDR nor US EPA has developed a MRL or RfD for exposure to lead." Because of this, ATSDR uses US EPA's Integrated</td><td>ATSDR did not misapply the IEUBK model in our lead evaluation for this site to include all ages. We did not use blood lead level (BLL) data from JCDH and</td></tr>
</table>

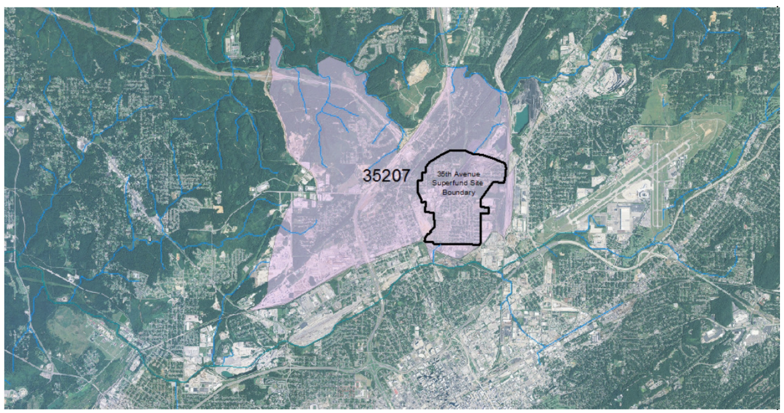
Reviewer	Reviewer Comment	ATSDR Response
	Exposure Uptake Biokinetic (IEUBK) model for lead in children to evaluate exposure to lead in this report. Importantly, US EPA's IEUBK model is intended to be used to project BLL based on assumed conditions only for children between the ages of six months and 7 years. The model was misapplied in this report to include all ages, since ATSDR reviewed available BLL data from two sources: 1) the Jefferson County Department of Health's (JCDH) screening of 44 participants 1-70 years of age, and 2) the Alabama Department of Public Health's (ADPH) 2010-2014 BLL data for zip code 35207 for children 21 years of age and under.	ADPH in our IEUBK model runs, nor did the JCDH and ADPH BLL data impact our health findings regarding exposure to lead in soil at this site. In general, if BLL data are available for a site and surrounding area, we report those data in our public health documents to provide perspective on actual BLLs observed in the site area's population. In the public comment version of this report, our health evaluation for soil lead exposures using the IEUBK model was presented in Section 7.2.1 (Soil Exposure), with the BLL data presented in that same section under the bolded title "Blood Lead Data Review". Because placing the BLL data review in the soil section caused confusion, we created a new section and moved the BLL data review to this new section (see new Section 7.2.3).
4	Not only was the model misapplied to include all ages, but it was also misused in that ATSDR included questionable assumptions and values in the model to project BLL from contaminants. For example, lead was detected in only one of the washed produce samples. In this one sample, lead was detected at a level of 0.57 mg/kg, which was also the highest lead value detected in all twenty of the garden produce samples, washed or unwashed. This was the value ATSDR used in the IEUBK model with the diet values set to 100% vegetables. This is an unrealistic approach that is not justified by the data, considering that only one piece of produce in the washed produce samples contained lead.	As stated in the previous response, we did not misapply the IEUBK model to include all ages. The garden sample data were limited. US EPA intended to sample produce from 10 gardens, but only 5 gardens had enough vegetables for analysis. Lead was detected in 4 of 20 garden produce samples (20% of the samples). Three of the lead detections were from unwashed garden produce samples and one was from a washed sample. The lead detection in the one washed sample is likely from root uptake (movement of lead from the soil into the produce). The lead detections in the three unwashed garden produce samples could be from 1) soil adhering to the garden produce samples, 2) aerial deposition on the surface of the samples, or 3) root uptake, or a combination of the three. Reviewer #4 is correct that we set the diet value for vegetables to 100%. Based on this comment, we realized the text in the public comment version of this document was not clear. The previous text could be interpreted that the person's entire diet was 100% homegrown vegetables and no other food, which we agree would be unrealistic. However, the alternative diet component of the IEUBK model is calculated as the summation of the lead intake rates for meat, vegetables, fruit, and other sources [USEPA 1994b]. The vegetables could be canned, fresh, or homegrown. When we ran the model, we set the vegetable intake to 100% homegrown and 0.57 mg/kg lead, but did not change the default parameters for meat, fruit, and other sources. We modified the text in Section 7.2.2 to include these points. Overall, because the highest lead concentration was from a washed garden produce sample, we chose to use that value in our evaluation. We also used a soil lead value of 100 ppm and set the BLL reference level for risk estimation to 5 µg/dL. The IEUBK model showed a 4.7% probability of exceeding a BLL of 5

Reviewer	***Reviewer Comment***	***ATSDR Response***
		µg/dL. Based on these results, we find the risk of elevated BLLs in children 6 months to 7 years of age from eating garden produce alone is low. However, we did note that with increasing soil lead concentrations, the IEUBK outputs show increasing probabilities of elevated BLLs in children.
4	ATSDR erroneously left all of the default values in the model with the exception of the soil lead level, which was varied, and the BLL reference level for risk estimation, which was set at 5 µg/dL. Although 5 µg/dL is the value currently used as a "reference level" as opposed to the past United States Center for Disease Control's (CDC) "level of concern" for lead in blood of 10 µg/dL, it does not indicate a level of lead in blood that can be attributed to the soil concentrations at the Site. This extremely conservative value was used in the model even though it has no correlation to the BLL of children in the Site area.	According to US EPA, the IEUBK model results can be viewed as a predictive tool for estimating changes in blood lead concentrations as exposures are modified [USEPA 1994a]. We used the model for this purpose. We did not try to correlate model-predicted BLLs to actual measured BLLs of children in the site area. US EPA recommends the use of default parameters in the IEUBK model unless there are sufficient data to characterize site-specific conditions [USEPA 1994a]. For our soil evaluation, we varied soil levels in the model to be inclusive of the soil lead levels found in the site area. The only other variable we changed in the IEUBK model for our soil evaluation was the BLL reference level for risk estimation. We followed our guidance and used 5 µg/dL as this reference level; this is the reference level at which "CDC recommends public health actions be initiated" [CDC 2012, 2013].
4	The use of 5 µg/dL is based on a reference level proposed in a report by the Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP) as a statistical level to investigate children with elevated BLLs. See Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention Report of the Advisory Committee on Childhood Lead Poisoning Prevention of the Centers for Disease Control and Prevention, January 4, 2012. This report recommends that a reference value based on the 97.5th percentile of the National Health and Nutrition Examination Survey (NHANES)-generated BLL distribution in children 1-5 years old (currently 5 µg/dL) be used to identify children with elevated BLL. This is not a health-based risk level, but rather a level where the ACCLPP recommends certain activities be performed if children of this age are found with BLLs of 5 µg/dL or above. The report offers as a disclaimer: This document was solely produced by the Advisory Committee for Childhood Lead Poisoning Prevention. The posting of this document to our website in no way authorizes approval or adoption of the recommendations by CDC. See http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_010412.pdf.	Reviewer #4 describes the ACCLPP report. This reviewer correctly states that the ACCLPP report did not authorize approval or adoption of the recommendations by CDC. However, CDC concurred or concurred in principle with all of the recommendations in the ACCLPP report [CDC 2012]. A BLL of 5 µg/dL is the reference level at which "CDC recommends public health actions be initiated" [CDC 2013].
4	All the other default values are also the most conservative possible and do not necessarily represent the conditions associated with the 35th Avenue	Ideally, most of the IEUBK model input parameters would be based on site-specific data, but these site-specific data are often lacking. However, use of

Reviewer	Reviewer Comment	ATSDR Response
	Site. ATSDR itself notes that in this report default values are only used when "reliable site-specific inputs are not available," essentially conceding that the model is unreliable. This report states that "the IEUBK model ***depends on*** reliable estimates of site-specific information for several key parameters, including: lead concentration in outdoor soil, soil/dust ingestion rate, lead concentration in deteriorating paint and indoor paint dust, individual variability in child blood lead concentrations affecting the Geometric Standard Deviation (GSD), and rate and extent of lead absorption from soil (bioavailability)." Misrepresenting the data in such a way enabled ATSDR to reach its flawed conclusion in the Summary of this report that: Although ingestion of lead in garden produce is not of health concern, it will increase the risk of harm with increasing soil lead concentrations. The combined exposure to lead in surface soil and garden produce indicates the potential for elevating BLLs in children.	model default settings does not make the model unreliable. In fact, US EPA recommends use of model default values unless adequate, site-specific monitoring data exist [USEPA 1994a]. Model defaults are based on many studies. For example, the media intake default parameters were based on data for children with lead exposures that are characteristic of children in the U.S. since about 1980. While there is some uncertainty, these values provide a realistic basis for quantitative modeling as they were selected from the central portions of the ranges of values observed in the different studies [USEPA 2002]. In addition, it may not be feasible or practical to collect such data. For example, the model recommended GSD value is 1.6, which is based on analyses of data from neighborhoods with paired data sets for environmental concentrations and BLL data [USEPA 2002]. The GSD default value should be appropriate for all sites, and US EPA states model users should not substitute alternate values for the default GSD without detailed, scientifically defensible studies [USEPA 2002]. Overall, our use of default inputs in our IEUBK model runs was not a misrepresentation of the data.
4	Moreover, all the cumulative risks for lead are based on assumed default values inputted into the lead exposure model used by ATSDR, not actual sample data, which, again, likely overstates the BLL.	Please see previous response. US EPA recommends use of model default values unless adequate, site-specific monitoring data exist [USEPA 1994a]. As stated in a previous response, according to US EPA, the IEUBK model results can be viewed as a predictive tool for estimating changes in blood concentrations as exposures are modified [USEPA 1994a]. By using site-specific soil lead levels in the model with all other inputs kept constant, we were able to show the estimated probability of exceeding BLL of 5 µg/dL and the estimated geometric mean BLL for various soil lead level ranges.
4	Even more troubling is ATSDR use of "non-site specific" factors in this report that serve to bias the results towards an increased health risk that is not representative of the actual conditions at the Site. One example of ATSDR's use of non-site specific factors is the use of Blood Lead Levels (BLL) for children and adults from outside of the 35th Avenue Site area across zip code 35207. This served to identify and include individuals with BLLs above the 5 µg/dL exceedance reference level – even though this level was not present in any of the children tested within the 35th Avenue Site boundaries.	Our lead conclusions are based on the results of our IEUBK model runs, not on the BLL testing results for ZIP code 35207. These ZIP code level data were not used in our model runs, nor did it impact our health findings regarding exposure to lead in soil at the site. Unfortunately, BLL data are typically not available for smaller site-specific areas, but may be available for a larger ZIP code area that contains the site. As stated in a previous response, we report BLL data that are available for a site and surrounding area in our public health documents. We endeavor to list any limitations in our reporting of the BLL data. We show the site is only a portion of ZIP code 352907 in Figure 1A, Appendix A. We also explicitly state the ZIP

<table>
<tr><th>Reviewer</th><th>Reviewer Comment</th><th>ATSDR Response</th></tr>
<tr><td></td><td></td><td>code BLL data “may not necessarily be representative of the site area” in the Summary, main text, and Conclusion sections of this report.

Please also note, for the ZIP code level BLL data, we were not provided addresses. Therefore, it is unknown whether the 25 children with BLLs at or above 5 µg/dL in this dataset all resided outside the site boundary, all resided inside the site boundary, or were a combination with some residing outside and some residing inside the site boundary.</td></tr>
<tr><td>4</td><td>ATSDR also biased the BLL by using the ADPH’s 2010-2014 BLL data from throughout the zip code 35207, even though the 35th Avenue Site only comprises a small portion of this zip code. See Figure below. ATSDR notes this in its Limitations section, and also points out elsewhere that ACLPPP endeavors to test children with the highest risk for elevated BLL, which is another reason why the BLL for zip code 35207 is not representative of the Site.



</td><td>As stated previously, ATSDR agrees the ZIP code data are not necessarily representative of the site area. ATSDR did not use the ZIP-code level BLL data from ADPH in our IEUBK model estimations, nor did it impact our health findings regarding exposure to lead in soil at the site. We endeavor to list any limitations in our reporting of the BLL data, and in fact showed the site was only a portion of the ZIP code 352907 in this report (see Figure 1A in Appendix A).</td></tr>
<tr><td>4</td><td>The BLL for zip code 35207 showed 25 children with BLLs at or above 5 µg/dL. ATSDR apparently requested this zip code data in order to obtain results with BLLs above 5 µg/dL (16 of 329 BLL tests for children 1-5), since the JCDH blood screening data for the 35th Avenue Site showed no children with a BLL at 5 µg/dL. Even though ATSDR notes that this data may not be representative because the zip code encompasses a larger area than just the Site, it makes no attempt to distinguish between BLL levels within the Site versus outside the Site boundary, presumably since this would not show any results greater than 5 µg/dL. Even though 15 of the 44 participants in JCDH’s BLL screening did not live within the Site, for all children screened ages 1-5,</td><td>ATSDR asked both JCDH and ADPH for BLL data for the site and surrounding area. We were provided both sets of BLL data. Neither set included BLL data for only participants residing within the site boundaries. We reported both datasets, and stated their limitations. Of note, for the JCDH BLL data, we were provided addresses of participants and were able to report the number of participants residing within site boundaries and those residing in the surrounding area. As stated previously, for the ZIP code level data from ADPH, we were not provided addresses; therefore, it is unknown whether the 25 children with BLLs at or above 5 µg/dL in this dataset resided inside the site boundary or not.</td></tr>
</table>

Reviewer	Reviewer Comment	ATSDR Response
	the BLL was 1.4 µg/dL, and for children screened ages 1-5 that live within the Site, the BLL was even lower, 1.3 µg/dL.	
4	ATSDR appears to be basing any perceived increased health risk due to elevating BLL from soil or garden produce exposure on a potentially incorrect source of lead. By including cumulative risks that assume a conservative exposure from lead-based paint in the homes without obtaining actual sampling results that confirm the potential exposure, public health risks are likely overstated.	Exposure to lead paint can be direct (e.g., by ingestion of paint chips or flakes) or indirect (e.g., by ingestion of soil that has been contaminated by lead paint chips or flakes). Our evaluation did not address direct exposure to lead paint. With regard to the indirect exposure pathway, the contribution of paint was accounted for in the site-specific measurements of soil lead levels. According to US EPA, if soil lead levels are measured, there is no need to measure lead levels in the paint [USEPA 1996].
4	This report also solely focuses on the consumption of lead-contaminated soil and undermines the significance of other sources of lead which are more obvious exposure pathways for children. For example, this report mentions the homes in the area as containing "heavily leaded paint" based on their age, but there is limited discussion regarding children's exposure to lead-based paint, much less the use of actual test results to measure lead concentrations in the paint of area homes.	See previous response. In addition, US EPA states that although a [USEPA 1996] "…paint-to-soil/dust evaluation may be of value, a limitation is that the contribution of leaded paint to soil and dust depends on the condition of the paint, but the condition can easily change over time, either from 'good' to 'bad' (as a result of weathering and aging) or from 'bad' to 'good' (as a result of re-painting). Thus, leaded paint will always be a potential source of contamination for both soil and dust, but whether paint has actually served as an important source in the past, or will serve as an important source in the future, cannot be known with certainty." This report focuses on the levels of lead in soil.
4	Moreover, this report includes the following statement from the CDC report, "Lead can be found in many products and locations. Lead-based paint and contaminated dust are the most widespread and dangerous high-dose source of lead exposure for young children [CDC 2009]." In addition, this report lists several additional sources of lead exposure in two different appendices (Appendix B, Table 13B, and Appendix E). These additional sources include drinking water pumped through leaded pipes, tableware, certain consumer products such as candies, make-up and jewelry, and certain imported home remedies/folk medicines. However, ATSDR only casually references these other more likely sources of lead exposure in its conclusion, stating that "[o]ther indoor and outdoor sources of lead may result in elevating BLLs even further."	We completed this report in response to a US EPA request. Per this request, we focused our evaluation on soil and garden produce, not these other potential sources of lead. Therefore, we varied the soil lead levels in the IEUBK model to correspond to the lead levels found at the site. Our findings are based on the levels of lead in soil. However, multiple factors have been associated with increased risk of higher BLLs. Because there is no clear threshold for some of the more sensitive health effects associated with lead exposures, we believe it is important to mention these other sources even though our evaluation may not focus on them. As a federal public health advisory agency, in this report we recommended measures to reduce exposure to lead from soil and other possible sources (see Section 9).
4	In addition, ATSDR's assumptions did not consider vegetative cover over bare soil, but instead assumed that bare soil was available to children and adults, which is another questionable assumption without the use of actual	As stated in previous responses, US EPA recommends use of model default values unless adequate, site-specific monitoring data exist [USEPA 1994a]. Although ingestion rates of bare soil would likely be more than soil with

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	site-specific sampling and results. In summary, neither ATSDR nor US EPA has shown a direct link between the lead levels detected in the soil and their effect on increased BLLs.	vegetative cover, we did not have site-specific child soil ingestion rates. Therefore, we used the default child soil ingestion rates in the IEUBK model. We noted the model limitations in Section 7.4, such as that the model does not take into account the soil cover (e.g., vegetation). Also stated in previous responses, we did not try to correlate model-predicted BLLs to actual measured BLLs of children in the site area. We used the model only to estimate the probability of exceeding a BLL of 5 µg/dL for various soil lead level ranges.
4	This report also contains a "Limitations" section comprising a page and half of the report that sets forth significant limitations with the data and calls into question the overall validity of ATSDR's conclusions that there are any health risks associated with the 35th Avenue Site. For example, ATSDR explains that it "made several assumptions for site-specific exposure scenarios," and that "reliable site-specific inputs" were not available for most of the inputs in its lead exposure model. In addition, ATSDR notes that the health effects data are expressed in terms of "ingested dose" rather than "absorbed dose", and that ingestion of a metal compound in contaminated soil may be absorbed to a much lesser extent than when the metal is in drinking water. Moreover, ATSDR also states that "the harmful health effects observed in the studies on arsenic ingestion involved daily, long-term ingestion of elevated arsenic levels in drinking water. It is not likely that ingestion of large amounts of soil would occur 365 days a year for life." In addition, ATSDR explains that "[l]ead that is not stored in bones leaves the body as waste. About 99% of the amount of lead taken into the body of an adult will be excreted in the waste within a couple of weeks, while about 30% of the lead taken into the body of a child will leave in the waste [ATSDR 2007]." In contrast, the 2013 ATSDR soil report contained one paragraph of "notable exceptions" to the adequacy of the soil data, which explains that some of the samples collected may overestimate actual exposure.	Providing a thorough list of limitations is good, objective science and does not invalidate the conclusions of this report. Overall, there are recognized uncertainties in any ATSDR evaluation. Providing a framework that puts site-specific exposures and the potential for harm into perspective is one of the primary goals of this health evaluation process [ATSDR 2005].
Cancer Risk		
1	The target cancer risk level selected by US EPA is cause for concern. Although within US EPA's standard acceptable target, using the 1-in-10,000 cancer risk value results in the community bearing an unreasonably high cancer risk. The Alabama Department of Environmental Management	First, ATSDR does not set clean up levels, nor do we determine which homes will be selected for clean up, which is a regulatory function that falls within US EPA's purview. This report follows current ATSDR guidance; we consider our evaluation protective of public health. According to ATSDR's Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures [ATSDR 2004], risk

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	(ADEM) suggests a cancer risk of 1-in-100,000.[34] At the very least, ATSDR should have selected a cancer risk of 1-in-100,000. By analyzing under a more protective cancer risk value, more homes and properties would have been selected for clean up under US EPA's current plan. Cleaning up more of the contaminated properties would only further ATSDR's purpose of serving the public by taking responsive health actions.	estimates at and exceeding 1 in 10,000 people represent an increased risk of cancer. For perspective, the American Cancer Society estimated 1 in 3 Americans will get some form of cancer during their lifetime. That means for every 10,000 people, on average 3,333 will get some kind of cancer. A cancer risk estimate of 1 in 10,000 may make the risk of getting cancer higher by one case – from 3,333 to 3,334. The actual number of people getting cancer may be higher or lower, and could be none, because this is an estimate.
3	The selection of a target cancer risk level of 1-in-10,000 as the "acceptable" risk level is 100 times greater than the traditional acceptable target risk level of 1-in-1,000,000. As a consequence, the target cleanup goals for arsenic and PAHs in soil is too high. While the target cancer risk value used by ATSDR is within US EPA's standard "acceptable" target cancer risk range, which includes a high risk of 1-in-10,000 and a lower risk of 1-in-1,000,000, ATSDR choose to use the highest possible cancer risk value in US EPA's risk range to evaluate the risks posed by the contamination in the soil in this neighborhood. In this report, ATSDR defines this target risk level as a "Level of Concern" (p. 18). Deciding on which risk value to use is not a scientific decision. It is a value driven choice by the agency. By selecting this level, ATSDR is expecting the community to bear an unreasonably high risk. Why would the agency choose to use a target risk value at the upper extreme which allows the most possible risk? No explanation is given by the agency for why this target risk level was selected. This is not acceptable from the perspective of protecting public health.	See previous response. ATSDR selected cancer risk estimates at and exceeding 1 in 10,000 people to represent an increased risk of cancer, per our guidance [ATSDR 2004]. In our cancer risk calculations, we assumed people incidentally swallow soil every day, week after week, for many years. We also assumed people would repeatedly visit the portion of their yard with the highest level of each chemical. Our estimates are conservative and we consider our evaluation protective of public health.
3	The selection of a target cancer risk level of 1-in-10,000 may result in perhaps hundreds of homes with significant unacceptable levels of contamination in soil not being cleaned. The risk posed by the contamination found in the soil is the basis for determining how many homes need to be cleaned up in the neighborhood. If ATSDR chooses a high acceptable target cancer risk value, as they have in this report, then it will take a higher level of contamination in the soil to require cleanup at that property. For example, only 30 homes currently have arsenic levels in soil that increase cancer risk by 1-in-10,000 people. However, if the target cancer risk value is 1-in-100,000, the middle value in US EPA's target risk range and a risk value that	As stated previously, our cancer risk estimates are conservative and we consider our evaluation protective of public health. Moreover, our cancer risk estimates are not the basis for determining how many homes need to be cleaned up in the neighborhood. Clean up levels are determined by US EPA. Therefore, concerns about the clean up levels and the risk estimates they are based on should be directed to US EPA.

[34] Alabama Risk-Based Corrective Guidance Manual, see http://adem.alabama.gov/programs/land/landforms/ARBCAManual.pdf, page 3-13.

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	is 10 times lower (and more protective of public health), an estimated minimum of 338 homes would need to be targeted for cleanup, not just 30. By using the more protective target cancer risk value, more than 10 times as many homes/properties would need to be cleaned up than targeted under US PA's current plan. This is an estimate. Without specific individual data points being made available by ATSDR, it is not possible to accurately determine the number of homes that should be targeted for cleanup. Table 1 illustrates how the target cleanup goal changes with each target cancer risk value. As the risk value changes by a factor of ten, so too does the target cleanup goal or the "Level of Concern."	

Table 1: Levels of Concern for Various Target Cancer Risk Levels

	ATSDR Levels of Concern (ppm)	
Risk level	**Benzo(a)Pyrene Toxic Equivalents**	**Arsenic**
1 in 10,000 (c)	1.8	61
1 in 10,000	25.0	120
1 in 100,000 (c)	0.18	6.1
1 in 100,000	2.5	12
1 in 1,000,000 (c)	0.018	0.61
1 in 1,000,000	0.25	1.2

(c) Represents a level of concern for children

ppm = parts per million

Table 2 (next page) provides an estimate of the number of homes that would exceed the level of concern and be targeted for cleanup if the target cancer risk value was lowered to be more protective of public health.

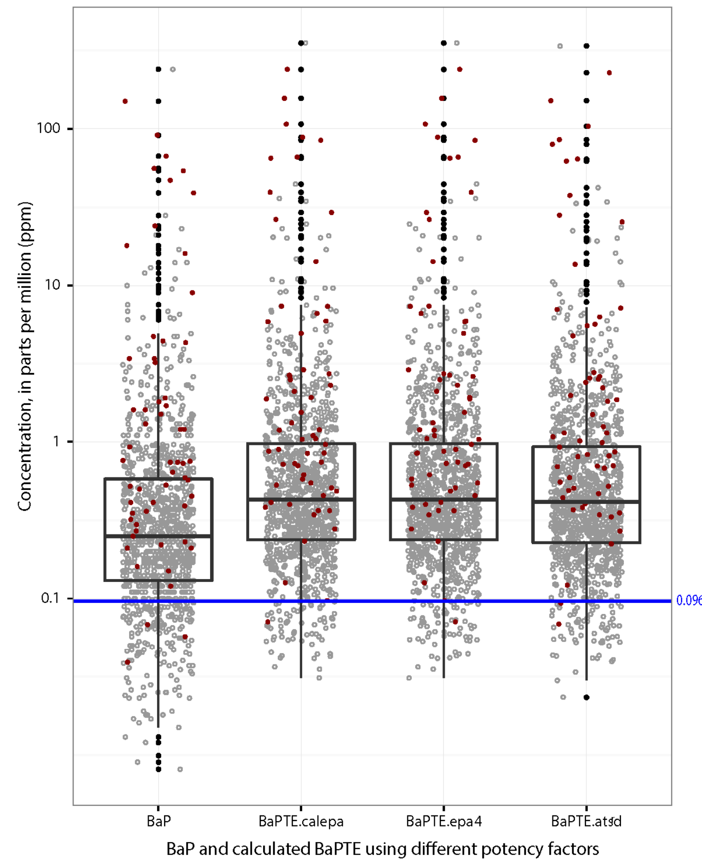
Reviewer	Reviewer Comment	ATSDR Response
	Table 2: Number of Properties Exceeding Various Target Cancer Risk Levels <table><tr><td></td><td colspan="2">**Number of Properties Above ATSDR Levels of Concern**</td></tr><tr><td>**Risk Level**</td><td>**Benzo(a)Pyrene Toxic Equivalents**</td><td>**Arsenic**</td></tr><tr><td>1 in 10,000 (c)</td><td>Approx. 86</td><td>Approx. 32</td></tr><tr><td>1 in 10,000</td><td>N/A</td><td>Approx. 3</td></tr><tr><td>1 in 100,000 (c)</td><td>At least 340</td><td>At least 338</td></tr><tr><td>1 in 100,000</td><td>At least 9</td><td>At least 338</td></tr><tr><td>1 in 1,000,000 (c)</td><td>At least 340</td><td>At least 338</td></tr><tr><td>1 in 1,000,000</td><td>At least 340</td><td>At least 338</td></tr></table>(c) Represents a level of concern for children	
3	ATSDR ignores the number of homes with polycyclic aromatic hydrocarbon (PAH) values that exceed the agency's Cancer Risk Evaluation Guide (CREG). According to the ATSDR, CREGs are calculated using US EPA cancer slope factors and are based on a target risk value of 1 in 1,000,000 persons (the standard comparison risk value). CREGs are used as a comparison value in Table 4B and briefly discussed in this report. Comparison to CREGs show that the vast majority of properties exceed this established value, even following the US EPA remediation efforts. According to ATSDR in this report, 1,025 properties had PAH values in soil that were greater than the agency's CREG of 0.096 parts per million (ppm). Instead of using the CREG value as remediation goal, ATSDR calculated cancer risk values for arsenic and benzo(a)pyrene (BaP) using a target cancer risk value of 1 in 10,000 and not the 1-in-1,000,000 target cancer risk value used to derive the CREGs. These calculated cancer risk estimates were used as comparison values in discussing the results in the public health evaluation and conclusion sections. No reason is given by ATSDR for why it chose a 1-in-10,000 target cancer risk value as starting point for assessing public health risk in this neighborhood and for determining clean up goals nor why it	See previous responses stating we use the 1 in 10,000 cancer risk level per our guidance [ATSDR 2004]. ATSDR comparison values, such as the CREG, are not used for determining clean up or remediation goals. Our comparison values are also not used to determine the potential for harmful health effects. Our comparison values are only used to screen environmental data to identify chemicals that might or might not need closer evaluation (see Section 6). Regarding the CREG, we stated in Appendix F of this report that "*CREGs are a screening tool for evaluating concentrations of carcinogens during an environmental guideline comparison. CREGs are based on possible estimates of cancer risk. Therefore, CREGs serve only as a screening tool and not that cancer is indicated, expected, or predicted.*"

Reviewer	Reviewer Comment	ATSDR Response
	ignored the large number of homes/properties where the concentration of PAHs in soil exceeded the CREG value for PAHs of 0.096 ppm.	
3	ATSDR should provide a range of risks in its analysis of the contamination present in the 35th street neighborhood in North Birmingham, AL including target cancer risks of 1-in-100,000 and 1-in-1,000,000. ATSDR should also provide an assessment of the number of homes/properties that would require cleanup for these target cancer risk levels instead of 1-in-10,000 as exists in this report.	See previous responses; our cancer risk estimates are conservative and we consider our evaluation protective of public health. The information and data presented in this document is considered appropriate for the purposes of our evaluation.
3	ATSDR should conduct a cumulative risk analysis that takes into consideration total cancer risks posed by contaminant levels of arsenic, PAHs and lead in soil for each the homes/properties in the 35th street neighborhood in North Birmingham.	The science of evaluating chemical mixtures is still evolving and there are many uncertainties in any chemical mixtures evaluation. A cumulative cancer risk analysis would not change our health conclusion that some properties could harm people's health. The information and data presented in this document is considered sufficient for the purposes of our evaluation.
3	ATSDR should conduct a cumulative risk analysis that takes into consideration total non-cancer risks posed by contaminant levels of arsenic, PAHs and lead in soil for each the homes/properties in the 35th street neighborhood in North Birmingham.	To conduct a cumulative risk analysis for illnesses other than cancer, ATSDR starts by calculating a hazard quotient (HQ) using each chemical's minimal risk level (MRL). However, for this site only arsenic has an MRL so a noncancer cumulative risk analysis could not be performed. See also previous answer; a cumulative risk analysis would not change our health conclusion that some properties could harm people's health.
4	ATSDR also changed what it considers to be a level of concern for adverse health effects – again, without any explanation or justification as to why. Specifically, ATSDR summarily concludes in this report that an increase in the risk of cancer by 1 in 10,000 people is now a level of concern for lifetime cancer risk. This directly conflicts with the 2015 ATSDR air report and the 2013 ATSDR soil report for this site, both of which correctly reported that the acceptable risk range for USEPA cleanups under Superfund is 1 in 10,000 to 1 in 1,000,000. Although not explained in this report, both the 2015 ATSDR air report and 2013 ATSDR soil report explain as follows: "US EPA uses the general 10^{-4} (1 in 10,000) to 10^{-6} (1 in 1,000,000) risk range as a "target range" within which the Agency strives to manage risks as part of a Superfund cleanup. . . A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions, including any remaining uncertainties on the nature and extent of contamination and associated risks. Therefore, in certain cases US EPA may consider risk estimates slightly greater than 1×10^{-4} to be protective."	As stated previously, this report followed ATSDR guidance [2004] and selected cancer risk estimates at and exceeding 1 in 10,000 people as representing an increased cancer risk. In the 2013 ATSDR soil report on this site, the highest arsenic and BaP-TE concentrations in soil just reached the 1 in 10,000 cancer risk level. All other concentrations of these compounds in soil were below this cancer risk level. Similarly, the 2015 ATSDR air report on this site found that some chemical concentrations in North Birmingham air are at the 1 in 10,000 cancer risk level. Many chemicals were below this risk level. Conversely, for this report, some residential soil levels of arsenic and BaP-TE were not only at the 1 in 10,000 cancer risk level, but *exceeded* this level by a substantial margin (i.e., 10 to 100 times higher). For clarity, ATSDR updated this report in the summary and conclusions sections to include language indicating soil levels of these compounds "result in an estimated cancer risk *at and exceeding* 1 in 10,000 people".

Reviewer	Reviewer Comment	ATSDR Response
	The 2015 ATSDR air report and 2013 ATSDR soil report for this site both reported that 1 in 10,000 is within USEPA's target risk range and represents a low increased cancer risk. For example, see the 2015 ATSDR air report, page 80, noting that the estimated cumulative cancer risk from air contaminants in North Birmingham of one additional cancer out of 10,000 people exposed is "within US EPA's target risk range and represent[s] a low to very low increased cancer risk". Another example, see the 2013 ATSDR soil report, page 14, noting that the lifetime excess cancer risk for property with the highest BaP-TE concentration is 1E-04, and that "[t]his risk estimate is within the US EPA acceptable risk range of 1.0E-04 to 1.0E-06 and represents a low increased risk of cancer." In fact, "in certain cases, US EPA may consider risk estimates slightly greater than 1 x 10^{-4} to be protective." ATSDR's conclusion that an increase in cancer by 1 in 10,000 people is now a level of concern is clearly another attempt to overstate the risk associated with the Site and reach a predetermined conclusion to support USEPA's activities.	
4	Consistent with the results in the 2013 ATSDR soil report and 2015 ATSDR air report, another study conducted by the Jefferson County Department of Health (JCDH) evaluating pollution in the area identified no excess incidence of cancer due to pollution in North Birmingham neighborhoods. See JCDH, Summary of the Comparison of Death Rates and Birth Outcomes of African-Americans Living in Collegeville, Fairmont and Harriman Park to African Americans Living in the Rest of Jefferson County, Alabama (Aug. 6, 2014).	As part of its evaluation, we calculate cancer risk estimates. We note that the actual number of people getting cancer may be higher or lower, and could be none, because our calculations only represent an estimate.
4	ATSDR calculated the cancer risk for BaP-TE and dibenz(ah)anthracene using questionable assumptions and data to reach exposure levels that could cause an increase in cancer risk of 1 × 10^{-4}. Unlike the 2013 ATSDR soil report, which derived a BaP-TE from the seven (7) most common PAHs, this report derived the BaP-TE from only 6 PAHs, excluding and addressing separately dibenz(ah)anthracene, because according to ATSDR, there is no health-based Comparison Value (CV) for that PAH. ATSDR apparently used California EPA's available cancer potency factors in this report, rather than US EPA's toxic equivalency factors, as it had in the 2013 ATSDR soil report. Presumably because California EPA has no potency equivalency factor for dibenz(ah)anthracene, ATSDR separated this PAH out in this report so that it could still use California's potency equivalent factors, which, as explained below, have increased values for two of the PAHs, which in turn, artificially increases the concern for potential cancer risk.	As stated in a previous response, BaP-TE levels were not only at the 1 in 10,000 cancer risk level for some properties, but *exceeded* this level by a substantial margin. In early 2015, ATSDR's Division of Community Health Investigations reviewed information on the BaP equivalency factors the agency was using in its calculations to determine BaP-TEs. Following its review, the division recommended agency staff use the California EPA 2005 potency equivalency factors (PEFs). This report follows current agency guidance. Of note, our BaP-TE calculations were not impacted in a significant way by using the California EPA 2005 PEFs because at this site chrysene and benzo(k)fluoranthene were consistently small contributors to the total BaP-TE (less than 3%). Also, when we first began analyzing the soil data, we completed some internal agency draft figures to see how using different BaP equivalency factors impacted the results. For illustrative purposes only, the figure on the next

Reviewer	***Reviewer Comment***	***ATSDR Response***
	The BaP-TE is a derived concentration of either 6 (in this report) or 7 (in the 2013 ATSDR soil report) of the most common PAHs with their specific concentrations adjusted for their toxicity relative to BaP. Both the 2013 ATSDR soil report and this report included a table with the specific PAHs and their relative toxicities (expressed in 2013 as toxic equivalency factors (TEFs) and in this report as potency equivalency factors). The table below shows a comparison of the six BaP-TE PAHs used in both reports. **Comparison of the 2013 PHC to the 2015 PHC:** Polycyclic Aromatic Hydrocarbon / Potency Equivalency Factor in 2015 PHC / TEF in 2013 PHC Benzo(a)pyrene / 1 / 1 Benzo(a)anthracene / 0.1 / 0.1 Benzo(b)fluoranthene / 0.1 / 0.1 Benzo(k)fluoranthene / 0.1 / 0.01 Chrysene / 0.01 / 0.001 Indeno(123-cd)pyrene / 0.1 / 0.1 As shown above, the TEF, now identified as "Potency Equivalency Factor," for Chrysene increased from 0.001 in the 2013 ATSDR soil report to 0.01 in this report, and the TEF Benzo(k)fluoranthene increased from 0.01 to 0.1, respectively, without an obvious explanation. Upon further review, it appears that ATSDR used US EPA's TEF values in the 2013 ATSDR soil report and California EPA's available cancer potency factors in this report, which contained increased values for these two PAHs. The end result is that use of these values produces an increase in concern for potential cancer risk, although the results still do not show a cancer risk exceeding 1 in 10,000.	page is one of those internal draft boxplots[35]. Overall, the draft boxplots show that using different potency factors do not impact this site's dataset in a manner that would lead to a different health call. The boxplots show the results of just BaP levels (with no other PAHs), the results of using our current guidance for BaP-TE calculations (i.e., using the California EPA PEFs), the results of US EPA Region 4 guidance for BaP-TE calculations (i.e., used to make clean up decisions at this site), and the results of using past ATSDR guidance for BaP-TE calculations (i.e., the potency factors used in the 2013 ATSDR soil report).

[35] The figure is a boxplot. The body of the boxplot consists of a "box" (hence, the name), which goes from the first quartile (Q1) to the third quartile (Q3) and shows the middle 50% of the dataset. Within the box, a vertical line is drawn at the Q2, which is the median of the dataset. Two horizontal lines, called whiskers, extend from the front and back of the box.

<table>
<tr><th>Reviewer</th><th>Reviewer Comment</th><th>ATSDR Response</th></tr>
<tr><td></td><td></td><td>Max soil concentration at each property (all sample depths and all analyses types included)
n = 1,122 properties (over 3,000 quadrants)


ATSDR CV
EPA has cleaned up one or more quadrants of the property
TRUE
FALSE
<table>
<tr><th>ATSDR CV (0.096)</th><th>BaP</th><th>BaP-TE Cal EPA</th><th>BaP-TE EPA R4</th><th>BaP-TE ATSDR past</th></tr>
<tr><td>Percent properties with exceedance(s)</td><td>84%</td><td>94%</td><td>94%</td><td>94%</td></tr>
<tr><td>Number of properties with exceedance(s)</td><td>948</td><td>1,057</td><td>1,057</td><td>1,053</td></tr>
</table></td></tr>
<tr><td>4</td><td>Using these more conservative levels, ATSDR concluded in this report on page 27 that:</td><td>Mean chemical levels are calculated and discussed in the main text of this report to give perspective about general community-wide exposure levels using all available sample results. However, people are not exposed to these</td></tr>
</table>

Reviewer	Reviewer Comment	ATSDR Response
	• For children, BaP-TE surface soil levels ≥ 1.8 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4} , which ATSDR considers a level of concern for lifetime cancer risk [ATSDR 2004]. • For adults, BaP-TE surface soil levels ≥ 25 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. • For children, dibenz(ah)anthracene surface soil levels ≥ 3.5 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. • For adults, dibenz(ah)anthracene surface soil levels ≥ 45 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. However, ATSDR also states that following removal activities, the mean BaP-TE level for the remaining properties is now 0.44 ppm, and the mean dibenz(ah)anthracene level for the remaining properties is 0.10 ppm. These levels are far below the above noted levels indicating a potential risk at or exceeding 1 in 10,000.	community-wide calculated mean chemical levels. People are exposed to the chemical levels in their own yards. We used the highest grid sample chemical level for each yard to represent the exposure point concentration because certain areas of the yard, like play areas and gardens, may be visited repeatedly by young children and gardeners. Using a community-wide calculated mean chemical level would result in underestimating the exposure point concentration for these sensitive populations.
4	The 2015 ATSDR air report references the 2013 ATSDR soil report with respect to BaP-TE and concludes that the combined effects from exposure to BaP-TE from the soils and the air at the Site would not create an adverse health risk. Specifically, as with arsenic, the 2015 ATSDR air report explains that the 2013 ATSDR soil report used the highest property soil BaP-TE concentration and assumed 100% bioavailability of BaP-TE by way of ingestion to reach an estimated cancer risk of 1×10^{-4}. ATSDR states that "[i]f a more realistic bioavailability factor of 50% is used the estimated cancer risk based upon the maximum exposure concentration would only be 9×10^{-5}," and even if this estimate is combined with the highest cancer risk estimate for BaP-TE in the air of 1×10^{-5}, "the results would still be within US EPA's target risk range of 1×10^{-4}" Therefore, when it issued its 2015 ATSDR air report, ATSDR concluded that the combined effects from exposure to arsenic from the soils and the air at the Site would not create an adverse health risk.	In this report, we evaluated surface soil data collected by US EPA from November 2012 through January 2016. Our findings in this report are based on a different dataset than the 2013 ATSDR soil report. Arsenic and BaP-TE soil levels in some yards were found to be 10 to 100 times higher in this report than those reported in the 2013 ATSDR soil report, which impacted our conclusions for the site.
Conclusions		
2	We do not believe that ATSDR has any basis for reaching any conclusion or asserting any view as to the source of the arsenic, lead, or PAHs. Nor should	We agree this report should not reach conclusions regarding the source of the arsenic, lead, and PAHs in soil and garden produce. Therefore, this report only notes general sources of potential contamination and does not reach any conclusions about the source of the contamination. Additionally, in Section 3.2,

Reviewer	Reviewer Comment	ATSDR Response
	ATSDR be put in the position of implicitly or explicitly choosing sides in a factual dispute. This report should be neutral on this point.	footnote that states "ATSDR does not attempt to determine contaminant sources and notes there are many facilities in the surrounding area."
2	Exhibit "B" reflects requested changes that would result in a more neutral document (and the report's figures should also be revised to account for this comment). Exhibit "B" also reflects certain other recommended edits not specifically addressed in this letter.	Exhibit "B", which is not included in this report, provided text insertions and strike-through text on certain sections of this report. Instead of providing the full exhibit, we have summarized here the general substance of the suggested revisions (in italics) as well as our responses: • *Revisions to the three conclusions of this report to include community-wide statements.* Response: These proposed edits were not made because 45% of the site area has not been tested and we cannot reach conclusions regarding those untested properties. • *Miscellaneous revisions to the three conclusions of this report.* Response: The majority of these changes were not made because 1) the suggested text revision changed the meaning of the conclusion statement, or 2) the suggested text insertion was not appropriate in the overarching conclusion statements (i.e., that text is contained in the "Basis for Conclusion" text instead). • *Revisions to the Basis for Decision 2 to include a statement that we have no information indicating elevated BLLs within the study area.* Response: For the ZIP code BLL data, we were not provided addresses; therefore, it is unknown whether or not the 25 children with BLLs at or above 5 µg/dL in this data set resided inside the site boundary. The current text, indicating that this ZIP code BLL data may not be representative of the site area, is correct as is. • *Revisions to the Basis for Decisions 1 and 3 to include comparisons to the number of expected cancers for the population.* Response: In the main text of this report, we provided comparisons to the American Cancer Society estimates that 1 out of every 3 Americans will get some form of cancer during his or her lifetime. We also stated that this estimate means that for every 10,000 people, 3,333 may get cancer. Reviewer #2 provided revisions to our language in the main text and requested we add similar statements to the Basis for Decisions 1 and 3. We chose to keep our current language in the main text. We also believe that this type of information belongs in the main text only because our findings are not based on

<table>
<tr><th>Reviewer</th><th>Reviewer Comment</th><th>ATSDR Response</th></tr>
<tr><td></td><td></td><td>the American Cancer Society’s expected number of cancers for a population.
Revisions to the Next Steps to include that recommendations 1 and 2 only apply to the relevant yards.
Response: We added text to these recommendations to state they apply “especially for those yards with elevated levels that have not yet been cleaned up and for those yards that have not yet been tested.”
Revisions to this report’s Statement of Issues section to state chemicals exceeded RMLs in a small percentage of yards.
Response: We did not compile data on the number of exceedances above the U.S. EPA’s RMLs so we cannot added text to this report about that percentage.
Revision to this report’s Background section.
Response: We made the suggested revisions that we deemed were appropriate.</td></tr>
<tr><td>4</td><td>ATSDR has reversed its prior position regarding whether the evaluated areas pose adverse health risks associated with current and past exposure to the soils at the 35th Avenue Site. To justify its new conclusions for the same evaluated areas, the agency inexplicably used a different approach to quantify potential health risks in this report as compared to earlier ATSDR reports. A review of this report suggests that it is intended to present conclusions that justify and substantiate the US EPA’s past and ongoing removal activities at the Site. Indeed, ATSDR's conclusions that past and current exposures to arsenic and lead in "some" residential yards "could" harm people's health, especially children, and that long-term exposure to PAHs is at a level of concern for lifetime cancer risk, not only conflict with its two prior public health reports on the Site, but also with other statements within this report itself.</td><td>The 2015 ATSDR air report evaluated outdoor air levels, not soil levels. Chemicals found in one environmental medium may be of health concern while in another environmental medium, these same chemicals may not be of health concern. Therefore, the conclusions of the 2015 ATSDR air report are not comparable to this report on soil and garden produce levels.

Although evaluating chemicals in the same environmental medium (i.e., soil), the 2013 ATSDR soil report is not directly comparable to this report either. The 2013 ATSDR soil report looked at only 75 properties near the Walter Coke facility. This report evaluates soil data from over 1,200 properties found in the larger 35th Avenue site area. Also, the 2013 ATSDR soil report evaluated arsenic and PAHs, whereas this report evaluates these compounds in addition to lead. Moreover, for this report, some of the yards found levels of arsenic and PAHs in the larger 35th Avenue site area that were 10 to 100 times higher than the levels reported in the 2013 ATSDR soil report. Overall, compared to the 2013 ATSDR soil report, this report 1) encompasses a larger geographic area, 2) evaluates a larger number of properties, 3) evaluates soil lead data, and 4) evaluates higher levels of arsenic and PAHs found in soil.</td></tr>
<tr><td>4</td><td>This report’s conclusions directly conflict with the conclusions reached in the 2015 ATSDR air report. For example, the 2015 ATSDR air report concluded the following with respect to air quality in North Birmingham:</td><td>Please see previous response. Chemicals found in one environmental medium may be of health concern while in another environmental medium, these same chemicals are not of health concern. Therefore, the conclusions of the 2015 ATSDR air report, as well as US EPA’s air reports, are not directly comparable to this report on soil and garden produce.</td></tr>
</table>

Reviewer	Reviewer Comment	ATSDR Response
	1. The current estimated cumulative ***cancer risks from air contaminants in North Birmingham are within USEPA's target risk range and represent a low to very low increased cancer risk.*** 2. Levels of air contaminants (volatile organic compounds, semi-volatile organic compounds, carbonyls, and metals) in North Birmingham air ***are not likely to result in harmful noncancerous health effects.*** 3. Current exposures to particulate matter in North Birmingham air ***are unlikely to result in harmful effects in individuals.*** 4. Exposures to particulate matter in North Birmingham air in the past (1999-2012) ***could*** have resulted in harmful effects in sensitive individuals ***but not the general public***. These "no impact" conclusions are consistent with air studies of the area conducted by US EPA as well, including the following: • US EPA, North Birmingham Air Toxics Risk Assessment (Mar. 2013), *available at* http://www.epa.gov/region4/air/airtoxic/North-Birmingham-Air-Toxics-Risk-Assessment-final-03282013.pdf (concluding that long-term cancer risks were within US EPA's range of acceptability and that it is unlikely that adverse non-cancer effects from long-term exposure would occur). • US EPA, SAT Initiative: Tarrant Elementary School (Birmingham, AL) (June 1, 2011), *available at* http://www.epa.gov/schoolair/pdfs/TarrantTechReport.pdf (US EPA health-based risk assessment of Tarrant Elementary School determined that the air quality in the area does not pose a health risk to the populations around that school).	
4	The 2013 ATSDR soil report evaluated arsenic and the benzo(a)pyrene (BaP) toxic equivalent (BaP-TE) only—*importantly, lead was not evaluated because it was not detected above health screening levels.* The 2013 ATSDR soil report reached the following conclusions: **Arsenic.** Soil exposures to arsenic in sampled properties around the Walter Coke, Inc. site ***do not present a public health hazard*** with the possible exception of a child with pica behavior eating a large amount of soil from the property with the highest arsenic concentration. In this case, the pica child could develop short term health effects such as pain, nausea, vomiting, and diarrhea. Three of the sampled properties had average arsenic concentrations above the proposed cleanup value. ***Adverse health effects***	Please see previous responses. US EPA requested only arsenic and PAHs in soil be evaluated for the 2013 ATSDR soil report. ATSDR did not review or evaluate lead data as part of that report. However, in the 2013 ATSDR soil report, in response to Comment #3 on page 25 (Appendix A), we responded, "ATSDR agrees that lead in soil may be a public health hazard for the Collegeville, Harriman Park, and Fairmont communities. ATSDR will evaluate the potential public health hazard of lead in soil in a separate consultation." In this report, we evaluate soil lead levels. As stated previously, compared to the 2013 ATSDR soil report, this report 1) encompasses a larger geographic area, 2) evaluates a larger number of

Reviewer	Reviewer Comment	ATSDR Response
	are not expected from arsenic soil exposures at properties with average arsenic concentrations below the proposed cleanup value. **BaP-TE.** Soil exposures to BaP-TE in sampled properties around the Walter Coke, Inc. site ***do not present a public health hazard.*** Fifteen properties have average BaP-TE values above the proposed cleanup value. ***Adverse health effects are not expected from BaPTE soil exposures at properties with average BaP-TE concentrations below the proposed cleanup value.***	properties, 3) evaluates soil lead data, and 4) evaluates higher levels of arsenic and PAHs found in soil.
4	ATSDR's conclusions in this report that past and current exposure to arsenic, lead, and PAHs in the soils in the area could harm people's health directly conflicts with its conclusions reached just two years ago from soil samples with similar contaminant levels.	As noted in previous responses, arsenic and PAH levels evaluated in this report were 10 to 100 times higher in some yards compared to the highest levels evaluated in the 2013 ATSDR soil report. Lead was not evaluated in the 2013 ATSDR soil report.
4	ATSDR concludes in this report that exposure to arsenic found in "some residential yards . . . could harm people's health" and that "children are especially at risk." However, this conclusion is based on the use of unreliable XRF data, which prevents a definitive conclusion regarding whether an actual risk from arsenic exposure exists at the 35th Avenue Site. As noted earlier, US EPA's sampling activities for the Site did not follow US EPA guidelines or industry best practices for scientific reliability.	As stated previously, regardless of whether we base our conclusions on the laboratory and XRF data combined or on just the laboratory data alone, the arsenic health conclusion does not change. Overall, a small percentage of properties are of health concern. For example, we previously reported that for children, arsenic surface soil levels ≥ 61 ppm indicate levels at and exceeding an overall cancer risk estimate of 1×10^{-4}. Table 6 B, Appendix B, shows for the laboratory and XRF data combined for past soil arsenic exposures, about 6.5% of the properties (80 of the 1,234 total properties) were ≥ 61 ppm and Table 7B, Appendix B, shows for just the laboratory data the percentage of properties was about the same (6.6%, or 36 of the 543 total properties). For current soil arsenic exposures, these tables show the laboratory data alone actually has a higher percentage of properties that were ≥61 ppm at 5.2% (22 of the 424 total properties) than the laboratory and XRF data combined at 3.9% (43 of the 1,113 total properties).
4	ATSDR's conclusion that any risk exists is biased by the use of questionable exposure assumptions such as the 5,000 mg/day Central Tendency Exposure value as opposed to the pica child value of 1,000 mg/day used in the 2013 ATSDR soil report. ATSDR also uses a more conservative chronic child exposure scenario resulting in an environmental media evaluation guideline (EMEG) of 15 ppm in this report, as compared to the 20 ppm EMEG in the 2013 ATSDR soil report. The use of a lower EMEG, which is an estimated contaminant concentration that is not expected to result in adverse non-carcinogenic health effects, has the outcome of potentially increasing the risk that may exist at properties in the Site.	As stated in previous responses, ATSDR developed new exposure dose guidance in 2014. For a child who intentionally eats soil, this guidance recommends 5,000 mg/event, with a frequency of 3 events per week. This guidance was finalized after the release of the 2013 ATSDR soil report. This PHC follows the new guidance, which represents our best science and new ATSDR policy. Also as stated in previous responses, ATSDR changed its procedures with regard to rounding its comparison values (CVs). When the 2013 ATSDR soil report was written, we rounded to one significant digit when calculating CVs. However, current guidance rounds CVs to two significant digits [ATSDR 2013].

Reviewer	Reviewer Comment	ATSDR Response
		Although the actual CV calculations did not change, displaying the results of the calculations using two significant digits instead of one can lower or raise the CV. Moreover, our CVs are not used to determine the potential for harmful health effects and therefore, were not used to determine the number of properties presenting a potential health risk. Our CVs are only used for screening the data. Arsenic would have screened into our public health evaluation even if we had used the former one significant digit arsenic EMEG.
4	ATSDR's conclusion that lead levels found in the surface soil of "some" residential yards "could" harm people's health is based on questionable assumptions and values for exposure and includes exposure to numerous other sources of lead contamination such as lead-based paint where no testing has been conducted to determine a cumulative source. Additionally, the exclusive reliance on the use of XRF field analysis serves as the basis for this conclusion and, as explained earlier, is not an accurate measure of actual risk from lead levels in soil at the 35th Avenue Site. Notably, the 2013 ATSDR soil report did not discuss lead contamination at the 35th Avenue Site because the sampling results and laboratory analyses for RCRA metals only indicated arsenic as being a potential health concern.	As stated in a previous response, the contribution of lead-based paint was accounted for in the site-specific measurements of soil lead levels. According to US EPA, if soil lead levels are measured, there is no need to measure lead levels in the paint [USEPA 1996]. Furthermore, US EPA recommends use of model default values unless adequate, site-specific monitoring data exist [USEPA 1994a]. By using site-specific soil lead levels in the model with all other inputs kept constant, we were able to show the estimated probability of exceeding BLL of 5 µg/dL and the estimated geometric mean BLL for various soil lead level ranges. As stated previously with regard to the XRF data, we added tables and information in this report containing just laboratory data alone to show our arsenic and lead conclusions did not change. In the 2013 ATSDR soil report, we did not review or evaluate lead data. However, in response to comments on that document, we stated that lead in soil may be a public health hazard and indicated we would review lead data in a separate report. This report includes our evaluation of lead data.
4	ATSDR's conclusion that lead concentrations could have "in the past" harmed children's health is also interesting since lead was not detected above screening values or considered a contaminant of concern in the 2013 ATSDR soil report. ATSDR notes that USEPA "is currently determining its options toward future phases of removal action," and states that, "[b]ecause ATSDR recognizes that even low levels of lead in blood have been shown to have harmful effects, the agency supports additional efforts by US EPA to reduce lead levels in soil at the 35th Avenue site." Again, this conclusion is interesting considering the lack of lead discussion in the 2013 ATSDR soil report and the absence of lead testing of other sources that were assumed by ATSDR to exist. As with its arsenic conclusion, ATSDR has skewed the data and exaggerated the lead sampling results in a way to support USEPA's ongoing removal activities at the Site.	See previous responses. We did not review or evaluate soil lead data in the 2013 ATSDR soil report, but did state we would review soil lead data in a separate report because "lead in soil may be a public health hazard for the Collegeville, Harriman Park, and Fairmont communities." The IEUBK model calculates combined exposures from lead in air, water, soil, dust, diet, and other sources. US EPA notes that the model predicts a BLL value of 1.15 µg/dL even when all input values are set to zero because in batch mode the contribution from other dietary sources is always present [USEPA 2015]. US EPA recommends the use of default parameters in the IEUBK model unless there is sufficient data to characterize site-specific conditions [USEPA 1994a]. We used model default values for most inputs, with the exception of the reference level for risk estimation and soil levels. For our soil evaluation, we

Reviewer	*Reviewer Comment*	*ATSDR Response*
		held all model values constant and varied soil levels to be inclusive of the soil lead levels found in the site area.
4	Although ATSDR concludes in this report that overall, it considers "long-term PAH soil exposure at most residential properties to represent a low cancer risk," ATSDR still issues a conclusion that the levels of PAHs found in the surface soil of "some" residential yards is a concern for lifetime cancer risk. To reach this conclusion, ATSDR used questionable assumptions and data to calculate the level of PAHs that could cause an adverse health effect. First, ATSDR has modified what it considers to be a level of concern for adverse health effects. As with its arsenic conclusions, ATSDR includes statements indicating that a potential increase in the risk of cancer of 1 in 10,000 is now a level of concern for ATSDR without also mentioning that this level is within USEPA's acceptable risk range, or that this level was not considered a level of concern in prior ATSDR reports. Another glaring omission from ATSDR's PAH conclusion section is the fact that "ATSDR has not derived oral MRLs for PAHs because there are no adequate human or animal dose-response data available that identify threshold levels for non-cancer health effects," and "[t]herefore, it is unlikely that any noncancerous harmful health effects from PAH soil exposure would occur in children or adults." Indeed, the doses at which non-cancer health effects occurred in mice were many orders of magnitude higher than PAH doses from soil exposure at the 35th Avenue Site.	We selected cancer risk estimates at and exceeding 1 in 10,000 as representing an increased cancer risk, per our guidance [ATSDR 2004]. For this report, some residential soil levels of arsenic and PAHs were not only at the 1 in 10,000 cancer risk level, but exceeded this level by a substantial margin (i.e., 10 to 100 times higher). In our cancer risk calculations, we assumed people incidentally swallow soil every day, week after week, for many years. We also assumed people would repeatedly visit the portion of their yard with the highest level of each chemical. Our estimates are conservative and we consider our evaluation protective of public health. Regarding noncancer harmful health effects, Reviewer # 4 is correct that we found long-term exposure to the levels of PAHs found in soil are not expected to result in noncancer harmful health effects (see Section 7.3.1). Although we focused our Conclusion #3 on cancer risk and the potential for harm, in response to this comment, we added noncancer findings to the text as well (see updated Section 1 and Section 8).
4	In sum, it appears that ATSDR changed the assumptions and data used in the 2013 ATSDR soil report to much more questionable and unrealistic assumptions and data in this report to show an increase in cancer risk of 1 in 10,000. ATSDR's conclusions in this report are very different from its 2013 ATSDR soil report, which noted that "a BaP-TE dose from the property with the highest BaP-TE concentration is about 10 times lower than the dose from eating a 6 ounce grilled hamburger every day (Figure 4; Jones, et al, 1998)." No such comparison to other typical sources of PAHs is included in this report. Even with these more conservative assumptions, however, this report shows minimal risk with no actual direct link to the levels detected in the soils.	As stated in previous responses, we developed new guidance since the release of the 2013 ATSDR soil report [ATSDR 2014]. To calculate PAH cancer risk, we now follow US EPA's proposed risk calculations for chemicals that act with a mutagenic mode of action for carcinogenesis. This report follows our new guidance, which represents our best science and ATSDR policy. We also selected cancer risk estimates at and exceeding 1 in 10,000 as representing an increased cancer risk, per our guidance [ATSDR 2004]. Note also that the highest BaP-TE concentration reported in the 2013 ATSDR soil report was 10.2 milligrams per kilogram (mg/kg) and includes the contribution from dibenz(ah)anthracene. The BaP-TE concentration in this report is about 30 times higher (at 347 mg/kg) and does not include the contribution from dibenz(ah)anthracene. Compared to the 2013 ATSDR soil report, this report 1) encompasses a larger geographic area, 2) evaluates a larger number of properties, and 3) evaluates higher levels of PAHs found in soil.

Reviewer	Reviewer Comment	ATSDR Response
4	This report is not an independent, scientific review and assessment of the data for the 35th Avenue Site. Instead, our comments demonstrate that the sole purpose of this report was to arrive at a conclusion that would justify and substantiate US EPA's past and ongoing removal activities at the Site. This underlying purpose explains the improper use of data and the numerous conflicting statements within this report itself. The numerous conflicting internal statements, combined with ATSDR's new perspective regarding what constitutes an unacceptable health risk, calls into question the accuracy of the results of this report and its credibility and reliability as an assessment of any current or future impact on public health from contaminant exposures at the Site. Given all of the above, we request the following from ATSDR: 1. A peer review of this report to determine the accuracy and subjectivity of its conclusions. The Office of Management and Budget (OMB) has stated that "[p]eer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community."[36] 2. An official statement as to whether this report accurately reflects the professional standards and practices that are acceptable to ATSDR. 3. An official statement as to whether this report is a reflection of an independent, scientific-based study, free from undue influence from other entities.	This report follows our current guidance for evaluating environmental chemical exposures, and represents our best science and ATSDR policy. Regarding point #1, our public health consultations like this report are not typically released for external peer review. However, our reports receive internal agency review from management, technical, communication, and policy staff. Of importance for this report, technical reviews were provided by both branch and division associate directors of science, as well as by the agency's Office of Science. Technical reviews of the lead portion of this report were completed by the division's lead subject matter expert and the branch chief of CDC's Healthy Homes and Lead Poisoning Prevention Branch. Before release to the public, we also shared a copy with US EPA to review this report for data validation errors because our report was based on US EPA data (e.g., to ensure we correctly described sampling procedures and data, history of US EPA involvement at the site, etc.) Regarding points #2 and #3, ATSDR officially states: *This report reflects an independent, scientific-based public health evaluation, free from undue influence from other entities. As such, this report accurately reflects the professional standards and practices that are acceptable to ATSDR.*
Recommendations		
1	We were not surprised by the conclusions that there are serious health risks at the 35th Avenue site. We contend that ATSDR's weak recommendations are incongruous with the strong conclusions in this report. ATSDR's purpose is to "serve the public by using the best science, taking responsive public health actions and providing trusted health information to prevent people from	Our 2015 ATSDR air report evaluated over 100 contaminants in outdoor air including arsenic, lead, and PAHs. In that 2015 ATSDR air report, we found that breathing the levels of arsenic, lead, and PAHs found in outdoor air is not likely to result in harmful health effects.

[36] See OMB, Final Information Quality Bulletin for Peer Review, at 7 (Dec. 16, 2004), available at: http://www.cdc.gov/od/science/quality/support/peer-review.htm ("Peer Review Bulletin") ("Section II requires each agency to subject 'influential' scientific information to peer review prior to dissemination."); see id. at 11 ("The term 'influential scientific information' means scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions . . ."). OMB's Peer Review Bulletin is intended to "ensur[e] and maximize[] the quality, objectivity, utility and integrity of information disseminated by Federal agencies." Id.

Reviewer	***Reviewer Comment***	***ATSDR Response***
	coming into contact with harmful toxic substances." We contend that the weak recommendations do not fulfill ATSDR's obligations to prevent contact with harmful toxic substances. Although this report focuses on soil exposure and garden produce, we remain concerned with facility emissions that impact surface soil and garden produce through aerial deposition. We believe that ATSDR could and should have made stronger recommendations in light of their conclusions.	Although we acknowledged that soil could be impacted by aerial deposition from facility emissions in the area, this report focuses on soil and garden produce, not air. We found past and current exposures to surface soil of some residential yards could harm people's health. Note that US EPA has cleaned up, and continues to clean up, properties with elevated levels of arsenic, lead, and PAHs in soil. Our recommendations support those efforts. Our recommendations also provide ways concerned residents can reduce or eliminate potentially harmful exposures in their environment (i.e., both inside and outside their homes). As such, our recommendations are appropriate and protective of public health.
1	ATSDR first concludes in this report about arsenic that "past and current exposures found in surface soil of some residential yards could harm people's health. Children are especially at risk." ATSDR then concludes that "past and current exposures to lead in the surface soil of some yards could harm people's health, especially children and the developing fetus of a pregnant woman." Finally, ATSDR also concludes that "long-term exposure to PAHs found in the surface soil of some residential yards is at a level of concern for lifetime cancer risk." On their face, these conclusions are alarming. It would be reasonable for members of the North Birmingham, Collegeville, Fairmont and Harriman Park communities to be highly concerned about these conclusions. ATSDR's recommendations suggest ways for residents to reduce their personal exposures to arsenic, lead and PAHs. This information is helpful, but is grossly inadequate in light of the gravity of the conclusions.	As stated in the previous response, US EPA has cleaned up, and continues to clean up, properties with elevated levels of arsenic, lead, and PAHs in soil and our recommendations support those efforts. In addition, our recommendations provide ways concerned residents can reduce or eliminate potentially harmful exposures in their environment and are considered to be protective of public health. We also note that although some yards have (or had) these chemicals at levels of health concern, most properties in the site area are below levels of health concern. To put the number of yards of health concern into perspective, in addition to stating the number of yards in our findings, we have added the percentage of the total these yards represent.
1	Although in the 2015 ATSDR air report ATSDR makes recommendations that the Jefferson County Department of Health (JCDH) continue monitoring for particulate matter at the North Birmingham and Shuttlesworth monitors, such recommendations are not seen in this report. Five of the seven recommendations instruct parents and residents on how to avoid or reduce exposure to arsenic, lead and PAH while living in these neighborhoods. The last two recommendations merely reinforce US EPA's existing soil remediation plans. ATSDR could and should have made recommendations to local government and local agencies tasked with safeguarding the public health of the residents in these communities.	The recommendations in this report do not negate the recommendations in the 2015 ATSDR air report. Our recommendations for both reports are valid for the environmental medium each report is focused on (i.e., air or soil). For soil and garden produce exposures, we did not identify any specific actions local government and local agencies should implement with regard to safeguarding the public health of residents in these communities.
1	Providing trusted health information and preventing people from coming into contact with harmful toxic substances requires ATSDR to provide recommendations beyond focusing solely on the personal responsibility of residents in North Birmingham, Collegeville, Fairmont and Harriman Park. It	As stated previously, our 2015 ATSDR air report evaluated over 100 contaminants in outdoor air. Recommendations for continued monitoring of the air were made in that report.

Reviewer	*Reviewer Comment*	*ATSDR Response*
	does not logically compute that ATSDR recognizes in the 2015 ATSDR air report that "[a] resident living in North Birmingham[,] Collegeville, Harriman Park and Fairmont communities *could be exposed to air contaminants from nearby facilities*. *Exposure occurred in the past, is occurring now, and will likely occur in the future*" and concludes that such exposures result in serious public health risks that none of ATSDR's recommendations focus on the nearby facilities to which such air contaminants are attributed.	In that 2015 ATSDR air report, we found that breathing the levels of arsenic, lead, and PAHs found in outdoor air is not likely to result in harmful health effects. Although we acknowledged that soil could be impacted by aerial deposition from facility emissions in the area, this report focuses on soil and garden produce, not air. Further, we do not try to attribute the arsenic, lead, and PAHs found in soil to specific facilities or other sources in the community. And note that US EPA has cleaned up, and continues to clean up, properties with elevated levels of arsenic, lead, and PAHs in soil. Our recommendations support US EPA's efforts.
1	In the 2015 ATSDR air report, ATSDR made several recommendations. One of which is that the JCDH continue to monitor for particulate matter at the North Birmingham and Shuttlesworth monitoring stations. ATSDR also asserts in the 2015 ATSDR air report that "[i]n considering the potential health effects from $PM_{2.5}$, it would have been helpful to have more $PM_{2.5}$ data from the Shuttlesworth monitoring location." However, in the 2015 Ambient Air Monitoring Plan, JCDH states that there are no plans to continue monitoring for $PM_{2.5}$ at the Sloss Shuttlesworth site.[37] The air migration pathways and their role in the serious conclusions reached by ATSDR in this report are of further concern where JCDH has not heeded the recommendations of ATSDR and does not plan to continue monitoring for $PM_{2.5}$ at the Shuttlesworth monitor.	As a public health advisory agency, we unfortunately have no authority to enforce our recommendations. Our goal is to develop strong partnerships with other agencies and work with them to implement our public health recommendations, but sometimes decisions are made outside of our control.
1	Based on the foregoing analyses, we offer the following recommendations for ATSDR to strengthen its recommendations in this report: 1. Where ATSDR acknowledges that arsenic, lead and PAHs can move through the air onto the soil, the recommendations should reflect the industries culpable for such emissions. For example, ATSDR should echo its recommendations from the Evaluation of Air Exposures that JCDH continue to monitor for criteria pollutants and/or suggest JCDH take further steps to monitor the polluting industries and prevent or reduce	As stated in the previous responses, the recommendation for air monitoring outlined in the 2015 ATSDR air report continues to be valid, and as such, does not need to be repeated in this report. With regard to cancer risk, this report followed ATSDR guidance [2004] and selected 1 in 10,000 as representing an increased cancer risk. In our cancer risk calculations, we assumed people incidentally swallow soil every day, week after week, for many years. We also assumed people would repeatedly visit the portion of their yard with the highest level of each chemical. Our estimates are conservative and we consider our evaluation protective of public health. Overall, we found some residential soil levels of arsenic and PAHs are of concern because they were at and exceeding the 1 in 10,000 cancer risk level.

[37] ADEM, State of Alabama Ambient Air Monitoring 2015 Consolidated Network Review (2015), see http://adem.alabama.gov/programs/air/airquality/2015AmbientAirPlan.pdf, page 53.

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	exposures to members of the community through air monitoring and meaningful regulation; and 2. ATSDR should select a cancer risk value greater than the current 1-in-10,000 that is the least protective cancer risk in US EPA's acceptable target cancer risk range. It would more align with the purpose of the Health Consultation to select the target risk level of 1-in-1,000,000, or at the very least, 1-in-100,000.	
3	It is quite clear, based on the conclusions reached by ATSDR, that there are serious public health risks in the neighborhood where these samples were collected. Despite this, ATSDR's recommendations primarily target steps that people living in this community can take to reduce their ***personal exposures*** to the toxic chemicals identified by ATSDR in this report. Five of ATSDR's recommendations are directed to what parents and residents can do to prevent and/or reduce exposures to contaminated soil while playing and living in this neighborhood. The remaining two recommendations are directed at US EPA, essentially telling the agency to continue with its scheduled remediation plan. The focus of these recommendations is quite surprising given the conclusions arrived at by ATSDR in this report. The agency came to 3 very strong conclusions: (1) Exposure to arsenic in the surface soil of some yards could harm people's health, especially children; (2) Exposure to lead in surface soil of some yards could harm people's health, especially children and the developing fetus of pregnant women; and (3) Long-term exposure to PAHs in the surface soil of some yards is at a level of concern for lifetime cancer risk. It is unfathomable to me that ATSDR could come to these conclusions and offer such weak recommendations that allow families at significant risks to remain in their homes while remediation of select homes continues all around them. It is unbelievable that ATSDR could come to the conclusions it has and not offer specific concrete action steps that government agencies could take to better protect the people who live in this neighborhood.	Our conclusions find that arsenic, lead, and PAHs in soil for *some* properties are of health concern. However, the *majority* of the tested properties were below levels of health concern. Further, US EPA has cleaned up, and continues to clean up, properties with elevated levels of arsenic, lead, and PAHs in soil. We also note that US EPA, as a part of their Phase 2 removal effort, targeted properties with children or pregnant women, or both, living on the property. Our recommendations support US EPA's efforts. In the interim, during US EPA's Phase 4 efforts, we provided ways concerned residents can reduce or eliminate potentially harmful exposures in their environment. We consider our recommendations to be protective of public health.
3	This report comes to strong conclusions but fails to provide recommendations or appropriate guidance consistent with the high risks identified in the conclusions. It is baffling and troubling how ATSDR can come to the conclusions it has in this report and offer such weak recommendations that allow families at significant unacceptable risks to remain in their homes while remediation of select homes continues. It is irresponsible for ATSDR to place	We found that the majority of tested yards do not have arsenic, lead, and PAHs at levels of health concern in soil. For those yards of health concern, US EPA, a federal regulatory agency, shoulders the burden of reducing the exposure risk to residents from arsenic, lead, and PAHs in soil though its Phase 1, 2, 3, and 4 removal actions at this

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	virtually the entire burden of reducing/eliminating exposure to toxic substances present in this neighborhood solely on the parents and residents who live there and to not offer specific concrete action steps that government agencies could take to better protect the people who live in this neighborhood.	site. In the interim, while US EPA removal actions are occurring, we provided ways concerned residents can reduce or eliminate potentially harmful exposures in their environment and we consider our recommendations to be protective of public health.
3	The recommendations in this report would lead one to believe that the solution to the contamination in this neighborhood lies solely with the parents and residents who live there. For ATSDR to abandon this community in its greatest time of need is a terrible indictment of the ineffectiveness of this agency in protecting the health of the public it is charged with serving. While it's fine to educate parents and residents on steps they can take to reduce exposures to residential soil and to protect themselves, their families, and visitors, the ATSDR has a further responsibility to recommend actions that the government can take in addition to individual personal action steps to reduce/eliminate exposure to toxic substances present in this neighborhood.	As stated previously, we provided ways concerned residents can reduce or eliminate potentially harmful exposures in their environment and we consider our recommendations to be protective of public health. We also did recommend actions to another government agency to take to reduce or eliminate exposure to arsenic, lead, and PAHs in soil; that is, we support and recommend US EPA to continue their removal actions at this site. We also note that US EPA, as a part of their Phase 2 removal effort, targeted properties with children or pregnant women, or both, living on the property.

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