Health Consultation

SEVEN OUT, LLC FACILITY AND SOIL CONTAMINATION CONCERNS AT MARY STREET PARK (FOLKS PARK)

WAYCROSS, WARE COUNTY, GEORGIA
EPA ID: GAN000407811

Georgia Department of Public Health

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

Contents

Statement of Issues

In July 2013, the Georgia Department of Public Health (DPH) received a request from a resident to evaluate soil sampling data from Folks Park (also known as Mary Street Park) in Waycross, Ware County, Georgia. This resident reported cancer and other illnesses in the community and was concerned that contamination found at the Folks Park may have originated from the Seven Out, LLC, Superfund site (Figure 1).

The purpose of this health consultation is to determine if soil contaminants found at Folks Park are a public health hazard for people who live near and frequent the park. DPH evaluated the Seven Out site history and soil sample data collected by the resident. In addition, DPH reviewed self-reported illnesses of residents living near Folks Park and cancer data for Ware County.

Facility Description and Background

The Seven Out, LLC (Seven Out) property is located at 901 Francis Street in south Waycross, Georgia. Seven Out consists of a tank farm, an abandoned office building and a small warehouse. The site has 37 tanks ranging from 8,000 to 44,000 gallons in volume (Figure 2). The tanks are on approximately one-half acre of concrete with a short concrete containment berm. The tanks are located adjacent to a public road in an area frequented by the public. Access to the site is unrestricted. South of the tank containment area is an office building. Around the south and east sides of the office building is a fenced lot that contains a warehouse. The warehouse contains several drums, totes, and dry bags of material [1, 2].

The facility operated as an industrial wastewater treatment facility from 2002 to 2004. Industrial wastewater was treated in a batch mode where solids were precipitated for removal from the wastewater. Sodium hydroxide, aluminum sulfate, ferric acid, and sulfuric acid were used to precipitate the solids, which were sent to a filter press for concentration and drying. The pressed solids were sent to the Broadhurst Environmental landfill in Screvin, Georgia. The treated wastewater was discharged to the City of Waycross publically owned treatment works (POTW) using the City's wastewater collection system [1].

The treatment process was generally unsuccessful and effluents regularly exceeded the requirement of the facility's wastewater discharge permit. Seven Out received several Notices of Violation and an Administrative Order from the City of Waycross over their short operational history. On March 1, 2004, the City of Waycross disconnected the facility's connection to the POTW. The facility discontinued processing wastewater, although it still received shipments. These incoming wastewater shipments were stored in four rented portable tanks (frac tanks) that were placed on the adjoining property owned by CSX. Shortly thereafter and since that time, Seven Out ceased all operations without discharging the remaining waste in storage. The State of Georgia, Department of Natural Resources, Environmental Protection Division (EPD) determined the facility to be incorrectly storing hazardous waste and out of compliance with State of Georgia regulations [1, 2].

EPD referred Seven Out to the U.S. Environmental Protection Agency (EPA) for a Removal Site Evaluation. In August, 2004, EPA sampled the tanks at the request of the EPD. Because EPA

noted discolored soil in some areas near the tank farm, soil samples were collected from a drainage ditch near the containment area, an area adjacent to the rented frac tanks, and along the south wall of the containment area. An emergency action was initiated by EPA on January 27, 2005 while inspecting the site during the Removal Site Evaluation. Under the emergency response action, pumpable liquids in the tanks and standing water in the secondary containment area were removed to mitigate the threat of release [2]. Discolored soil outside the tank farm was not removed.

From August 28 to September 1, 2006, EPD collected samples from the site and the surrounding area as part of a site inspection. EPD's findings were submitted to EPA's Superfund Assessment Program where it was determined that the Seven Out site did not qualify for further remedial site assessment because of the lack of releases to groundwater, surface water, and soil pathways [2].

Following the 2005 emergency action, several tanks still contained a significant volume of unpumpable sludges and rainwater began collecting again in the secondary containment area, causing deterioration of the tanks still holding material. An Administrative Order was signed on July 30, 2008, between EPA and Seven Out respondents (consisting of several generators that previously sent waste to the facility) to conduct a time-critical removal action to remove all remaining waste materials from the site. EPA conducted oversight of all removal activities. Over the course of the removal action, 300,000 gallons of rainwater was discharged to the Waycross POTW, 905 tons of non-hazardous solid wastes (sludge) were sent to an off-site landfill for disposal, and 3,900 gallons plus another 108 tons (sludge) were sent off-site to a permitted hazardous waste treatment and disposal facility. All on-site tanks were decontaminated by pressure washing, and all piping was vacuumed out and disconnected. The Seven Out clean-up effort was completed on July 2009, and EPA issued a notice of completion letter on November 16, 2009 [2, 3].

Site Drainage

Seven Out lies in an area of minimal flooding outside the 100-year and 500-year flood zones. Surface water runoff from the site flows into a drainage ditch south of the tank farm and north of the CSX railroad tracks. The drainage ditch continues west, roughly parallel to the railroad tracks for approximately 1200 feet into an unnamed creek. The creek flows northeast for approximately 5000 feet, flowing through Folks Park and underground through the city center after which it emerges at Lee Avenue and Memorial Drive (Hwy. 23). Water then flows east for less than 1000 feet, and then joins the Waycross City Drainage Canal. The City Drainage Canal flows northeast for approximately 3 miles before joining the Satilla River [2].

Area Demographics

Using 2010 U.S. Census data, the federal Agency for Toxic Substances and Disease Registry (ATSDR) calculated population information for individuals living within a 1-mile radius beyond the property boundary of Seven Out. The population within one mile of the perimeter of Seven Out is approximately 5,743 people in 2,983 households. In this population are 1,185 women of child-bearing age, 577 elderly and 739 children below age six. Figure 1 shows detailed demographic information.

Environmental Data Analyses

Site-related Soil Sampling Data

During EPA's removal assessment activities in 2004, three on-site surface soil samples were collected. One background soil sample was collected from a nearby residential property located about 1,000 feet west of Seven Out [1]. All soil samples collected were analyzed for TCLP[1] metals, total metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs) [1].

Total metals were found at detectable concentrations in all four soil samples, and the background sample generally had the lowest metals concentrations among the sample set. The surface soil sample results from the drainage ditch showed that TCLP for lead (8.1 mg/kg) exceeded that TCLP regulatory standard of 5.0 mg/kg. Surface soil sample results from the south wall of the tank farm showed that arsenic exceeded both the residential and industrial EPA Region 9 PRG[2] (preliminary remedial guideline) for arsenic (151 mg/kg). In addition, lead found at this location exceeded the residential soil Region 9 PRG (264 mg/kg). PAHs found at the south wall of the tank farm that exceeded both the residential soil and the industrial soil Region 9 PRGs included: benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene). In addition, the concentration of benzo(b)fluoranthene found at this location exceeded the residential soil Region 9 PRG. Three PAHs (2-methylnaphthalene, Di-n-butyl phthalate, and phenanthrene) were found in the drainage ditch located at the southeast corner of the tank farm; however, none of the PAHs found at this location exceeded Region 9 PRGs.

Folks Park Soil Sampling Data

On June 24, 2013 a resident collected a soil sample from the unnamed creek that runs through Folks Park. DPH does not know: 1) the location of the sample; 2) whether the sample was obtained from the surface or from subsurface soil (depth of sample), 3) if sample was from soil or sediment, and, 4) whether the sample was a composite sample or a grab sample (but assumes it was a composite sample). The sample (two client supplied glass containers) was shipped to Ana-Lab Corporation (Ana-Lab) in Kilgore, Texas for analysis. Ana-Lab analyzed the soil sample for SVOCs using EPA Method 8270C and for total petroleum hydrocarbons using the Texas Commission of Environmental Quality Method TNRCC 1005. No petroleum hydrocarbons were found in the sample. However, seven SVOCs were found in the soil sample and all were PAHs.

PAHs are a group of chemicals that result from the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. While there are several hundred different PAHs, they are usually present in mixtures and are generally not used

[1] TCLP-Toxicity Characteristic Leaching Procedure: a laboratory technique designed to help identify wastes likely to leach concentrations of chemicals into the soil and groundwater that may be harmful to human health or the environment.

[2] EPA Region 9 PRGs were soil, water, and air screening values used by the Superfund Program prior to 2011, when EPA harmonized both the Region 9 PRGs and the Region 3 RBCs (risk-based concentrations) into a single table now called the Regional Screening Levels.

commercially. Exposure to these chemicals usually occurs as an exposure to mixtures of PAHs and not as individual chemicals. Most PAHs do not readily dissolve in water and do not volatilize. Exposure can occur through air, water, soil, or food. PAHs enter the air from motor vehicle exhaust, residential and industrial furnaces, tobacco smoke, volcanoes, agricultural burning, residential wood burning, and wildfires. Seasonal variations in exposure to PAHs are known to occur. The soil and water near industrialized areas can contain elevated concentrations of PAHs. Foods that contain PAHs include smoked, charcoal-broiled, and roasted foods and plant foods that become contaminated by atmospheric deposition. Cereal products (e.g., wheat, corn, oats, and barley) may contain PAHs because of methods used to dry them [5].

Exposure Pathway

When a hazardous substance is released to the environment, people are not always exposed to it. Exposure happens when people breathe, eat, drink, or have skin contact with a contaminant. Several factors determine whether health effects occur, and the type and severity of health effects associated with exposure to chemicals. Such factors include chemical concentration, frequency and duration of exposure, route of exposure (e.g., ingestion, inhalation) and cumulative exposures (i.e., the combination of chemicals and routes of exposures). Once exposure takes place, individual characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status influence how that person absorbs, distributes, metabolizes, and excretes the chemical. These characteristics, together with the exposure factors discussed above and the toxicological effects of the substance, determine whether and which health effects may result.

In order for any environmental contaminant to be a health concern, the contaminant must be present at a high enough concentration to cause potential harm and there must be a completed route of exposure to people. A pathways analysis considers five principle elements: a source of contamination, transport through an environmental medium, a point of exposure, a route of human exposure, and a receptor population. Completed exposure pathways are those in which all five elements are present, and indicate that exposure to a contaminant has occurred in the past, is presently occurring, or will occur in the future. DPH regards people who come into contact with contamination as exposed. It should be noted that the identification of an exposure pathway does not imply that health effects will occur. Exposures may, or may not be substantive. Thus, even if exposure has occurred, human health effects may not necessarily result [4].

DPH assumes that exposure to contaminants found in the unnamed creek that flows through Folks Park is a completed exposure pathway that occurs from contact with surface soil and/or sediment. These exposures occur primarily as accidental ingestion of soil and by dermal contact with soil and sediment.

Toxicologic Evaluation

DPH utilized a two-stage evaluation process in the assessment of the soil/sediment data from Folks Park. The first step involves a review of available sampling data and the selection of contaminants that may warrant further evaluation, based on the potential for exposure to these contaminants to result in adverse health effects. DPH examines the types and concentrations of contaminants, which are then screened with health-based comparison values generally established by ATSDR and EPA. Comparison Values (CVs) are concentrations of a contaminant

that can reasonably (and conservatively) be regarded as harmless to human health, assuming default conditions of exposure. CVs include ample uncertainty factors to ensure protection of sensitive populations. Because CVs do not represent thresholds of toxicity, exposure to contaminant concentrations above CVs will not necessarily lead to adverse health effects [4]. DPH then considers how people may come into contact with the contaminants. Because the level of exposure depends on the route, frequency, and duration of exposure and the concentration of contaminants, this exposure information is essential to determine if a public health hazard exists.

The next step in the evaluation process involves an in-depth health-effects evaluation of the contaminants detected in the site media (in this case, soil/sediment) above their respective CVs. The primary focus of this effort is to evaluate the potential for the contaminant(s) to produce cancer and non-cancer health effects as a result of human exposure. A more detailed description of both steps of the evaluation process is presented in Appendix A.

Folks Park Sample Results

Table 1 summarizes the analytical results from the soil/sediment sample collected by a resident from the unnamed creek in Folks Park. It should be noted that the June, 2013 sample results are similar to PAHs found during the EPA Removal Site Evaluation at Seven Out in 2004. It should also be noted that the corresponding PAHs were not found in the drainage ditch at the southeast corner of the tank farm but at the south wall of the tank farm.

Table 1: Corresponding PAHs in Soil/Sediment Sample Results from the Unnamed Creek in Folks Park and during EPA's Site Removal Assessment

Contaminant	2013 Sample Folks Park[a] mg/kg	2004 Sample South Wall of Tank Farm mg/kg	Lowest Health Based Comparison Value mg/kg	Type of CV[b]
Benz(a)anthracene	**0.556**	2.4	0.15	RSL
Benzo(b)fluoranthene	**0.827**	1.8	0.15	RSL
Benzo(k)fluoranthene	0.398	3.2	1.5	RSL
Chrysene	0.671	3.1	15	RSL
Fluoranthene	0.691	4.6	2300	RSL
Phenanthrene	0.378	1.8	None	--
Pyrene	1.52	4	1700	RSL

Bold values exceed lowest comparison value
mg/kg: milligrams per kilogram (parts per million)
CV: comparison value
[a]Source: Ana-Lab Corp., Report of Soil Sample Results from Mary Street (Folks) Park, Waycross, GA, 07/03/2013.
[b]RSL: EPA Regional Screening Level for residential soil (June 2011). RSLs are integrated screening levels that incorporate cancer risk from inhalation, ingestion, and dermal exposures yielding a cancer risk of one in a million exposed people over a lifetime or a non-cancer risk not exceeding a hazard quotient of 1.

Sample results for the unnamed creek that runs through Folks Park show that benz(a)anthracene and benzo(b)fluoranthene exceeded CVs; therefore, DPH further evaluated the potential for adverse non-cancer and cancer health effects of these two PAHs. Because CVs include safety factors to ensure that people are unlikely to be harmed by exposure to soil/sediment in contaminants above these levels, DPH will not evaluate the remaining PAHs that did not exceed their lowest CV for potential adverse non-cancer health effects. However, the remaining PAHs will be evaluated further for potential cancer risk.

General Information on Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a group of chemicals that result from the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. Exposure can occur through air, water, soil, or food. While there are several hundred different PAHs, they are usually present in mixtures and are generally not used commercially. Exposure to these chemicals usually occurs as an exposure to mixtures of PAHs and not as individual chemicals. PAHs released to soil adsorb (bind) to soil and sediment, and most do not easily dissolve in water or volatilize to air.(PAHs enter the air from motor vehicle exhaust, residential and industrial furnaces, tobacco smoke, volcanoes, agricultural burning, residential wood burning, and wildfires [5].

Health effects experienced from exposure to PAHs depend on the magnitude, duration, and route of exposure as well as the chemical properties of the PAH mixture. Most of our understanding of how PAHs can affect health is based on toxicological studies of animals. It is not clear whether PAHs cause short-term health effects. Skin irritation and sensitization is well documented in studies of anthracene and benzo(a)pyrene [5].

There are far more animal studies than human studies available for evaluating chronic toxicity to PAHs. Occupational studies of workers exposed to high levels of PAHs have demonstrated that inhalation or dermal exposure can result in lung and skin cancer. Most animal studies of health effects from oral exposures to PAHs demonstrated adverse impacts to most organ systems (respiratory, cardiovascular, gastrointestinal, etc.) and cancer, but only at very high concentrations for mice and rats dosed orally by gavage[3] [5].

Non-cancer Health Effects

Numerous studies have determined that the relative oral bioavailability of PAHs from soil is less than 100% [4]. Reported PAH absorption (from ingestion) values range from 17% to 66% (in mice, rats, and swine) and had a cumulative PAH absorption of 40% [6]. Similarly, cumulative dermal absorption values for PAHs were reported to be 10% [7].

For estimating exposure doses, DPH used a very conservative exposure scenario. The exposure dose calculations are based on 6 to <11 year old children playing near the drainage ditch where the samples were obtained. In a worst case scenario, DPH assumed that children play in the park (near and in the drainage ditch) for 2 hours per day, 5 days per week, for three months a year.

[3] introduction into the stomach via a tube

DPH used the U.S. mean soil and dust ingestion rate for 6 to <11 year old children[4] of 100 milligrams (mg) for each day that they play at Folks Park, and assumed that they weigh the U.S. mean 6 to <11 year old child weight[5] of 31.9 kilograms(kg) to estimate oral exposure doses. In addition, an oral ingestion absorption rate of 100% and a dermal absorption rate of 10% were used to estimate exposure doses. For comparison, DPH also estimated oral exposure doses for these children assuming that exposure is occurring daily, year round. Dermal exposure doses were negligible and did not add to the cumulative total exposure doses. Table 2 shows the estimated exposure doses that children playing at Folks Park may have incurred under both the assumed exposure scenario established for this health consultation, and a scenario where daily exposure is on-going.

Table 2: Estimated Benz(a)anthracene and Benzo(b)fluoranthene Exposure Doses for Children Ages 6 through 10 Years Old from Incidental Ingestion/Dermal Absorption of Soil/Sediment from the Unnamed Creek in Folks Park

Contaminant	Estimated Exposure Dose mg/kg/day	Estimated Exposure Dose from Daily Year Round Exposure mg/kg/day	Proposed EPA Oral RfD* mg/kg/day
Benz(a)anthracene	0.00000002	0.000002	0.0003
Benzo(b)fluoranthene	0.00000004	0.000003	0.0003

mg/kg/day: milligrams per kilogram per day

*the proposed oral reference dose (RfD) is based on the most current research on benzo(a)pyrene, considered to be the most toxic member of the of the PAH group of chemicals. EPA released a public comment draft on September 30, 2013 of their reassessment of benzo(a)pyrene initially published in EPA' Integrated Risk Information System (IRIS) in 1987.

Because ATSDR health-based guidelines, known as minimal risk levels (MRLs) are not available for the PAHs found at Folks Park, DPH used EPA's currently proposed health guideline known as a reference dose (RfD) for benzo(a)pyrene (considered to be the most toxic member of the PAH group of chemicals). RfDs are estimate of daily human exposure, including exposure to sensitive subpopulations that are likely to be without appreciable risk of adverse health effects during a lifetime (70 years) of exposure. These guidelines are derived from experimental data using the lowest observed adverse effects levels (LOAELs) found in the experimental group of animals (or no observed adverse effects levels (NOAELs)), and adjusted downward using uncertainty factors (margins of safety).

To estimate an exposure level below which effects from benzo(a)pyrene exposure are not expected to occur, the lowest organ/system-specific RfD (3×10^{-4} mg/kg/day) is being proposed as the overall reference dose for benzo(a)pyrene. This value, based on induction of neurobehavioral changes in rats exposed to benzo(a)pyrene during a susceptible life-stage is supported by several animal and human studies [8].There is evidence in humans and animals that benzo(a)pyrene induces developmental neurotoxicity. In addition to the persistent reductions in cognitive ability observed in epidemiology studies of prenatal PAH exposure, the two epidemiology studies that examined benzo(a)pyrene-specific measures observed effects on

[4]U.S. EPA analysis of NHANES 1999-2006 data.

[5]U.S. EPA analysis of NHANES 1999-2006 data.

neurodevelopment and behavior in young children. Altered learning and memory, motor activity, anxiety-like behavior, and electrophysiological changes have also been observed in animals following oral and inhalation exposure to benzo(a)pyrene [8].

The lowest dose identified (LOAEL) to cause harmful effects and the endpoint used for the RfD derivation was 0.09 mg/kg/day based on a study of rat pups who were given daily doses of benzo(a)pyrene through a period of rapid brain development (post-natal days 5-11) where observed increased latency in negative geotaxis, increased motor activity in the open field test, decreased anxiety-like behaviors in the elevated plus maze test, and impaired performance in the Morris water maze test as measured by an increase in latency time to find a hidden platform were observed [9]. These effects were not observed in adolescent pups. To derive the chronic oral RfD, EPA divided the LOAEL of 0.09 mg/kg/day by an uncertainty factor of 300. The uncertainty factor used in the RfD determination included 10x for interspecies variation, 10x for human variability, and 3x for a database uncertainty factor from many animal studies, resulting in a proposed RfD of 0.0003 mg/kg/day [8].

It is important to know that the estimated PAH exposure doses in people who come into contact with soil/sediment in the unnamed creek in Folks Park will be compared to EPA's chronic oral RfD of 0.0003 mg/kg/day. An easy way to determine if the estimated dose is less than or greater than the MRL is to determine a hazard quotient (HQ) for benz(a)anthracene and benzo(b)fluoranthene. The HQ is derived by dividing the estimated benz(a)anthracene or benzo(b)fluoranthene dose by the RfD. Whenever the HQ is below 1, then the estimated dose is below the RfD and non-cancerous harmful effects are not expected. When the HQ exceeds 1, then the estimated dose exceeds the RfD. The HQ for 6 to <11 year old children coming into contact with benz(a)anthracene from the unnamed creek at Folks Park, and incidentally ingesting soil/sediment using the assumed exposure scenario is 0.00007 (6.6×10^{-5}); and, if exposure was occurring on a daily basis for a lifetime, the HQ would be 0.007 (6.7×10^{-3}). The estimated exposure dose from benz(a)anthracene is approximately 15,000 times below and 150 times below the RfD, respectively. The HQ for 6 to <11 year old children coming into contact with benzo(b)fluoranthene from the unnamed creek at Folks Park, and incidentally ingesting soil/sediment using the assumed exposure scenario is 0.0001 (1.3×10^{-5}); and, if exposure was occurring on a daily basis for a lifetime, the HQ would be 0.01 (1×10^{-2}). The estimated exposure dose from benzo(b)fluoranthene is approximately 7,500 times below and 100 times below the RfD, respectively. Therefore, DPH has determined that people (children) coming into contact with PAHs found in soil/sediment at Folks Park are not likely to experience adverse non-cancer health effects from this exposure.

Cumulative Dose and Cumulative Cancer Risk

In addition to the estimated exposure doses for individual PAHs, DPH calculated the estimated cumulative exposure dose, as well as the estimated cumulative cancer risk that children may have from exposure to bare soil in the park. PAHs act similarly in the body, meaning that the metabolism and excretion of individual PAHs are alike. Because PAH exposure usually occurs as a mixture of PAHs, providing an estimated cumulative exposure dose, as well as a cumulative cancer risk is a prudent and very conservative approach to assess the potential for adverse health effects from exposure to PAHs. In 1993, EPA provided guidance for the quantitative risk assessment for PAHs [10].This guidance provides a systematic approach to the way PAHs can be

evaluated as benzo(a)pyrene toxic equivalents (BaP-TE). The BaP-toxic equivalent is a derived concentration of the 7 most common PAHs with their specific concentrations adjusted for their toxicity relative to BaP. Those specific PAHs and relative toxicities (expressed as toxic equivalent factors; TEFs) are as follows:

PAH compound	TEF
Benzo(a)pyrene	1
Benz(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Chrysene	0.001
Dibenzo(ah)anthracene	1
Indeno(123-cd)pyrene	0.1

BaP-TE equals the sum of the individual concentrations multiplied by their respective TEF.

Table 3 summarizes the BaP-TE exposure dose using the assumed exposure scenario from all the PAHs found in the unnamed creek at Folks Park and compares that exposure dose to EPA's proposed RfD for benzo(a)pyrene.

Table 3: Sum of Cumulative BaP-TE PAH Exposure Dose Compared to the EPA Reference Doses (RfD)

Sum of Cumulative BaP-TE PAH[a] Exposure Dose for 9 Year Old Children (mg/kg/day)	EPA RfD (mg/kg/day)	Estimated Cancer Risk[b]
6.3×10^{-9}	0.0003	4.6×10^{-8}

mg/kg/day: milligrams per kilogram of body weight per day

[a]Benzo(a)pyrene TEF's for fluoranthene, phenanthrene and pyrene are not available so DPH used a TEF of 0.001 for these PAHs.

[b] The estimated cancer risk is based a lifetime of exposure to BaP-TE and includes 12 years of exposure as a child and 58 years exposure as an adult. As a conservative measure, DPH used the EPA cancer slope factor (CSF) for benzo(a)pyrene $(7.3 \text{ mg/kg/day})^{-1}$; the highest CSF (cancer potency factor) available for PAHs.

Cumulative BaP-TE exposure doses from the levels of PAHs found in Folks Park are approximately 47,000 times lower than the proposed RfD for benzo(a)pyrene. Therefore, DPH has determined that people (children) coming into contact with PAHs found at Folks Park are not likely to experience adverse non-cancer health effects from this exposure.

The International Agency for Research on Cancer (IARC) classifies benzo(a)anthracene as a probable human carcinogen, and benzo(b)fluoranthene, benzo(j)fluoranthene, and benzo(k)fluoranthene as possible human carcinogens. The National Toxicology Program (NTP) lists the following chemicals as reasonably anticipated to be human carcinogens: benzo(b)fluoranthene and benzo(k)fluoranthene. The U.S. EPA has classified as probable

carcinogens the following: benzo(a)]anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene. Pyrene was reviewed by IARC and determined not to be classifiable for its human carcinogenicity. IARC, NTP, and EPA also list chemical mixtures (e.g., soot, coke-oven emissions, coal tars), which contain PAH chemicals, as known carcinogens.

The estimated risk for cancer from exposure to contaminants is usually calculated by multiplying the exposure dose by a cancer potency factor; usually EPA's corresponding cancer slope factor $(mg/kg/day)^{-1}$ for a carcinogen. This cancer slope factor (CSF) is equivalent to the 95% upper-bound lifetime cancer risk to an individual, rather than the average risk, suggesting that cancer risk is actually lower, perhaps by several orders of magnitude. EPA and the broader scientific community consider a cancer risk range of between one in a million to one in ten thousand (10^{-6} to 10^{-4}) as an acceptable range. That means that it is used by EPA for evaluation of human food-chain exposures because it provides assurance that risk is not underestimated. An increased cancer risk of one in a million or less is generally considered an insignificant increase in cancer risk.

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk of cancer for evaluation purposes. To estimate lifetime cancer risk from exposure to soil/sediment found in the unnamed creek in Folks Park, DPH used an exposure period of 70 years (12 years as a child and 58 years as an adult).

Lung, genitourinary, and skin cancers have been reported in occupational settings, where the amount of PAH exposure is greater than it is in the general population [5].

To give the excess cancer risk context, it should be noted that the lifetime risk in the United States of being diagnosed with cancer an individual from all causes is slightly less than 1 in 2 for men (50,000/100,000) and a little more than 1 in 3 for women (33,000/100,000) [11]. The estimated lifetime cancer risk from exposure to PAHs at levels found in the soil/sediment in the unnamed creek that runs through Folks Park is approximately 1 excess cancer that can be expected from this exposure in 460,000,000 people experiencing the same levels of exposure to the PAHs found in Folks Park. Therefore, DPH has determined that the increased cancer risk from exposure to soil/sediment in the unnamed creek in Folks Park to be insignificant.

Health Outcome Data

DPH conducted phone interviews with some residents living in Waycross who are experiencing health issues or have known Waycross residents living near Folks Park who have died because of a health condition they had. Self-reported disease symptoms included cancer, benign masses, respiratory, neurological, and other symptoms. Appendix B lists these self-reported health conditions along with the age, gender, year of onset of the health condition, and disease symptoms. All these self-reported condition have not been validated by DPH. Analyses of these reports of symptoms and disease do not indicate any trends in illnesses, nor are the numbers of cases of any specific illness among a specific group higher than would be expected (e.g., children with typically adult onset cancer). However, the data do not contain enough information (e.g., age of employees, length of residency, lifestyle factors, type of cancer) to definitively conclude that there are no elevated rates or numbers of cases of illness among residents. In addition, many

illnesses reported are very common, most descriptions are vague, and the terms "mass" and "tumor" include numerous diagnoses.

In addition, the DPH Georgia Comprehensive Cancer Registry (GCCR) conducted a cancer cluster investigation on concerns of a Waycross resident and at Ruskin Elementary School teacher seemingly alarming number of recent diagnoses of brain tumors and leukemias among children in Ware and Pierce Counties. The elementary school teacher provided a list of nine children from Ware and Pierce Counties that were recently diagnosed with cancer. The GCCR analyzed the available cancer data in Ware and Pierce counties, as well as cancer data in all counties of Health District 9-2. The report documenting the results of the GCCR's Southeast Georgia Cancer Cluster Investigation conducted in the spring of 2013 has been provided to residents who requested a copy of the report.

Only the Ware County cancer cluster investigation results are summarized in this health consultation. The results from GCCR's cancer cluster investigation are shown in Appendix C. The cancer incidence rates for Ware County are provided in the following paragraphs.

The overall cancer incidence rate in Ware County is significantly lower than the state rate. The rates for colorectal cancer, melanoma, and breast cancer are significantly lower than the state rates for these cancers. There are no cancer sites for which there is an increased cancer incidence rate in Ware County.

Using the latest available cancer registry data (2001-2010), the overall childhood cancer incidence rate for Ware County (197.6 per million population) is significantly higher than the state rate (154.2 per million population). Upon further analysis, Ware County seems to have an elevated number of newly-diagnosed lymphoma cases among children. There were 6 lymphoma cases during this time period (2001 – 2010), whereas about 2 cases would be likely. These cases were spread evenly over the 10 year period and were not geographically clustered, leading to a conclusion that this increase is likely due to chance rather than a specific cause.

GCCR data shows that childhood cancer incidence has been below the expected rates for Ware over the past decade. The only elevated rate found in the registry data was for lymphomas in Ware County, but these cases were not clustered geographically or temporally, and thus do not meet the definition for a cancer cluster.

From the list of nine children provided to GCCR by the Ruskin Elementary School teacher, two were from Ware County. This is well within the limits of what we would expect during this time period (2011-2013). These two cases were of different types and were widely distributed geographically.

The three childhood cancer cases whose mothers worked at the school were of three different types (leukemia, brain, and fibrosarcoma). Although there is no direct evidence of such exposure in this situation, the literature states that the only potential environmental risk factor that might link these three types of cancers would be radiation exposure (particularly medical radiation such as cancer treatment). In addition, two of the confirmed cancer cases have related mothers (who are sisters), lending to the possibility that there may be a genetic component.

Child Health Considerations

In communities faced with contamination of the water, soil, air, or food, DPH recognizes that the unique vulnerabilities of infants and children demand special emphasis. Due to their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are more likely to be exposed because they play outdoors and they often bring food into contaminated areas. They are also more likely to encounter dust, soil, and contaminated vapors close to the ground. Children are generally smaller than adults, which results in higher doses of chemical exposure because of their lower body weights relative to adults. In addition, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

This health consultation uses child-specific exposure factors, such as body weights, intake rates, and skin exposure areas, as the basis for calculating exposures to contaminants found in soil/sediment (Appendix A). Because the resulting exposure doses for children are higher than adult exposure doses would be, they represent the basis for the following public health conclusions and recommendations.

Conclusions

DPH evaluated past, current, and future exposure to PAHs in soil sampled from the unnamed creeks that runs through Folks Park. This evaluation included an estimation of exposure doses from oral ingestion and dermal absorption of contaminants found in the soil/sediment sample submitted for analysis. It is important to note that DPH's conclusions were based on a single sample from Folks Park. DPH assumed that the samples obtained from Folk Park were bare soil samples. However, from satellite views of Folks Park, the creek contains heavy vegetation, which would decrease actual exposure to soil/sediment in the unnamed creek.

1. DPH concludes that children playing in or near the unnamed creek in Folks Park are not likely to be harmed by the levels of PAHs found in the creek soil/sediment.

2. DPH concludes that the increased cancer risk from exposure to the soil/sediment found in the unnamed creek in Folks Park is well below EPA's "target range" (of 1 in 10,000 to 1 in 1,000,000) that is considered and acceptable risk.

Recommendation

DPH recommends that EPA conduct more soil/sediment sampling of the drainage canal and unnamed creek to determine if elevated levels of PAHs are present.

Public Health Action Plan

1. DPH will provide health education to residents.

2. As additional data become available, DPH will review the information and take appropriate actions to protect public health.

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6. Ounnas, F. et. al. *Relative Bioavailability of Soil-Bound Polycyclic Aromatic Hydrocarbons In Goats.* Chemosphere 77 (2009): 115-122.

7. Turkall, R.M. et. al. *Effects of Soil Matrix and Aging on the Dermal Bioavailability of Hydrocarbons and Metals in the Soil: Dermal Bioavailability of Soil Contaminants.* In: Proceeding of the Annual International Conference on Soils, Sediments, Water and Energy (2010), Vol. 13, Article 29.

8. U.S. Environmental Protection Agency. *Toxicological Review of Benzo(a)pyrene in Support of Summary Information on the Integrated Risk Information System (IRIS)-Draft for Public Comment.* August 2013.

9. Chen, C; Tang, Y, et. al. *Early Postnatal Benzo(a)poyrene Exposure in Sprague-Dawley Rats Causes Persistent Neurobehavioral Impairments that Emerge Postnatally and Continue into Adolescence and Adulthood*. Toxicological Sciences (2012), Vol. 125:1. pp. 248-261.

10. U.S. Environmental Protection Agency. *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons.* July 1993.

11. American Cancer Society. Cancer Facts & Figures 2012.

Report Preparers and Reviewers

This Health Consultation for the Seven Out Site was prepared by the Georgia Department of Public Health (DPH) under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication.

Author

Franklin Sanchez, REHS
Health Assessor
Chemical Hazards Program
Georgia Department of Public Health

Reviewer

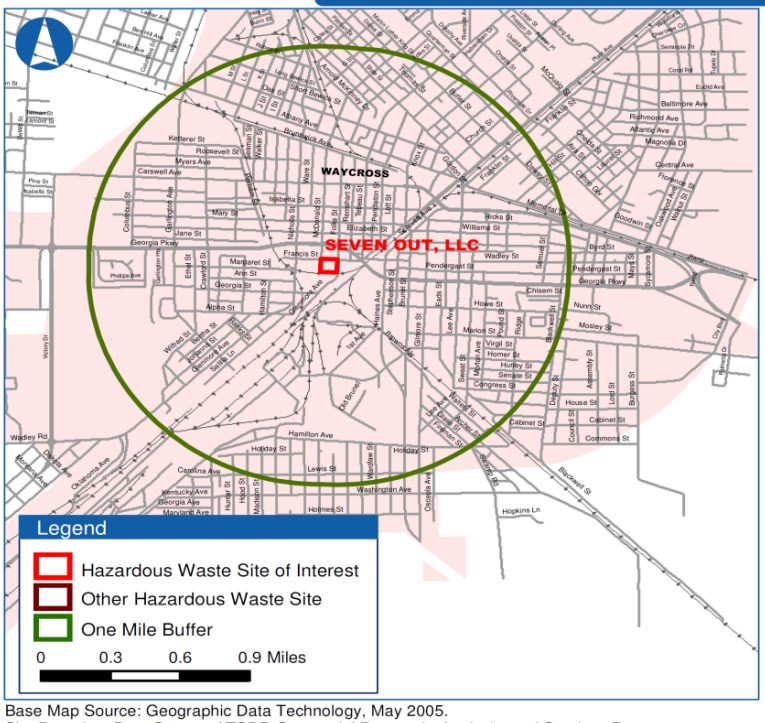
Jane Perry, MPH
Director
Chemical Hazards Program
Georgia Department of Public Health

Figures and Appendices

Figure 1: Site Location and Demographics

EPA Facility ID : GAN000407811

SEVEN OUT, LLC
WAYCROSS , GA



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_Georgia_East_FIPS_1001_Feet

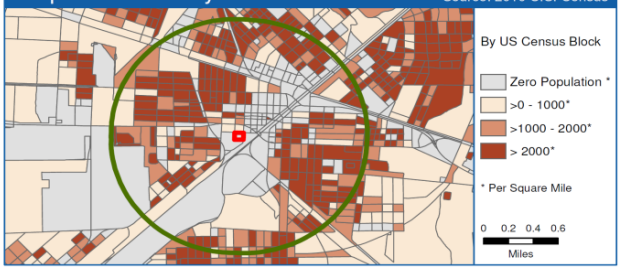
Site Location : Ware County , GA

Demographic Statistics
Within One Mile of Site*

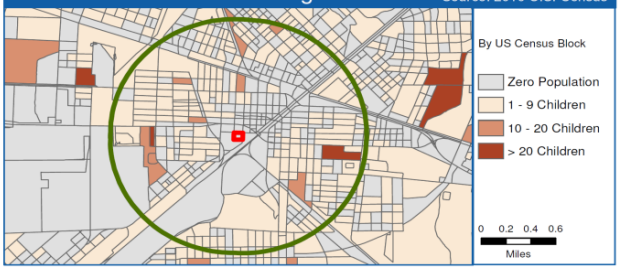
Total Population	5,743
White Alone	1,541
Black Alone	3,938
Am. Indian & Alaska Native Alone	20
Asian Alone	34
Native Hawaiian & Other Pacific Islander Alone	1
Some Other Race Alone	94
Two or More Races	115
Hispanic or Latino**	190
Children Aged 6 and Younger	739
Adults Aged 65 and Older	577
Females Aged 15 to 44	1,185
Total Housing Units	2,983

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.

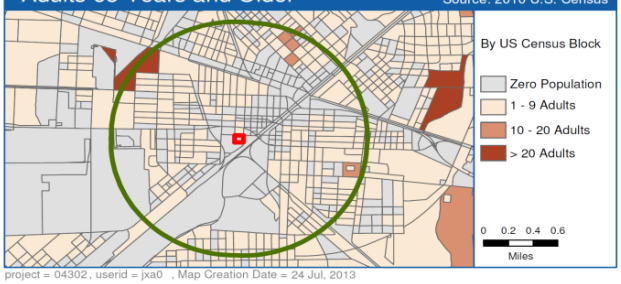
Population Density — Source: 2010 U.S. Census



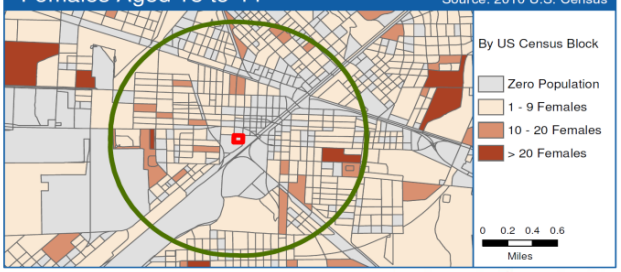
Children 6 Years and Younger — Source: 2010 U.S. Census



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



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

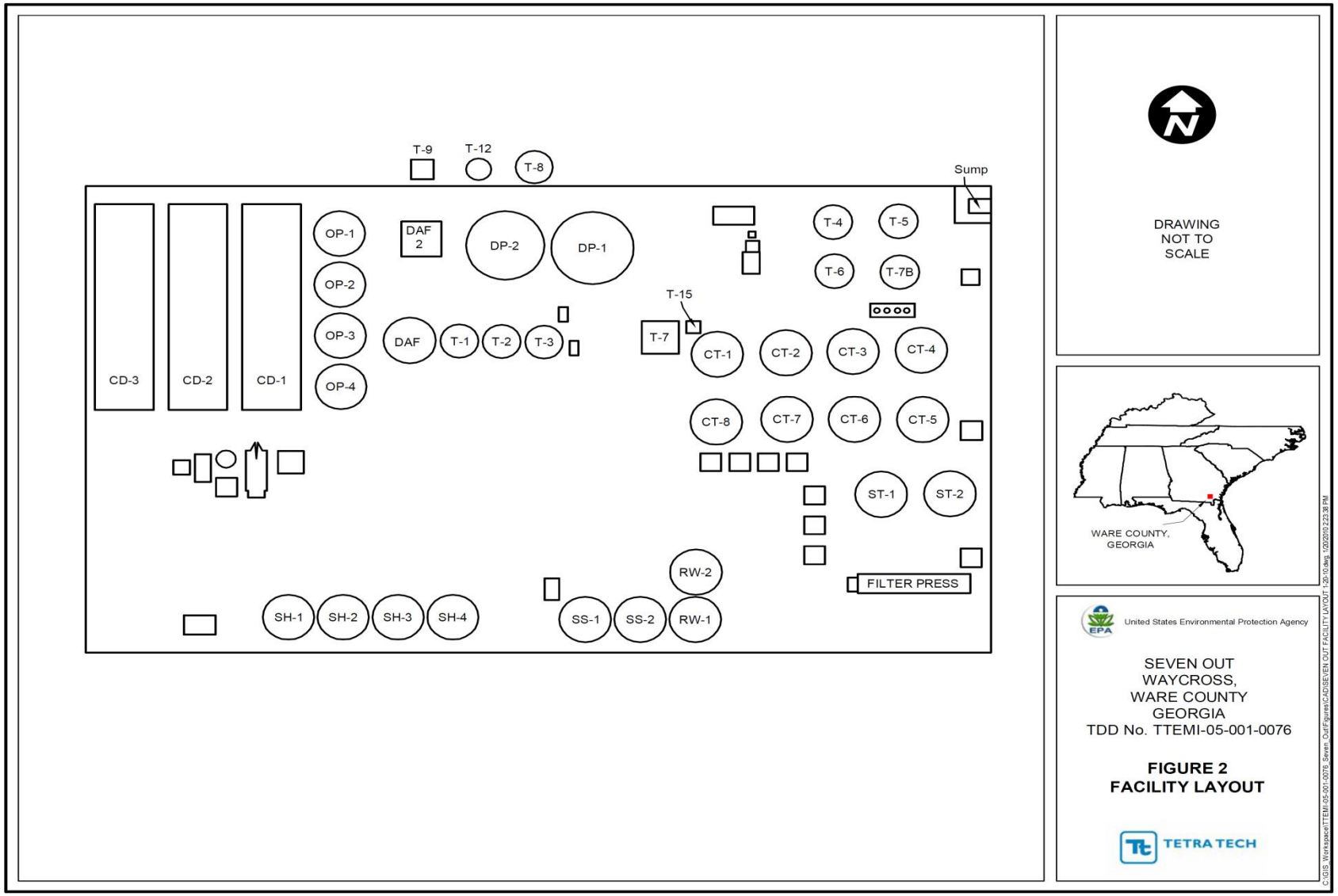


project = 04302 , userid = jxa0 , Map Creation Date = 24 Jul, 2013

GRASP

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

Figure 2: Site Description



Appendix A: Explanation of Evaluation Process

Step 1--The Screening Process

In order to evaluate the available data, DPH used comparison values (CVs) to determine which chemicals to examine more closely. CVs are contaminant concentrations found in a specific environmental media (air, soil, water, sediment, and food) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical and a standard amount of environmental media that someone may inhale or ingest each day. CVs are generated to be conservative and non-site specific. The CV is used as a screening level during the public health assessment (PHA) or health consultation process. CVs are not intended to be environmental clean-up levels or to indicate that health effects occur at concentrations that exceed these values.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based CVs are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factors for ingestion exposure, or inhalation risk units for inhalation exposure. Non-cancer CVs are calculated from ATSDR's minimal risk levels, EPA's reference doses for ingestion, or EPA's reference concentrations for inhalation exposure. When a cancer and non-cancer CV exist for the same chemical, the lower of these values is used as a conservative measure.

Step 2--Evaluation of Public Health Implications

The next step in the evaluation process is to take those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Separate child and adult exposure doses (or the amount of a contaminant that gets into a person's body) are calculated for site-specific scenarios, using assumptions regarding an individual's likelihood of exposure to contaminants found at Folks Park. A brief explanation of the calculation of estimated exposure doses used in this health consultation is presented below.

Ingestion of contaminants present in soil in the unnamed creek that runs through Folks Park. Exposure doses for the consumption of contaminants present in soil were calculated using the measured concentration of PAHs in milligrams per kilogram (mg/kg) of soil. The following equation is used to estimate the exposure doses resulting from ingestion of contaminated soil:

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

where;

ED = exposure dose from incidental (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = incidental ingestion rate (100 mg/day for 6 to<11 year old children)
EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for the purpose of this analysis was 0.014. This exposure factor assumes that exposure is occurring 2 hours per day, 5 days per week for 3 months per year.
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (based on the average body weight of a child aged 6<11 years old (31.9 kg)

For example, the following is an estimated exposure dose for 6 to <11 year old child incidentally ingesting soil with a benz(a)anthracene concentration of 0.556 mg/kg:

$$ED = \frac{0.556 \text{ mg/kg} \times 100 \text{ mg/day} \times 0.014 \times 10^{-6} \text{ kg/mg}}{31.9 \text{ kg}}$$

$= 2.4 \times 10^{-8}$ mg/kg/day (or 0.00000002 mg/kg/day) benz(a)anthracene

Dermal absorption of contaminants present in soil/sediment from unnamed creek in Folks Park. Exposure doses from dermal absorption of contaminants present in soil/sediment were calculated using the measured concentration of contaminants in milligrams per kilogram (mg/kg) in soil/sediment. The following equation is used to estimate the exposure doses resulting from dermal absorption of PAHs in soil/sediment:

$$ED = \frac{C \times BF \times TSA \times EF \times CF}{BW}$$

where;

ED = exposure dose from dermal absorption (mg/kg/day).

C = contaminant concentration (mg/kg).

BA= a chemical-specific absorption or bioavailability factor (unitless). The bioavailability factor used for PAH dermal absorption was 0.10 (or (10%)

TSA = total soil adhered in milligrams (exposed skin surface area x soil adherence value). For children, we used the mean of the 50th percentile cumulative body surface area of male and female between the ages of 6 to <11 years old is 9,310cm^2. The fraction of total body surface area for the face is 0.04, arms (0.123), forearms (0.0554), hands (0.053), and lower legs (0.115) was used for dermal exposure dose calculations. Therefore, 3,634 cm^2 was used for the total body-surface area potentially exposed to contaminants found in soil/sediment at Folks Park. The body part-specific soil adherence factor (assuming face, forearm, hands, and lower leg exposure) for children playing in soil used for dermal exposure calculations is the geometric mean of 0.04 mg/cm^2.

EF = exposure factor (based on frequency of exposure, exposure duration, and time of exposure). The exposure factor used for the purpose of this analysis was 0.014. This exposure factor assumes that exposure is occurring 2 hours per day, 5 days per week for 3 months per year.

CF = conversion factor (10^{-6} kg/mg)

BW = body weight (based on the average body weight of a child aged 6<11 years old (31.9 kg)

For example, the following is an estimated exposure dose from toxaphene for an adult showering for 20 minutes/day where the toxaphene concentration in water is 0.01945 mg/L:

$$ED = \frac{0.556 \text{ mg/kg} \times 0.1 \times [3634 \text{ cm}^2 \times 0.04 \text{ mg/cm}^2] \times 0.014 \times 10^{-6} \text{ kg/mg}}{31.9 \text{ kg}}$$

$$= \mathbf{3.55 \times 10^{-9} \text{ mg/kg/day}}$$

Sources for factors used for skin surface area, exposed skin surface area, and the soil adherence factor:

1. U. S. Environmental Protection Agency. *Risk Assessment for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).* Final. July 2004.
2. U. S. Environmental Protection Agency. *Exposure Factors Handbook.* September 2011.

Non-cancer Health Risks

The doses calculated for exposure to individual chemicals are then compared to an established health guideline, such as an ATSDR minimal risk level (MRL) or an EPA reference dose RfD), in order to assess whether adverse health impacts from exposure are expected. Health guidelines are chemical-specific values that are based on available scientific literature and are considered protective of human health. Non-carcinogenic effects, unlike carcinogenic effects, are believed to have a threshold, that is, a dose below which adverse health effects will not occur. As a result, the current practice to derive health guidelines is to identify, usually from animal toxicology experiments, a no observed adverse effect level (NOAEL). This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The values are summarized in ATSDR's *Toxicological Profiles* (*www.atsdr.cdc.gov/toxpro2.html).*The NOAEL is modified with an uncertainty (or safety) factor. The magnitude of the uncertainty factor considers various factors such as sensitive subpopulations (e.g., children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of the available data. Thus, exposure doses at or below the established health guideline are not expected

to cause adverse health effects because these guidelines are lower (and more human health protective) than doses that do not cause adverse health effects in laboratory animal studies.

For non-cancer health effects, RfDs were used in this PHA. A direct comparison of site-specific exposures and doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. If the estimated exposure dose to an individual is less than the RfD, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the RfD, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the health consultation.

It is important to consider that the methodology used to develop health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer risk evaluation is necessary for potentially cancer-causing contaminants detected at this site.

Cancer Risks

Exposure to a cancer-causing chemical, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated risk for developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific doses by EPA's chemical-specific cancer slope factors (CSFs) available at *www.epa.gov/iris*. This calculation estimates an excess cancer risk expressed as a proportion of the population that may be affected by a carcinogen during a lifetime of exposure. For example, an estimated risk of 1×10^{-6} predicts the probability of one additional cancer over background in a population of 1 million. An increased lifetime cancer risk is not a specified estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime in his or her lifetime following exposure to a particular contaminant under specific exposure scenarios. For children, the estimated excess cancer risk is not calculated for a lifetime of exposure, but from a fraction of lifetime; based on known or suspected length of exposure, or years of childhood.

Example Cancer Risk Calculation

Cumulative PAH Exposure Dose (0.000062 mg/kg/day) from incidental ingestion of soil x CSF x years of exposure/70 years

Therefore,

Cancer Risk $= 6.3 \times 1\text{-}^{-9}$ mg/kg/day x 7.3 $(\text{mg/kg/day})^{-1}$ for benzo(a)pyrene x [12/70 + 58/70]
$= 4.6 \times 10^{-8}$

Appendix B: Self-Reported Disease Data

Location	Resident Gender	Age	Year	Onset	Self-Reported Condition	Disease Group
City of Waycross Bldg.	Female				Cancer; deceased	Cancer
	Female			2009	Cancer; deceased	
	Female?	70		2011	Cancer; deceased	
	Female			2013	Cancer; deceased	
	Male			2006	Cancer; deceased	
	Male	56		2008	Cancer; deceased	
	Male				Cancer	
	Female				Cancer	
	Female				Cancer	
	Male			2005	Lung cancer (non-smoker);deceased	
	Male				Prostate cancer	
	Female				Breast cancer	
	Male				Cancer, lung disease	Cancer Respiratory
Home #6				2005	Cancerous masses	Cancer

Home #1	Female	44	2000	2004-2005 2011-2012	Age 44: masses, cyst on ovaries heavy menstrual cycle Age 50: mass in left leg, thyroid, and neck, headaches, brain fog, fatigue, ringing in ears, cold hands and feet, cough, cold sores in mouth, vision problems (woke up blind in right eye), blood pressure dropping 30 points in a few minutes, rapid heart rate, stomach problems, lost 30 pounds	Masses Neurological Respiratory Other
Home #3	Man	50			Masses all over his body; deceased	Masses
Home #5	Female	70+	2010?		Mass in stomach	
Home #5	Male	70+	2010?		Mass in lungs	
Home #7	Female	40?	2011-2012		Hysterectomy to remove masses on her ovaries	
Home #8	Male	40?	2012	3 months	Mass under chin	
	Female				Tumors on ovaries and in legs, chemical intolerance	Masses Other
	Male				Tumors, heart problems, kidney failure; deceased	
Home #4	Female	elderly	2002		Parkinson's disease; deceased	Neurological
Church #1	Males / Females				neurological problems, symptoms similar to Lyme disease or TIA	
Home #10	Male	50?		2004	Neurological problems with twitching and shaking in hands	
Bank #1	Female				Neurological problems, now disabled	
Home #7	Female	80?	2012		Breathing problems, chronic cough, memory problem	Neurological Respiratory

Home #2	Female	65	2013	Two months	Neurologic problems, cough, breathing problems, esophagus problems	Neurological Respiratory Other
Home #1	Male	25		Two week visit	Cold sores in mouth, respiratory/cough	Respiratory
Home #1	Female			2006-2011	Rapid heartbeat, endocrine system problems	Other
	Dog			2004-2005	Died of poisoning	
Home #3	Female	60	2004		Pre-cancer on face and other areas	
Home #4	Male	elderly	2002		Died of suspected drug treatment	
City of Waycross Bldg.	Male			2006	Deceased	
	Female				Sick	
	Parents of Female				Both died after one year of moving in neighborhood	
	Male				Heart problems	
	Male				Heart attack; deceased	

Appendix C: Cancer Incidence Data Summary

Ware County Cancer Incidence, 2006-2010

Data Summary

All Cancer Sites

- 902 new cancer cases were diagnosed in Ware County from 2006 to 2010, an average of 180 new cases per year.
- It is expected that about 98 males and 82 females will be diagnosed with cancer every year in Ware County.
- The overall age-adjusted cancer incidence rate in Ware County is 422.6 per 100,000 population. This is significantly lower than the rate for Georgia overall (470.9 per 100,000).
- Males are 52% more likely than females to be diagnosed with cancer in Ware County.

Males

- The overall age-adjusted cancer incidence rate for males in Ware County is 530.5 per 100,000 population. This is lower than the rate for Georgia males overall (567.9 per 100,000), but this difference is not statistically significant.
- Prostate, lung, and colorectal are the top cancer sites among males in both Ware County and the State of Georgia as a whole.
- The age-adjusted prostate cancer incidence rate is lower for males in Ware County (147.2 per 100,000) than for Georgia males overall (165.3 per 100,000), but this difference is not statistically significant.
- The age-adjusted lung cancer incidence rate is higher for males in Ware County (97.9 per 100,000) than for Georgia males overall (93.2 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate is lower for males in Ware County (50.5 per 100,000) than for Georgia males overall (52.1 per 100,000), but this difference is not statistically significant.
- The age-adjusted melanoma incidence rate is significantly lower for males in Ware County (17.4 per 100,000) than for Georgia males overall (28.8 per 100,000)

Females

- The overall age-adjusted cancer incidence rate for females in Ware County is 349.4 per 100,000 population. This is significantly lower than the rate for Georgia females overall (402.9 per 100,000).
- Breast, lung and colorectal are the top cancer sites among females in both Ware County and the State of Georgia as a whole.
- The age-adjusted breast cancer incidence rate is significantly lower for females in Ware County (101.6 per 100,000) than for Georgia females overall (121.5 per 100,000).
- The age-adjusted lung cancer incidence rate is lower for females in Ware County (52.8 per 100,000) than for Georgia females overall (55.0 per 100,000), but this difference is not statistically significant.
- The age-adjusted colorectal cancer incidence rate is significantly lower for females in Ware County (21.2 per 100,000) than for Georgia females overall (38.4 per 100,000).