Public Health Assessment

Public Comment Release

ARMSTRONG WORLD INDUSTRIES

MACON, BIBB COUNTY, GEORGIA

EPA FACILITY ID: GAN000410033

Prepared by
Georgia Division of Public Health

SEPTEMBER 5, 2012

COMMENT PERIOD ENDS: OCTOBER 5, 2012

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR's Cooperative Agreement Partner will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by 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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Agency for Toxic Substances and Disease Registry
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1600 Clifton Road, N.E., MS F-09
Atlanta, Georgia 30333

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Glossary of Acronyms

AIP	Allied Industrial Park
ATSDR	Agency for Toxic Substances and Disease Registry
COC	Contaminants of Concern
CREG	Cancer Risk Evaluation Guide
CSF	Cancer Slope Factor
CVs	Comparison Values
EMEG	Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
FMNOL	Former Macon Naval Ordnance Landfill
GEPD	Georgia Environmental Protection Division
GDPH	Georgia Department of Public Health
LOAEL	Lowest Observed Adverse Effects Level
mg/kg/day	milligrams per kilogram per day
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MRL	Minimal Risk Level
NOAEL	No Observed Adverse Effects Level
NPL	National Priorities List
PAHs	polycyclic aromatic hydrocarbons
PCBs	polychlorinated biphenyls
ppb	parts per billion
ppm	parts per million
RfD	Reference Dose
SVOCs	semi-volatile organic compounds
ug/l	micrograms per liter
USACE	U.S. Army Corp of Engineers
VOCs	volatile organic compounds
WWTP	Waste Water Treatment Plant

Summary

Introduction

The Georgia Department of Public Health (GDPH) and the Agency of Toxic Substances and Disease Registry (ATSDR) work together to ensure that people living near the Armstrong World Industries site in Macon, Georgia have the best information possible to protect their health.

Elevated levels of polychlorinated biphenyls (PCBs), metals, and polycyclic aromatic hydrocarbons (PAHs) were identified in surface and subsurface soils at the Wastewater Treatment Plant landfill, the Armstrong remote landfill, and between the Armstrong remote landfill and Rocky Creek. Elevated PCBs, metals, and PAHs were also found in the surface water and sediment of a drainage ditch receiving runoff from the Armstrong site, Allied Industrial Park adjacent to Armstrong, and the Former Macon Naval Ordinance Landfill southeast of Armstrong. The drainage ditch flows into Rocky Creek, located south of the Armstrong site.

The purpose of this public health assessment (PHA) is to determine whether the community may have been harmed by exposure to site-related contaminants in soil, surface water, sediment, and fish caught in Rocky Creek, and what public health actions need to be taken to reduce harmful exposures.

Conclusions

GDPH has reached four conclusions in the PHA:

Conclusion 1

People who ate, or are currently eating fish caught in Rocky Creek south and southeast of the Armstrong site sources could have been/could be exposed to PCBs at levels that could harm their health, especially if the fish being consumed are pan-fried.

Basis for Decision

At least one community member reported fishing recreationally in Rocky Creek for over 35 years and in 2007, Georgia Environmental Protection Division (GEPD) personnel observed people fishing in Rocky Creek just upstream of the convergence of the drainage ditch and Rocky Creek. The fishers indicated to GEPD personnel that they eat the fish that they catch. In addition, a contractor hired by EPA in 2009 observed fishing gear, including a fishing-line and weight, near Rocky Creek south and southeast of the Armstrong site contamination sources.

Based on fish tissue sampling results, the calculated exposure dose for non-subsistence adults eating 6 ounces of fish with the highest concentration of PCBs found is only five times lower than an exposure dose that resulted in immunological effects in adult monkeys from exposure to

Aroclor 1254[1]. If the fish are pan-fried, PCB exposure may actually approach and/or surpass the lowest observed adverse health effects level (LOAEL).

Conclusion 2

People who ate or are currently eating fish caught in Rocky Creek south and southeast of the Armstrong site have an increased risk of cancer.

Basis for Decision

At least one community member reported fishing recreationally in Rocky Creek for over 35 years and in 2007, GEPD personnel observed people fishing in Rocky Creek just upstream of the convergence of the drainage ditch and Rocky Creek. The fishers indicated to GEPD personnel that they eat the fish that they catch. In addition, a contractor hired by EPA in 2009 observed fishing gear, including a fishing-line and weight, near Rocky Creek south and southeast of the Armstrong site.

The EPA has determined that PCBs probably cause cancer in humans; however, there are inadequate human studies to state conclusively that PCBs are human carcinogens. Adult recreational anglers increase their theoretical risk for acquiring cancer over a 40 year PCB-exposure period to approximately 1 extra cancer case in 1,000 persons. The predicted theoretical risk for cancer from exposure to PCBs for an adult subsistence angler would be approximately 7 cancer cases per 1,000 people exposed. These theoretical cancer risks are based on the assumption that people are eating fish containing the highest level of PCBs found. However, it is more likely that fish ingestion is occurring with PCB concentrations closer to the average levels found, making the theoretical cancer risk lower (1 extra cancer case in 10,000 persons for recreational anglers consuming their catch).

Conclusion 3

GDPH concludes that exposure to contaminated soil at the Waste Water Treatment Plant landfill, the Armstrong remote landfill, and the Former Macon Naval Ordnance Landfill is unlikely and therefore, is not expected to harm people's health. In addition, exposure to contaminated surface water and sediment in the drainage ditch that begins on Armstrong property and eventually drains into Rocky Creek, and in Rocky Creek itself, is unlikely and not expected to harm people's health.

Basis for Decision

Current exposure to contaminated soil is unlikely because these landfills are fenced and overgrown with vegetation. Current and past exposure to contaminated soil, surface water and sediment is unlikely because the landfills and drainage ditch are located in a forested wetland area. The area is often partially submerged by Rocky Creek floodwaters making access difficult and unlikely.

[1] Aroclor is a trade name for a PCB mixture produced from approximately 1930 to 1979. There are many types of Aroclors (analytes) and each has a distinguishing suffix number that indicates the degree of chlorination. The Minimal Risk Level is based on Aroclor 1254, among the most commonly used PCB analyte.

Purpose and Statement of Issues

The Armstrong World Industries site located in Macon, Bibb County, Georgia, was proposed for the National Priorities List[2] (NPL) by the U.S. Environmental Protection Agency (EPA) in October 2010, and finalized in September 2011. The Agency for Toxic Substances and Disease Registry (ATSDR) is mandated by Congress to conduct a public health assessment (PHA) at each of the sites proposed to the NPL [1]. The purpose of a PHA is to determine the potential for human exposure to site-related contaminants and the potential for adverse health effects. ATSDR requested that the Georgia Department of Public Health (GDPH), as a Cooperative Agreement partner of ATSDR, provide this PHA.

GDPH reviewed available site-related data provided by EPA's hazard ranking system package [2] based on field work conducted by EPA's Superfund Technical Assessment and Response Team contractor during their 2009 Armstrong Site Investigation. This data includes surface soil, subsurface soil, surface water, and sediment sampling analysis results. GDPH also reviewed results of fish tissue sampling obtained from Rocky Creek during 1996 and 1999 U.S. Army Corp of Engineers investigations of the Former Macon Naval Ordnance Landfill located in the Armstrong NPL site boundary. The information in this PHA is specifically designed to provide the community with information about possible public health implications from exposure to hazardous substances at this site, and to identify populations for which further health actions are needed. It is not intended to address liability or other non-health issues.

BACKGROUND

Site Description

Armstrong World Industries (Armstrong) is a 130-acre property located at 4520 Broadway in an industrial area of south Macon, Bibb County, Georgia (Figure 1). The facility is divided into northern and southern parcels. The northern parcel is made up of the manufacturing area, the Waste Water Treatment Plant (WWTP) that includes the sludge storage yard landfill (WWTP landfill), and a landfill referred to as the woodyard landfill. The southern parcel contains an approximately 5-acre landfill referred to as the Armstrong remote landfill and the Former Macon Naval Ordnance Landfill (FMNOL), which was operated by the Navy from 1941 through 1974. These landfills are often partially submerged by Rocky Creek floodwaters.

The Armstrong NPL site includes the WWTP landfill, the Armstrong remote landfill, the FMNOL, and the surface water drainage ditch from the Armstrong facility to Rocky Creek. The NPL site does not include the woodyard landfill located on the Armstrong manufacturing plant property. The contaminants that led to the Armstrong site being proposed to the NPL are polychlorinated biphenyls (PCBs) and metals [2].

Armstrong is bordered to the north by industry and small businesses, to the east by Central of Georgia Railroad and Allied Industrial Park, to the west by woodland and industry, and to the

[2] The National Priorities List (NPL) is the list of hazardous waste sites in the United States eligible for long-term remedial action (cleanup) financed under the federal Superfund program.

south by a sand quarry and Rocky Creek. Rocky Creek flows into Tobesofkee Creek and approximately six miles downstream of the Armstrong site, into the Ocmulgee River.

Armstrong does not permit unauthorized access to the property. The perimeter of the facility is fenced and all buildings and equipment are located within the fenced area. The Armstrong remote landfill is approximately 1,400 feet south of the manufacturing area and this landfill also has a fence surrounding the perimeter.

The closest residents are approximately one-quarter mile north of the manufacturing area. Fishing occurs in Rocky Creek even though access to Rocky Creek is limited. Rocky Creek is accessible by foot near the bridge on Houston Road (Hawkinsville Highway) approximately one mile southwest of Armstrong.

Site History

Based in Lancaster, PA, Armstrong World Industries, Inc., operates 33 plants in eight countries and has approximately 9,500 employees worldwide. Armstrong has operated a ceiling tile manufacturing facility at the Macon site since 1948. The Macon facility is one of five Armstrong ceiling tile manufacturing facilities in the United States. In the late 1960s, three types of ceiling tiles manufactured by Armstrong—Travertone Sanserra, Santaglio, and Embossed Design—were coated with a formulation containing Aroclor 1254, a commercial formulation of PCBs. Although these tiles were not manufactured at the Macon plant, the plant is believed to have recycled the tiles. Armstrong representatives have stated that possible sources of PCB contamination found on the property are from recycled raw materials and recycled newsprint with older dye formulations [3].

What are PCBs?

Polychlorinated biphenyls (PCBs) are man made organic chemicals that were commercially produced in the United States and marketed by their industrial trade name Aroclor. PCBs inability to burn easily and resistance to degradation resulted in their wide use as coolants, lubricants and insulation materials for transformers, capacitors, and other electrical equipment. Manufacturing of PCBs ceased in the U.S. in 1977 after evidence showed that PCBs persist in the environment, biomagnify in the food chain, and may potentially cause harmful health effects to people who are exposed.

Armstrong began disposing of general and industrial trash, used equipment, and excess scrap wood in the Armstrong remote landfill in the mid-1960s [3]. The former Macon Naval Ordnance Plant (currently Allied Industrial Park) adjacent to the Armstrong facility disposed of wastes in a 15-acre landfill (FMNOL) adjacent to the Armstrong remote landfill. The FMNOL was used for disposal of solid wastes, military supplies, used equipment, and construction debris throughout the operational history of the Macon Naval Ordnance Plant from 1941 to 1974 [4]. Aerial photographs taken over a 50-year period from 1938 to 1988 indicate that the Armstrong remote landfill and the FMNOL appear to be one large landfill between 1975 and 1988 [5]. Sometime in 1996, a fence was erected between the two landfills, which gives the appearance that there are two distinctly separate landfills. However, based on the aerial photographs, there appears to be some comingling of wastes [5, 6].

From around 1970 to the late 1980s, Armstrong stockpiled wastes generated by the facility in an area that became the WWTP landfill. In late 1971, Armstrong installed two large coil filters that removed excess fiber from the WWTP influent. The filtered sludge waste was subsequently disposed of in either the remote landfill or in the WWTP landfill. Armstrong constructed the woodyard landfill in the late 1970s or early 1980s as an additional area to dispose of the sludge waste [3, 7].

During the late 1980s and early 1990s, Armstrong ceased disposing of its filtered sludge waste in the WWTP landfill and began disposing of all of its filtered sludge waste in the woodyard landfill. In July 2000, Armstrong ceased disposing of waste in the woodyard landfill. Armstrong officially closed the woodyard landfill in 2004, following a state-approved closure plan. Although the WWTP landfill has been stabilized with a vegetative cover and security fencing, it has not been formally closed. Armstrong currently sends all of its WWTP sludge waste to a local industrial landfill [3].

Regulatory History

In 1980, Armstrong notified the Georgia Environmental Protection Division (GEPD) that it was a generator of hazardous waste. Armstrong was subsequently assigned EPA identification number GAD003297413 and was classified as a "conditionally exempt small quantity generator" under the Resource Conservation and Recovery Act. In 1996, Armstrong notified GEPD about the presence of PCBs in sludge waste in the on-site WWTP landfill [7].

Additionally, Armstrong operates under National Pollutant Discharge Elimination System (NPDES) permit number GA0003077 for its wastewater treatment system. The Armstrong facility outfall discharges treated wastewater to an on-site drainage ditch that eventually flows to Rocky Creek.

On January 13, 2006, GEPD issued a Corrective Action Consent Order to Armstrong for investigation and, if necessary, remediation of PCBs detected on site and in Rocky Creek [8]. The Consent Order require that Armstrong conduct investigations at the Armstrong remote landfill, the WWTP landfill, and the woodyard landfill to delineate the nature and extent of PCB contamination, including releases extending beyond its property boundary, and to identify potential migration pathways (i.e. air, land, surface water, and groundwater), actual or potential receptors, and applicable background concentrations. GEPD referred the site to EPA because of the extent of contamination of onsite soils and the PCB contamination in Rocky Creek. EPA received a letter from the state supporting listing of the site on the NPL.

Previous Investigations

In January 1996, Armstrong collected three composite sludge samples from excavated pits in the WWTP landfill. PCBs were detected at levels between 1.36 milligrams of PCBs per kilogram of sludge (mg/kg) and 9.31 mg/kg in two of the composite sludge samples. They collected four composite sludge samples from excavated test pits in the woodyard landfill. PCBs were not detected in these sludge samples.

Armstrong collected composite sludge samples from four excavated sludge pits at the Armstrong remote landfill. Analytical results showed PCBs at concentrations ranging from 1.65 mg/kg to 6.65 mg/kg. Chromium, copper, lead, nickel, and zinc were detected at concentrations below regulatory (Hazardous Site Response Act) concentrations [7].

1996 U.S. Army Corps of Engineers (USACE) Site Investigation

From January through May 1996, a U.S. Army Corps of Engineers (USACE) contractor conducted a site investigation at the FMNOL. Analysis of soil samples collected from the FMNOL, including areas adjacent to the Armstrong remote landfill, indicated the presence of heavy metals and PCBs in surface and subsurface soil. Surface water and sediment samples collected from the drainage ditch leading from Armstrong to Rocky Creek, as well as Rocky Creek itself, were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals and explosive residues. These samples were not analyzed for PCBs. Analytical results for the surface water samples collected from the drainage ditch revealed the presence of lead, zinc, *cis*-1,2-dichloroethene (DCE), and trichloroethene (TCE). Sediment samples collected from the drainage ditch showed the presence of cadmium, chromium, lead, mercury, *cis*1,2-DCE, TCE, vinyl chloride, and benzo(a)pyrene. Surface water samples collected from Rocky Creek downstream from the FMNOL and the Armstrong remote landfill did not indicate the presence of heavy metals, VOCs, or SVOCs. However, sediment samples collected from the same Rocky Creek locations contained cadmium, chromium, lead, and benzo(a)pyrene [9].

During the USACE site investigation, fish tissue samples were also collected. Fish species including bluegill, white crappie, spotted sucker, and silver redhorse sucker were caught from Rocky Creek at locations upstream and downstream from the FMNOL. Analytical results showed that Aroclor 1254 was detected in all the fish tissue, both upstream and downstream of the FMNOL [9].

1998 and 1999 USACE Remedial Investigation

From February 1998 to March 1999, another contractor for the USACE conducted a Phase I Remedial Investigation at the FMNOL property. Analytical results for surface water samples collected from the drainage ditch leading from the Armstrong WWTP to Rocky Creek indicated the presence of arsenic, cadmium, chromium, lead, DCE, TCE, tetrachloroethene (PCE), vinyl chloride and PCBs, specifically Aroclor 1248. Sediment samples collected from the drainage ditch between the WWTP landfill outfall and the FMNOL and Armstrong remote landfill contained arsenic, beryllium, cadmium, chromium, lead, and Aroclor 1248. Analysis of sediment samples collected from Rocky Creek downstream of the drainage ditch found arsenic, beryllium, cadmium, chromium, lead, mercury, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, pyrene, Aroclor 1248, and Aroclor 1254.

Background sediment samples were collected in Rocky Creek upstream of the drainage ditch, the Armstrong remote landfill, and the FMNOL near the abandoned Central of Georgia railroad trestle (Figure 1). Sediment analyses indicated the presence of arsenic, cadmium, chromium, lead, DCE, TCE, tetrachloroethene (PCE), and vinyl chloride. PCBs were not detected in sediment samples collected in Rocky Creek upstream of the drainage ditch [9].

Fish tissue samples collected from Rocky Creek during the USACE Phase I Remedial Investigation included redear sunfish, bluegill, largemouth bass, American eel, and brown bullhead catfish. The fish were caught from Rocky Creek at locations upstream and downstream of the drainage ditch (Figure 2) and analyzed for PCBs. Results showed the presence of Aroclor

1248 and Aroclor 1254 in fish caught adjacent to the abandoned Central of Georgia Railroad trestle, south of the FMNOL, and adjacent to the Norfolk-Southern Railroad trestle [9]. USACE posted signs advising fishers that the fish in Rocky Creek contain PCBs.

Demographics

Using 2000 U.S. Census data, the Agency for Toxic Substances and Disease Registry (ATSDR) calculated population information for individuals living within a 1-mile radius of the Armstrong facility. The population within one mile of Armstrong is approximately 3,902 people (Figure 3). No one lives within 0.25 miles of Armstrong, and 51 persons live between 0.25 and 0.50 miles of Armstrong. Figure 3 shows detailed demographic information.

Natural Resource Uses

No municipal surface water intakes are located within 15 miles downstream of the Armstrong site. The Ocmulgee River, located several miles east of the Armstrong site, is used for outdoor recreation [9].

Municipal water within a four-mile radius of Armstrong is obtained from the Macon Water Authority (MWA). Municipal water is supplied by two surface water intakes maintained by the MWA on the Ocmulgee River several miles upstream of the Armstrong site. The surface water intakes fill an MWA owned reservoir–Javors Lucas Lake–that serves as the water supply source for Macon residents. This reservoir is located approximately eight miles north and upstream of the Armstrong site.

Some areas within a two-mile radius of Armstrong are supplied drinking water by private wells. The Bibb County Health Department provided GDPH with a list of recorded private and industrial wells within a two-mile radius of Armstrong. Four private wells and five industrial wells are recorded in county health department records as being within a one-mile radius of Armstrong. Twenty-six private wells and 15 industrial wells are located between a one-mile and two-mile radius of Armstrong. Five mobile home parks located within a two-mile radius of Armstrong also have permitted drinking water wells.

Surface water runoff from the WWTP landfill area on the northern parcel of the Armstrong property is directed into a drainage ditch that flows south into Rocky Creek. The WWTP also discharges into this ditch daily. The drainage ditch starts at the WWTP and flows southeast to the FMNOL and then south-southeast into wetlands along Rocky Creek [9]. Rocky Creek flows east-southeast for about 1.5 miles before it converges with Tobesofkee Creek. Tobesofkee Creek flows south-southeast for about 4 miles before it converges with the Ocmulgee River. The southern half of the Armstrong remote landfill property is located in the 100-year flood plain of Rocky Creek [10].

Community Involvement

GDPH, the North Central Health District (NCHD), GEPD, and EPA are working together to address community concerns. GDPH uses various methods to gather community concerns, including talking with residents and government agency staff, public meetings, community environmental health surveys, and review of historical information and local media coverage. The few concerns reported to the above agencies involve water quality issues (drinking water, streams, and creeks), fish advisories, and fish consumption guidelines.

In March 2011, EPA began community interviews in neighborhoods near the Armstrong site. One community member reported fishing from Rocky Creek for 35 years, and complained of a strong odor that was attributed to Armstrong's periodic discharges. EPA also conducted three community meetings:

- April 19—EPA briefed the Bibb County Commission members about the site.
- April 26—EPA briefed the Macon City Council about the site.
- April 28—EPA led a Public Availability Session for various agency staff to meet with the media, present site information, and gather community concerns.

GDPH staff attended these three meetings. At the County Commission meeting, Commissioners asked questions about the site history, groundwater contamination, and fish advisory-primarily which fish are safe to eat. At the Macon City Council meeting, some members had concerns regarding fish advisory signage posted at Rocky Creek, what types of analysis have been conducted on soils, and about the safety of eating catfish that swim upstream of the site.

Approximately 40 residents from the area attended the public availability session to meet with staff from EPA, GDPH, GEPD, NCHD, and the Bibb County Health Department. GDPH staff provided information about agency services and contacts, fish consumption guidelines, and a summary of the Public Health Assessment process.

On June 7, EPA staff investigated the odor concern reported in the community interviews. The location in question is southeast of the site and downstream of Armstrong's discharge from the WWTP. Nothing out of the ordinary was observed. Since the surface water in question had already been sampled as part of EPA's 2009 Site Investigation, no samples were taken at the time.

On June 28 and August 25, GDPH staff visited the area near Armstrong and the surrounding community (approximate 5-mile radius). GDPH learned the following during the site visits:

- There are approximately six small brick cottages with "For Rent" signs located on Broadway approximately three-quarters of a mile west of the Armstrong remote landfill. Vacant lots, abandoned properties, and small businesses immediately surround these brick cottages on Broadway.
- Adjacent to the Armstrong site property to the northwest is South Macon Park. The park is fenced and no one was observed at the park.
- No crop cultivation or livestock were visible near Armstrong.
- Access to Rocky Creek is limited. Rocky Creek is potentially accessible by foot near the bridge on Houston Road (Hawkinsville Highway) approximately two miles south of Armstrong. One sign near the bridge over Rocky Creek, off of Houston Road (Hawkinsville Highway), stated "PCB's Present, Fish at Your Own Risk". The PCB warning sign is presumably telling the public with the universal NO symbol superimposed over the fish drawn on it: do not eat fish from Rocky Creek.
- Numerous fish (approximately 20) were visible swimming in Rocky Creek below the bridge on Houston Road (Hawkinsville Highway). Bank fishing is possible at this location.
- No individuals were seen fishing in Rocky Creek.

Rocky Creek access from bridge on Houston Road (Hawkinsville Highway)

PCB warning sign near bridge on Houston Road (Hawkinsville Highway)

During July 2011, GDPH and NCHD staff developed a community environmental health survey (Appendix B) to gather information about residents' knowledge and concerns about Armstrong. The purpose of the survey was to collect information about individuals eating fish caught in Rocky Creek, Tobesofkee Creek, and the Ocmulgee River in Bibb County, to document environmental and health concerns, and to help GDPH design appropriate health education programs. Participation in this survey was voluntary and offered at no cost to residents.

On August 1, 85 surveys were distributed to elected officials (10), local businesses (29) and industry (5), environmental groups (3), parks (12), the local library (1), two fish and bait shops (22), and three residents (3). On August 10, surveys were mailed to local churches leaders and school principals, media, community groups, and additional business operators. GDPH issued a press release and an article was printed in the Macon Telegraph/Macon.com informing residents of the survey. A post card reminder was sent to the first group that received the surveys, extending the deadline to August 26, 2011. As of August 30, six surveys were returned and no others have been returned since

Based on the lack of historical evidence of community concern, small number of requests received by agencies and others reported to GDPH, low level of community participation in the survey, and the survey responses regarding environmental concerns, it appears that the majority of residents near the Armstrong facility do not have health concerns about the site.

DISCUSSION

Environmental Data Evaluation

Data evaluated in this report include the hazard ranking system package [2] from data gathered during EPA's 2009 Site Inspection activities [9]. Surface soil, subsurface soil, surface water, and sediment samples were analyzed.

- Twelve surface (0 to 6 inches below ground surface [bgs]) and 12 subsurface soil (12 to 24 inches bgs) samples were collected from the northern parcel of the Armstrong property, specifically in areas surrounding the WWTP and woodyard landfills.

- Four surface and four subsurface soil samples were collected from the Armstrong remote landfill.
- One surface water and two sediment samples were collected from the woodyard landfill runoff collection pond and drainage ditch.
- Three surface water and eight sediment samples were collected from the drainage ditch that receive runoff from Armstrong.
- Six surface water and six sediment samples were collected from Rocky Creek.

Background samples were also collected during Site Inspection activities. One mixed (composite) background surface and subsurface soil sample was collected to compare with contaminants detected in on-site soil samples. Two background sediment samples from two areas in the drainage ditch upgradient of Armstrong and the Armstrong remote landfill were collected to compare with contaminants detected in samples of site runoff. In addition, five composited background surface water and sediment samples were collected from Rocky Creek. Groundwater and air samples were not collected during EPA's 2009 Site Investigation. A description of the sampling locations is summarized in Appendix A.

Samples collected from the Armstrong plant (woodyard and WWTP landfills) were analyzed for Target Compound List (TCL) PCBs in accordance with the EPA Contract Laboratory Program (CLP) Statement of Work (SOW) for Organics Analysis, Multi-Media, and Multi-Concentration SOM01.2[3] [9]. Samples collected from the Armstrong remote landfill were analyzed for all parameters on the EPA Target Analyte List (TAL), including metals and cyanide, in accordance with the EPA CLP SOW for Inorganic Analysis, Multi-Media, Multi-Concentration ILM05.4[4] [9]. Samples collected from the Armstrong remote landfill were also analyzed for all parameters on the EPA TCL, which includes volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, and PCBs in accordance with SOM01.2 and for explosive compounds [9]. Surface water and sediment samples collected from Rocky Creek and the drainage ditch were analyzed for all parameters on the EPA TAL, TCP, and energetic compounds. In addition, surface water samples collected from Rocky Creek and the drainage ditch at selected locations were analyzed for dissolved metals and cyanide in accordance with EPA CLP SOW ILM05.4.

All analytical data were subject to a quality assurance review, as described in the EPA Region 4 Science and Ecosystem Support Division (SESD) laboratory evaluation guide [11]. The CLP and non-CLP data packages were validated by the EPA Region 4 SESD, Office of Quality Assurance [9]. GDPH concurs with EPA's quality assurance review.

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[3] SOM01.2 defines methods for the isolation, detection, and quantitative measurement of trace volatile, low/medium volatile, semivolatile, pesticide, and Aroclor target compounds in water and soil/sediment environmental samples. This document has incorporated major changes to the organic methods. Changes include: the separation of the pesticide and Aroclor methods; the incorporation of the new Staged Electronic Data Deliverable (SEDD); and the inclusion of Selected Ion Monitoring (SIM) analysis. www.epa.gov/superfund/programs/clp/som1.htm

[4] The ILM05.4 defines the analytical methods accepted by the CLP for the isolation, detection, and quantitative measurement of 23 target analyte metals (including mercury) and cyanide in both water and soil/sediment environmental samples. Analyses are performed using Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), Cold Vapor Atomic Absorption (CVAA), and colorimetric techniques. www.epa.gov/superfund/programs/clp/ilm5.htm

In addition, GDPH reviewed existing fish tissue sampling results obtained from Rocky Creek during the Site Investigation of the FMNOL conducted by the USACE in 1996, and the Phase I Remedial Investigation conducted by the USACE in 1998.

Pathways Analysis

The next step is to determine if people are coming into contact with chemicals from the site by examining exposure pathways. GDPH identifies pathways of human exposure by identifying environmental and human components that might lead to contact with contaminants in environmental media (e.g., air, soil, and groundwater). 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. GDPH regards people who come into contact with contamination as exposed. For example, people who drink water known to be contaminated, or who work or play in contaminated soil are considered to be exposed to contamination. Potential exposure pathways are those for which exposure seems possible, but one or more of the elements is not clearly defined. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. However, key information regarding a potential pathway may not be available. 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 [12].

GDPH identified one completed exposure pathway at the Armstrong site where all five major elements exist. A completed exposure pathway existed in the past, currently exists, and may exist in the future for exposure to PCBs from eating fish caught in Rocky Creek. The components of this completed pathway are:

1. **Contamination source:** The sources of site-related contamination include the WWTP landfill, the FMNOL, and the Armstrong remote landfill.
2. **Transport of contamination through an environmental medium:** Elevated levels of PCBs have been found in fish and in surface water and sediment samples from Rocky Creek.
3. **Exposure point:** Fish caught in Rocky Creek downstream of the Armstrong site contaminant sources.
4. **Exposure route:** Eating fish caught in Rocky Creek downstream of the Armstrong site contaminant sources.
5. **Exposure population:** People that eat fish from Rocky Creek downstream of the Armstrong site contaminant sources.

In 2007, GEPD personnel saw people fishing in Rocky Creek and the fishers said they eat the fish that they catch [2, 9]. In 2009, EPA's contractor observed fishing gear, including a fishing-line and weight, along Rocky Creek [2].

A potential exposure pathway exists for the ingestion of contaminated soil located at the WWTP landfill, the Armstrong remote landfill, and the FMNOL landfill; however, exposure to contaminated soil is unlikely because these landfills are fenced, and overgrown with vegetation [9]. Moreover, the area is often partially submerged by Rocky Creek floodwaters making access

to these landfills difficult for trespassers. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route.

Other potential exposure pathways include unintentionally ingesting contaminated surface water and sediment in the drainage ditch that begins on Armstrong property and drains into Rocky Creek, and in Rocky Creek. However, the area is often partially submerged by Rocky Creek floodwaters making access to the drainage ditch and to the receiving portions of Rocky Creek difficult for the public. Moreover, the surrounding area is industrial and less likely to be casually accessed by the general public. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposure population and/or an exposure route.

Evaluation Process

For each environmental medium, GDPH examines the types and concentrations of contaminants of concern, which are then screened with 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 [12]. GDPH 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 the contaminants, this exposure information is essential to determine if a public health hazard exists. CVs and the evaluation process used in this document are described in more detail in Appendix C.

Contaminants of Concern

Tables 1 through 3 show that PCBs, metals, and polycyclic aromatic hydrocarbons (PAHs) were detected in surface and subsurface soils at the WWTP landfill, the Armstrong remote landfill, and between the Armstrong remote landfill and Rocky Creek at levels higher than soil CVs. Tables 4 through 6 show that PCBs, metals, and PAHs were found above CVs and EPA drinking water standards in the surface water and sediment of the drainage ditch receiving runoff from the Armstrong site, Allied Industrial Park, the FMNOL, and in Rocky Creek. Tables 7 and 8 show PCB concentrations detected in fish tissue from different fish species caught in Rocky Creek southwest and southeast of the Armstrong site during the 1996 and 1999 USACE site investigations.

PCBs enter the environment as mixtures comprised of up to 209 individual chlorinated biphenyl compounds. They exist as either oily liquids or solids and are colorless to light yellow and once in the environment, persist for long periods of time. There are no known natural sources of PCBs in the environment.

Potential Exposure Pathways

Soil

Woodyard Landfill

During EPA's 2009 Site Investigation, six surface soil and six subsurface soil samples were collected along the perimeter of the woodyard landfill so as not to jeopardize the integrity of the clay cap installed in 2004. Sample collection locations included the east side, southeast side, southwest side, west side, and the northwestern corner of the woodyard landfill. Samples collected from the woodyard landfill were only analyzed for PCBs. PCBs were not detected above analytical detection limits. Since the integrity of the clay cap has not been compromised, based on sampling results, we assume that this landfill is not a source of PCB contaminated soil.

Waste Water Treatment Plant Landfill

Six surface soil samples and six subsurface soil samples were collected from the perimeter of the WWTP landfill and found to contain elevated concentrations of PCBs. PCBs detected at the WWTP landfill above CVs are shown in Table 1.

Table 1: Soil Contaminants Detected above Comparison Values (CVs) at the Waste Water Treatment Plant Landfill

Analyte	Background Sample mg/kg	Highest Concentration mg/kg	Health-Based CV mg/kg	Type of CV
Surface soil collected at a depth of 0-6" below the surface				
Aroclor 1248	Not detected	2.10	0.74	EPA Regional Screening Level*$_{\text{Industrial Soil}}$
Aroclor 1254	0.02	1.80	10 1	Chronic EMEG**$_{\text{adult}}$ Chronic EMEG$_{\text{child}}$
Subsurface soil collected at a depth of 12-24" below the surface				
Aroclor 1248	Not detected	200	0.74	EPA Regional Screening Level$_{\text{Industrial Soil}}$
Aroclor 1260	0.02	10	0.74	EPA Regional Screening Level$_{\text{Industrial Soil}}$

mg/kg: milligram per kilogram (same as part per million)
Chronic EMEG: chronic Environmental Media Evaluation Guide (exposures lasting longer than 1 year)
*EPA Regional Screening Levels (November 2010)
**ATSDR Soil Comparison Values (September 2011)

Ingestion of soil from the WWTP landfill is not likely because this landfill is fenced, overgrown with vegetation, and it is an active facility with 24-hour security. Access to this landfill by trespassers is highly unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Armstrong Remote Landfill

Two surface soil samples collected from the Armstrong remote landfill contained elevated concentrations of arsenic and benzo(a)pyrene. Two subsurface soil samples collected from the Armstrong remote landfill contained elevated concentrations of Aroclor 1254, arsenic, benzo(a)pyrene, and dibenzo(a,h)anthracene. Contaminants detected at the Armstrong remote landfill above CVs are shown in Table 2.

Table 2: Soil Contaminants Detected above Comparison Values (CVs) at the Armstrong Remote Landfill

Analyte	Background Sample mg/kg	Highest Concentration mg/kg	Health-Based CV mg/kg	Type of CV
Surface soil				
Arsenic	2.2	0.96	200 20 0.5	Chronic EMEG*$_{adult}$ Chronic EMEG$_{child}$ CREG*
Benzo(a)pyrene	0.29	0.46	0.1	CREG
Subsurface soil				
Aroclor 1254	Not detected	2.0	10 1	Chronic EMEG$_{adult}$ Chronic EMEG$_{child}$
Arsenic	1.9	1.4	0.5	CREG
Benzo(a)pyrene	Not detected	1.1	0.1	CREG
Dibenzo(a,h) anthracene	Not detected	2.2	0.21	EPA Regional Screening Level**$_{Industrial\ Soil}$

mg/kg: milligram per kilogram (same as part per million)
Chronic EMEG: chronic Environmental Media Evaluation Guide for adults and children (exposures lasting longer than 1 year)
CREG: Cancer Risk Evaluation Guide. 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 Soil Comparison Values (September 2011)
**EPA Regional Screening Levels (November 2010)

The ingestion of soil from the Armstrong remote landfill is not likely because this landfill is fenced, overgrown with vegetation, and located in the swampy scrub-shrub forested area of the Armstrong site southern parcel. Access to this landfill by the general population is prohibitive and highly unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Between the Armstrong remote landfill and Rocky Creek

Two surface soil samples collected between the Armstrong remote landfill and Rocky Creek contained elevated concentrations of Aroclor 1254, arsenic, cadmium, and benzo(a)pyrene. Two subsurface soil samples collected between the Armstrong remote landfill and Rocky Creek contained elevated concentrations of Aroclor 1254, arsenic, benzo(a)pyrene, and dibenzo(a,h)anthracene. Contaminants detected between the Armstrong remote landfill and Rocky Creek above CVs are shown in Table 3.

Table 3: Soil Contaminants Detected above Comparison Values (CVs) between the Armstrong Remote Landfill and Rocky Creek

Analyte	Background Sample mg/kg	Highest Concentration mg/kg	Health-Based CV mg/kg	Type of CV
Surface soil				
Aroclor 1254	0.02	4.0	10 1	Chronic EMEG*$_{adult}$ Chronic EMEG$_{child}$
Arsenic	2.2	1.9	200 20 0.5	Chronic EMEG$_{adult}$ Chronic EMEG$_{child}$ CREG*
Benzo(a)pyrene	0.29	3.6	0.1	CREG
Cadmium	0.58	140	70 5	Chronic EMEG$_{adult}$ Chronic EMEG$_{child}$
Subsurface soil				
Aroclor 1254	Not detected	1.6	10 1	Chronic EMEG$_{adult}$ Chronic EMEG$_{child}$
Arsenic	1.9	1.9	0.5	CREG
Benzo(a)pyrene	Not detected	3.5	0.1	CREG
Dibenzo(a,h)an-thracene	Not detected	0.87	0.21	EPA Regional Screening Level**$_{Industrial\ Soil}$

mg/kg: milligram per kilogram (same as part per million)
Chronic EMEG: chronic Environmental Media Evaluation Guide (exposures lasting longer than 1 year)
CREG: Cancer Risk Evaluation Guide. 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 Soil Comparison Values (September 2011)
**EPA Regional Screening Levels (November 2010)

The ingestion of soil from this area is not likely because it is located in the swampy, scrub-shrub forested area of the Armstrong site southern parcel. Access to this area by the general population is prohibitive and unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Surface Water

During EPA's 2009 Site Investigation, three surface water samples from drainage ditch that receive runoff from the Armstrong plant and the Armstrong remote landfill were collected. Background surface water samples could not be collected for comparison to downgradient drainage ditch samples because surface water was not present in drainage ditches upgradient of the Armstrong plant and the Armstrong remote landfill properties.

Drainage Ditch

Surface water samples collected from sections of the drainage ditch contained Aroclor 1248 and arsenic. Contaminants detected in the drainage ditch above CVs are shown in Table 2.

Table 4: Surface Water Contaminants Detected above Comparison Values (CVs) in the Drainage Ditch that Flows into Rocky Creek

Analyte	Drainage Ditch that Receives Drainage from AIP, and Armstrong µg/L	Drainage Ditch that Receives Drainage from AIP, Armstrong, and FMNOL µg/L	Drainage Ditch that Receives Drainage from AIP, Armstrong, and FMNOL, North of Rocky Creek µg/L	Health-Based CV µg/L	Type of CV
Aroclor 1248	Not detected	Not detected	2.2	0.0034	EPA Regional Screening Level*$_{Tap\ water}$
Arsenic	Nor detected	4.4	2.3	10 3 0.02	Chronic EMEG**$_{adult}$ Chronic EMEG$_{child}$ CREG**

µg/L: microgram per liter (same as part per billion)
Chronic EMEG: chronic Environmental Media Evaluation Guide (exposures lasting longer than 1 year)
CREG: Cancer Risk Evaluation Guide. 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
* EPA Regional Screening Levels (November 2010)
** ATSDR Drinking Water Comparison Values (September 2011)

Incidental ingestion of surface water from the drainage ditch is not likely because the drainage ditch is located in the swampy, scrub-shrub forested area of the Armstrong site southern parcel. Access to this area by the general population and trespassers is prohibitive and unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Rocky Creek

Six collocated surface water samples and five collocated background surface water samples were collected from Rocky Creek. Analytical results from surface water samples collected from Rocky Creek did not indicate hazardous constituents at elevated concentrations. Therefore, this potential exposure pathway can be eliminated.

Sediment

Drainage Ditch

During EPA's 2009 Site Investigation, eight sediment samples from the drainage ditch that receives runoff from the Armstrong plant and the Armstrong remote landfill were collected. In addition, two background sediment samples were collected from the drainage ditch upgradient from the Armstrong plant and the Armstrong remote landfill to attribute contaminants detected in samples of site runoff.

Sediment samples collected from the drainage ditch contained Aroclor 1248, Aroclor 1260, benzo(a)anthracene, and benzo(a)pyrene. Analytical results above CVs and the locations where samples were collected are shown in Tables 5.1 and 5.2.

Table 5.1: Sediment Contaminants Detected above Comparison Values (CVs) in the Drainage Ditch that Flows into Rocky Creek

Analyte	Highest Background Concentration mg/kg	Armstrong WWTP Drainage mg/kg	Armstrong Drainage Just After the Ditch Leaves Armstrong Property mg/kg	Health-Based CV mg/kg	Type of CV
Aroclor 1248	Not detected	24	3.1	0.74	EPA Regional Screening Level*$_{\text{Industrial Soil}}$
Aroclor 1260	Not detected	1.1	ND	0.74	EPA Regional Screening Level$_{\text{Industrial Soil}}$
Benzo(a)anthracene	0.22	N/A	7.1	2.1	EPA Regional Screening Level$_{\text{Industrial Soil}}$
Benzo(a)pyrene	0.23	N/A	6.6	0.21 0.1	EPA Regional Screening Level$_{\text{Industrial Soil}}$ CREG**

mg/kg: milligram per kilogram (same as part per million)
CREG: Cancer Risk Evaluation Guide. 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
N/A: not applicable
*EPA Regional Screening Levels (November 2010)
**ATSDR Soil Comparison Values (September 2011)

Table 5.2: Sediment Contaminants Detected above Comparison Values (CVs) in the Drainage Ditch that Flows into Rocky Creek

Analyte	Highest Background Concentration mg/kg		Drainage Ditch that Receives Drainage from AIP, Armstrong, and FMNOL mg/kg	Drainage Ditch that Receives Drainage from AIP, Armstrong, and FMNOL, North of Rocky Creek mg/kg	Health-Based CV mg/kg	Type of CV
Aroclor 1248	Not detected	0.55	14	2.4	0.74	EPA Regional Screening Level*$_{\text{Industrial Soil}}$
Benzo(a)pyrene	0.23	0.41	3.7	1.9	0.21 0.1	EPA Regional Screening Level$_{\text{Industrial Soil}}$ CREG**

mg/kg: milligram per kilogram (same as part per million)
CREG: Cancer Risk Evaluation Guide. 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
*EPA Regional Screening Levels (November 2010)
**ATSDR Soil Comparison Values (September 2011)

Incidental ingestion of sediment from the drainage ditch is not likely because the drainage ditch is located in the swampy, scrub-shrub forested area of the Armstrong site southern parcel.

Access to the drainage ditch by the general population is prohibitive and unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Rocky Creek

During EPA's Site Investigation activities, six collocated sediment samples and five co-located background surface water samples were collected from Rocky Creek downstream from Armstrong sources (the WWTP and Armstrong remote landfill). Sediment samples collected from Rocky Creek contained elevated concentrations of Aroclor 1248, arsenic, cadmium, and benzo(a)pyrene. Analytical results above CVs and the locations where samples were collected are shown in Table 6.

Table 6: Sediment Contaminants Detected above Comparison Values (CVs) in Rocky Creek

Analyte	Highest Background Concentration mg/L	South of Armstrong Remote Landfill mg/L	Downstream from PPE 1 mg/L	At PPE 2 mg/L	Between PPE 2 and PPE 3 mg/L	At PPE 3 mg/L	Downstream from PPE 3 mg/L	Health-Based CV mg/L	Type of CV
Aroclor 1248	Not detected	Not detected	0.37	0.29	3.5	7.8	5.0	0.74	EPA Regional Screening Level*$_{Industrial\ Soil}$
Arsenic	2.8	4.2	0.91	1.7	1.8	5.0	4.0	0.5	CREG**
Benzo(a) pyrene	2.8	Not detected	0.13	0.24	3.8	6.6	5.1	0.1	CREG
Cadmium	Not detected	Not detected	Not detected	Not detected	6	15	6.2	70 5	Chronic EMEG**$_{adult}$ Chronic EMEG$_{child}$

mg/kg: milligram per kilogram (same as part per million)
PPE: Probable Point of Entry
Chronic EMEG: chronic Environmental Media Evaluation Guide for adults and children (exposures lasting longer than 1 year)
CREG: Cancer Risk Evaluation Guide. 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
*EPA Regional Screening Levels (November 2010)
**ATSDR Soil Comparison Values (September 2011)

The ingestion of sediment from Rocky Creek is not likely because the areas of Rocky Creek that lie in the southern parcel of the Armstrong site are located in the swampy, scrub-shrub forested area. Access to these areas of Rocky Creek by the general population is prohibitive and unlikely. Therefore, one or more principal elements of a completed exposure pathway are missing; notably, an exposed population and/or an exposure route. This potential exposure pathway can be eliminated.

Completed Exposure Pathway

Biota (Fish)

According to the Georgia Department of Natural Resources, fish species caught for consumption along Rocky Creek include redear sunfish, redbreast sunfish, bluegill, and brown bullhead catfish. Table 7 shows PCB concentrations detected in fish tissue (fillet) from various species of fish caught in Rocky Creek both upstream and downstream of the Armstrong remote landfill and

the FMNOL (Armstrong site sources) during the USACE Site Investigation conducted on the FMNOL property in 1996. Aroclor 1254 was detected in all fish sampled [9]. The analysis of fish tissue was limited to PCBs and does not include data on mercury and other contaminants.

Table 7: Fish Tissue (Fillet) PCB Concentrations Detected in Various Species of Fish Caught in Rocky Creek Upstream and Downstream of the Armstrong Site Sources in 1996.

Type of Fish	Background Sample mg/kg	Number of Samples	PCB Concentrations mg/kg	Recommended CV for PCBs mg/kg	Type of CV*
Bluegill	Not sampled	1	0.42	2.0	FDA tolerance level
Silver Redhorse Sucker	Not sampled	1	0.35	2.0	FDA tolerance level
Spotted Sucker	0.2	2	0.49	2.0	FDA tolerance level
White Crappie	Not sampled	1	0.45	2.0	FDA tolerance level

mg/kg: milligram per kilogram (same as part per million)
PCB: polychlorinated biphenyls
* Food and Drug Administration tolerance level: Tolerance levels are established based on the unavoidability of the poisonous or deleterious substances and do not represent permissible levels of contamination where available.

The 1996 USACE Site Investigation fish tissue data did not specify the locations of where the fish were caught, and also did not specify where the upstream sample was taken. Silver redhorse sucker and spotted sucker are not considered edible species by the Georgia Department of Natural Resources.

Table 8 shows PCB concentrations detected in fish tissue (fillets) from various species of fish caught in Rocky Creek upstream and downstream of the Armstrong remote landfill and the FMNOL (Armstrong site sources) during the USACE Phase 1 Remedial Investigation conducted on the FMNOL property in 1999. The contaminants detected were Aroclor 1248 and Aroclor 1254 [9].

Table 8: Fish Tissue (fillet) PCB Concentrations Detected in Various Species of Fish Caught in Rocky Creek South and Southeast of the Armstrong Site Sources in 1999.

Type of Fish	Background Sample mg/kg	Number of Samples	Range of PCB Concentrations mg/kg	Recommended CV fir PCBs mg/kg	Type of CV*
Bluegill	Not detected	5	ND - 0.73	2.0	FDA tolerance level
Bowfin	Not detected	2	ND - 1.36	2.0	FDA tolerance level
Brown Bullhead Catfish	Not detected	1	0.58	2.0	FDA tolerance level
Redbreast Sunfish	NA	12	ND - 2.55	2.0	FDA tolerance level
Redear	Not detected	2	0.14- 0.31	2.0	FDA tolerance level
Redfin Pickerel	Not detected	6	ND - 0.48	2.0	FDA tolerance level

mg/kg: milligram per kilogram (same as part per million)

ND: not detected
NA: not analyzed
* Food and Drug Administration tolerance level: Tolerance levels are established based on the unavoidability of the poisonous or deleterious substances and do not represent permissible levels of contamination where available.
Note: The redbreast sunfish species is highlighted to illustrate that this species was the only species sampled that had PCB concentration higher the FDA tolerance level.

EPA has not developed quantitative estimates of health risk for PCBs because of a lack of sufficient toxicological data. The health-based screening level, or CV, used by Georgia regulators for fish has followed the Food and Drug Administration (FDA) tolerance level for PCBs in edible fish portions of less than two parts per million (2 mg/kg), as stipulated in Federal Regulation 21 CRF 109.30. The FDA tolerance level considers total PCB concentrations rather than each PCB mixture (measured as Aroclor 1248 and Aroclor 1254 in the data reviewed). The fish data in this investigation will be evaluated in terms of Aroclor 1254 for health screening purposes because toxicological studies used to develop health guidelines for chronic exposures to PCBs were based on the Aroclor 1254 analyte.

Exposure Evaluation

PCBs can move from water and sediments into fish through the ingestion of these media. Fish can accumulate much higher concentrations of PCBs than are observed in the water or sediment to which they are exposed, and then people can be exposed to PCBs by eating the contaminated fish.

Evaluating the public health implications of exposure to an environmental medium is a multi-step process. When a contaminant exceeds a CV, the toxicological evaluation requires a comparison of calculated site-specific exposure doses (e.g., amount of the contaminant believed to enter the body at the person's body weight for an estimated duration of time) with an appropriate health guideline for each exposure pathway identified in the exposure assessment. The health guidelines are health-protective values that have incorporated various safety factors to account for varying human susceptibility and the use of animal data to evaluate human exposure. Health guidelines used include ATSDR's Minimal Risk Levels (MRLs) and the EPA's Reference Dose (RfDs). MRLs and RfDs are described in more detail in Appendix C. Usually little or no information is available for a site to know exactly how much exposure is actually occurring, so health assessors assume worse case scenarios where someone received a maximum dose. Actual exposure is likely much less than the assumed exposure. In the event that the calculated, site-specific exposure dose for a chemical is greater than the established health guideline, this exposure dose is evaluated further by comparing to exposure doses from individual studies documented in the scientific literature that have reported health effects. If a chemical of concern has been determined to be cancer causing (carcinogenic), a theoretical cancer risk is also estimated.

ATSDR lists a health effects screening value, or MRL, of 2×10^{-5} (or 0.00002) milligrams per kilogram per day (mg/kg/day) as the daily oral exposure to Aroclor 1254 that would not be expected to result in adverse non-cancer health effects in people who ingest this concentration of PCBs daily for one year or more (chronic exposure) [13]. This value is equal to the EPA chronic oral reference dose value (RfD), and is derived from an animal study in which the lowest observed adverse health effect level (LOAEL) occurred at a dose of 0.005 mg/kg/day and resulted in adverse immunological effects to adult monkeys; specifically for reduction in antibody levels [13].

To evaluate potential PCB exposure doses from eating PCB contaminated fish caught in Rocky Creek south and southeast of the Armstrong site sources, although Redbreast sunfish were the most sampled species during this investigation, GDPH evaluated one redbreast sunfish sample from the 48 fish samples collected upstream and downstream of the Armstrong site because it was the only sample analyzed to have a PCB concentration above a CV (the FDA tolerance level). However, because the sample analysis was conducted on fillets, and not whole-fish, we cannot assume that anglers also fillet their catch. Most likely, these fish are pan-fried. Therefore, PCB concentrations are likely to be higher that fillet analysis showed.

According to the EPA PCB Fish Advisory Fact Sheet, chemicals such as PCBs accumulate mainly in fatty tissues (i.e. belly flap, lateral line, subcutaneous and dorsal fat, dark muscle, gills, eye, brain, and internal organs). Removal of internal organs and skin and trimming the fat before cooking will decrease PCB exposure [15].

Based on fish intake studies conducted by EPA on recreational freshwater anglers, we used the 95th percentile value fish intake rate of 25,000 milligrams per day (mg/day) for the purpose of our exposure dose calculations [14]. This would be the equivalent of eating about 6 ounces of fish per week. We also assumed that an adult eating this fish weighed 70 kilograms (kg). A child eating these fish weighed 16 kg and ate about 3 ounces of fish per week (12,500 mg/day which is (half the EPA 95th percentile value fish intake rate). Based on the PCB concentration of 2.55 mg/kg found in a redbreast sunfish sample, an exposure dose was calculated for an adult and a child. A bioavailability factor of one was used assuming fish caught in Rocky Creek were pan-fried. Table 9 shows the estimated exposure doses for an adult and child from redbreast sunfish caught in Rocky Creek. An explanation on how estimated exposure doses were derived can be found in Appendix C.

Table 9: Estimated Exposure Doses from PCBs (Aroclor 1254) for adults eating 25,000 milligrams per day and children eating 12,500 milligrams per day of Redbreast Sunfish Caught in Rocky Creek South and Southeast of the Armstrong Site Sources.

Type of Fish/ Catch Location	Estimated Dose (mg/kg/day)	ATSDR MRL* (mg/kg/day)	Theoretical Cancer Risk**
Redbreast Sunfish	Adult: 0.0009 Child: 0.002	0.00002	1×10^{-3}

mg/kg/day: milligrams per kilogram of body weight per day
MRL: chronic oral minimal risk level (for exposures lasting longer than 1 year)
* ATSDR Health Guidelines for Aroclor 1254 (September 2011)
** The calculation for theoretical cancer risk assumes that an adult has been exposed for 40 years to PCBs at the highest concentration detected in all fish species sampled.

The calculated exposure dose for adult non-subsistence consumers, using the highest concentration of PCBs found in Rocky Creek as a conservative measure, is approximately 45 times higher than the MRL for Aroclor 1254. The calculated exposure dose for children who consume half the amount of fish (that an adult would) is approximately 100 times higher than the MRL. However, this exposure dose is approximately 5 times lower than the LOAEL that resulted in immunological effects of adult monkeys. However, if the fish are pan-fried before consumption, the actual PCB concentrations are likely to be higher than the PCB concentrations of the fillets analyzed. This is because PCBs concentrated in the fatty tissues of the fish will likely permeate the edible fish fillet and be present in pan drippings that may also be consumed.

GDPH has no evidence that subsistence fishing occurs on Rocky Creek; however, as a precautionary and conservative measure, GDPH made this assumption to calculate potential exposure doses from ingesting redbreast sunfish should subsistence fishing be taking place in Rocky Creek south and southeast of the Armstrong site. Based on fish intake studies conducted by EPA on subsistence anglers (for both marine and freshwater fish), we used the 95th percentile value fish intake rate of 170,000 milligrams per day (mg/day) for the purpose of our exposure dose calculations [14]. This is a consumption of approximately 42 ounces of fish per week, or one six ounce portion per day. Again, the children's estimated exposure dose was based on half the 95th percentile value fish intake rate for subsistence anglers (85,000 mg/day). This is a consumption of approximately 21 ounces of fish per week, or one three ounce portion per day. Table 10 shows the estimated exposure doses that subsistence freshwater anglers may ingest from redbreast sunfish caught in Rocky Creek.

Table 10: Estimated Exposure Doses from PCBs (Aroclor 1254) for adults eating 170,000 milligrams per day and children eating 85,000 milligrams per day of Redbreast Sunfish Caught in Rocky Creek South and Southeast of the Armstrong Site Sources.

Type of Fish/ Catch Location	Estimated Dose (mg/kg/day)	ATSDR MRL* (mg/kg/day)	Theoretical Cancer Risk**
Redbreast Sunfish	Adult: 0.006 Child: 0.01	0.00002	7×10^{-3}

mg/kg/day: milligrams per kilogram of body weight per day
MRL: chronic oral minimal risk level (for exposures lasting longer than 1 year)
*ATSDR Health Guidelines for Aroclor 1254 (September 2011)
**The calculation for theoretical cancer risk assumes that an adult has been exposed for 40 years to PCBs at the highest concentration detected in all fish species sampled

The calculated exposure dose for adult subsistence consumers, using the highest concentration of PCBs found in Rocky Creek as a conservative measure, is approximately 300 times higher than the MRL for Aroclor 1254. The calculated exposure dose for children who consume half the amount of fish (that an adult would) is approximately 500 times higher than the MRL. This exposure dose in adults is approximately the same as the LOAEL that resulted in immunological effects of adult monkeys [16].

Although fishing is known to have occurred in the past, and may still be occurring in Rocky Creek, it is not known if fishing occurs at the levels in Rocky Creek that recreational or subsistence anglers would normally fish. It is more likely that recreational and subsistence fishing occurs in the Ocmulgee River approximately 5.5 miles southeast of the Armstrong site.

The Georgia Department of Natural Resources (GDNR) has one of the most progressive fish testing programs in the southeast. Every ten years, a variety of different fish species are tested for 43 separate contaminants including metals, organic chemicals and pesticides in water bodies of Georgia. Two contaminants, PCBs and mercury are frequently detected in a few species

The Ocmulgee River is the closest water body to Rocky Creek where fish are sampled by GDNR. In 2001, GDNR analyzed largemouth bass, flathead catfish, and channel catfish from the Ocmulgee River six miles downstream of Tobesofkee Creek. PCBs were found in flathead

catfish and GDNR made a recommendation limiting consumption of flathead catfish to one meal per month. The "Guidelines for Eating Fish from Georgia Waters" make consumption recommendations based on health-risk calculations for someone eating fish with similar contamination over a period of 30 years or more [13]. GDNR updates the Guidelines every year.

Non-cancer Health Effects

PCBs

PCBs produce a wide range of adverse biological and toxicological effects. PCBs are absorbed through the gastrointestinal tract and distributed throughout the body. Absorption of PCBs from oral exposures is high, and because of their lipophilic ("fat-loving") nature, PCBs tend to accumulate in lipid-rich tissues (i.e., the liver, adipose tissue, skin, and breast milk). Human studies in a workplace environment where the repair and maintenance of PCB transformers is conducted have shown PCBs to cause acne and rashes, irritation of the nose and lungs, gastrointestinal discomfort, changes in the blood and liver, and depression and fatigue [16]. However, concentrations of PCBs in the workplace are usually much higher than what may be encountered by the general population.

Human studies of oral exposure to PCBs with exposure doses as low as what may be found by ingesting fish caught in Rocky Creek do not exist. However, several studies have been conducted on Rhesus monkeys. One study conducted on Rhesus monkeys in 1993 reported fingernail and toenail changes during treatment with as little as 0.005 mg/kg/day Aroclor 1254 over a 37-month period [16]. Another study conducted in 1989 examined several immunological parameters when female Rhesus monkeys were given 0.005 to 0.08 mg/kg/day Aroclor 1254 in their diets for 23 months. In response to immunization with sheep red blood cells, all doses tested induced a significant and dose-related decrease in antibody levels (IgG and IgM) 7, 14, and 21 days after immunization [16]. However, the animals were not tested for susceptibility to infectious agents. However, another similar study was conducted in 1997 where the decreased immunological effects were not seen in female Rhesus monkeys fed similar daily doses for 72 months.

Cancer Risk

The National Toxicology Program (NTP) has stated that PCBs are reasonably anticipated to be carcinogens, while EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probable human carcinogens but that, although sufficient animal studies exist, there are inadequate human studies to state conclusively that PCBs are a human carcinogen [16]. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The estimated theoretical risk for cancer from exposure to contaminants is usually calculated by multiplying the exposure dose by EPA's corresponding cancer slope factor (CSF) of 2.0 $(mg/kg/day)^{-1}$ for PCBs. This CSF is equivalent to the upper-bound value referenced by EPA, which means that it is used by EPA for evaluation of human food-chain exposures because it provides assurance that risk is not underestimated, and it represents a value for high risk and high persistence PCBs. For more information, see Appendix C.

For calculating the theoretical cancer risk from PCB exposure, GDPH assumed that recreational and/or subsistence fishing has occurred on Rocky Creek south and southeast of the Armstrong

site sources on a regular basis over the last 40 years where PCBs concentrations were at the maximum concentration detected (2.55 mg/kg). This is because PCBs are persistent contaminants that have the possibility of existing in the sediment and fish populations for long periods of time. The predicted theoretical risk for cancer from exposure to PCBs for an adult recreational angler would be (approximately 1 cancer case per 1,000 people exposed, or 1×10^{-3}). The predicted theoretical risk for cancer from exposure to PCBs for an adult subsistence angler would be (approximately 7 cancer cases per 1,000 people exposed, or 7×10^{-3}). This theoretical risk to increased cancer from exposure to PCBs in fish under the assumed exposure scenario is above an acceptable cancer risk of one in a million (1×10^{-6}), should PCBs be proven to be carcinogenic to humans.

Health Outcome Data

Health outcome data, such as cancer morbidity and mortality data, reports of symptoms and diseases from community members, and health statistics from community health studies can provide information on various aspects of the health of people living on or near a contaminated site. It may reveal whether people living or working near a site are experiencing adverse health effects at a rate higher than would be expected to occur.

GDPH did not evaluate health outcome data because although fishing is known to have occurred in the past, and may still be occurring in Rocky Creek, it is not known if fishing occurs at the levels in Rocky Creek that recreational or subsistence anglers would normally fish. It is more likely that recreational and subsistence fishing occurs in the Ocmulgee River approximately 5.5 miles southeast of the Armstrong site. In addition, state and federal environmental and public health agencies have not received reports of specific symptoms or diseases from fishing in the Ocmulgee River basin, nor have these agencies received requests to investigate potential fish consumption related illnesses in the Ocmulgee River basin.

CHILD HEALTH CONSIDERATIONS

In communities faced with contamination of the water, soil, air, or food, ATSDR and GDPH recognize 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.

For the Armstrong site, young children may have been exposed to PCBs if they consumed fish caught in Rocky Creek, Tobesofkee Creek, and the Ocmulgee River. In addition, since PCBs can cross the placenta and enter fetal tissues and can also concentrate in breast milk, infants and toddlers could be exposed to PCBs. Moreover, a few studies have reported a correlation between umbilical cord blood levels and reduced birth rate and size, and behavioral effects in infants. Because the brain, nervous system, thyroid, and reproductive organs are still developing in the fetus and neonate, the effect of PCBs on these target systems may be more profound after exposure during the prenatal and neonatal periods [13]. Therefore, pregnant women, women who may become pregnant and young children should follow the GDNR “Guidelines for Eating

Fish from Georgia Waters" and limit their consumption of fish caught in Rocky Creek, Tobesofkee Creek, and the Ocmulgee River.

CONCLUSIONS

GDPH evaluated the ways (exposure pathways) people could have come into contact with contaminants from the Armstrong Site. All conclusions were based on site visits and review of available data and reports. The conclusions of this evaluation are presented below.

1. GDPH and ATSDR conclude that people who ate, or are currently eating certain species of fish caught in Rocky Creek east of Houston Rd., Tobesofkee Creek, and the Ocmulgee River could have been/could be exposed to PCBs at levels that could harm their health, especially if the fish being consumed are pan-fried.

2. GDPH and ATSDR conclude that adults who eat certain species of fish increase their theoretical risk of acquiring cancer over a 40 year PCB exposure period. This theoretical cancer risk is based on the assumption that recreational freshwater anglers are eating fish containing the highest level of PCB's measured. However, it is more likely that exposure is occurring for PCB concentrations closer to the average levels found, making the theoretical cancer risk lower.

3. GDPH concludes that exposure to contaminated soil at the Waste Water Treatment Plant (WWTP) landfill, the Armstrong remote landfill, and the Former Macon Naval Ordnance Landfill (FMNOL) is unlikely because these landfills are fenced, and overgrown with vegetation. In addition, ingestion of contaminated surface water and sediment in the drainage ditch that begins on Armstrong property and eventually drains into Rocky Creek, and in Rocky Creek, is also not likely to occur because the southern parcel of the Armstrong site is located in an area often partially submerged by Rocky Creek floodwaters making it swampy and difficult for would-be-trespassers to access.

RECOMMENDATIONS

1. No fish caught in Rocky Creek east of Houston Road (Hawkinsville Highway) should be eaten, especially by pregnant women and children. If fish are caught, it is recommended that they be released back into Rocky Creek.

2. EPA should oversee fish collection in Rocky Creek and sample analysis. Analysis should be conducted on edible portions of fish, preferably fish fillets.

3. Residents should follow the "Guidelines for Eating Fish from Georgia Waters" published by the Georgia Department of Natural Resources. These Guidelines can be found at: www.dnr.org. The Guidelines for the Ocmulgee River make recommendations of no more than 1 meal/week for largemouth bass and no more than 1 meal/month for flathead catfish. Recommendations are based on mercury and PCB levels found in Ocmulgee River fish.

4. As a precautionary measure, people who eat fish from Tobesofkee Creek, which converges with Rocky Creek approximately 4 miles upstream of the Ocmulgee River, should follow the Guidelines for the Ocmulgee River as stated above.

5. During a site visit in August 2011, GDPH staff noticed one fishing advisory sign posted on the north bank of Rocky Creek at the Houston Road (Hawkinsville Highway) bridge. GDPH recommends another advisory sign be posted on the south bank of Rocky Creek at this location.

6. Exposure to PCBs from fish can be reduced by cleaning and preparing the fish by removing the head, guts, skin, trimming the fat along the back belly, and removing the fatty dark meat along the length of the fillet. Cook the fish by broiling, baking or grilling in a way so fat drips away and not using the drippings can also reduce PCB exposure.

PUBLIC HEALTH ACTION PLAN

Actions Completed

- Between October 2002 and January 2004, the county posted at least one advisory sign on Houston Road (Hawkinsville Highway) where it crosses Rocky Creek, advising the public "PCBs Present, Fish at Your Own Risk." The sign also included a fish drawn with the universal NO symbol superimposed over it.
- A Site Investigation of the Armstrong site has been completed under EPA oversight. Soil, surface water, and sediment samples were analyzed to determine what hazardous substances are present at the site, and whether these substances are migrating off-site.
- GDPH developed, distributed, and analyzed community surveys to assess health concerns regarding the Armstrong site.
- The final NPL listing for the Armstrong site was completed in September 2011. This allows for remediation of the site.

Actions Planned

- Under EPA oversight, on-site groundwater will be investigated to determine the extent of site-related contaminants.
- EPA will complete a remediation investigation/feasibility study of the Armstrong site. The total extent of site contamination will be determined.
- Once EPA decides on a remedial solution for the Armstrong site, remediation of the site will begin.
- GDPH will develop a "Polychorinated Biphenyls (PCBs) in Fish" fact sheet specific to the Armstrong site and distribute to residents, community leaders, local fishing and bait shops and other key contacts.
- As additional data become available, GDPH will review the information and take appropriate actions.
- GDPH will respond to all requests for information and health concerns regarding the Armstrong site.

REPORT PREPARATION

This Public Health Assessment for the Armstrong World Industries NPL Site was prepared by the Georgia Department of Public Health 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. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

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FIGURES

Figure 1: Armstrong Facility and Surrounding Area

Figure 2: Fish Sampling Locations

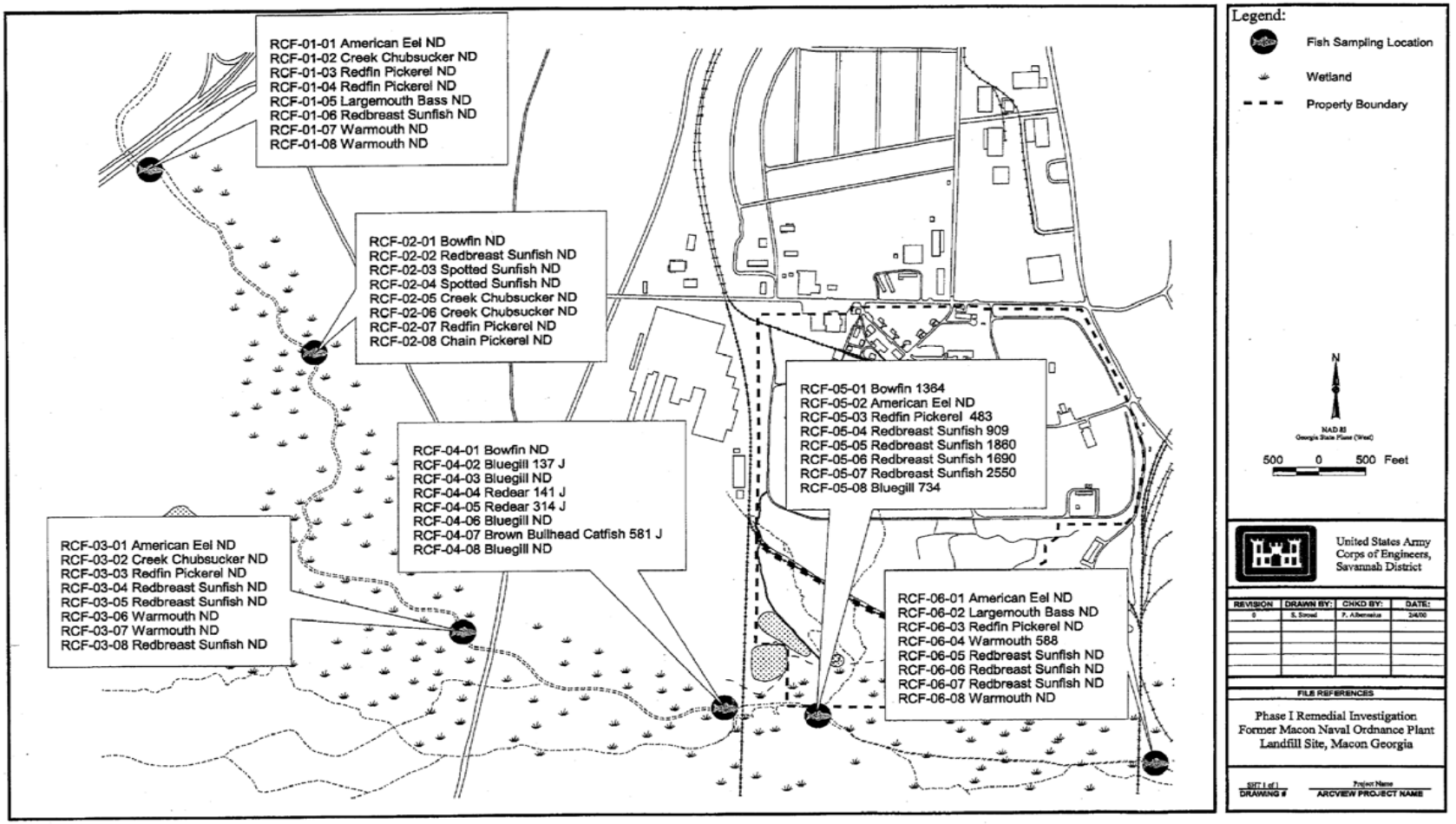
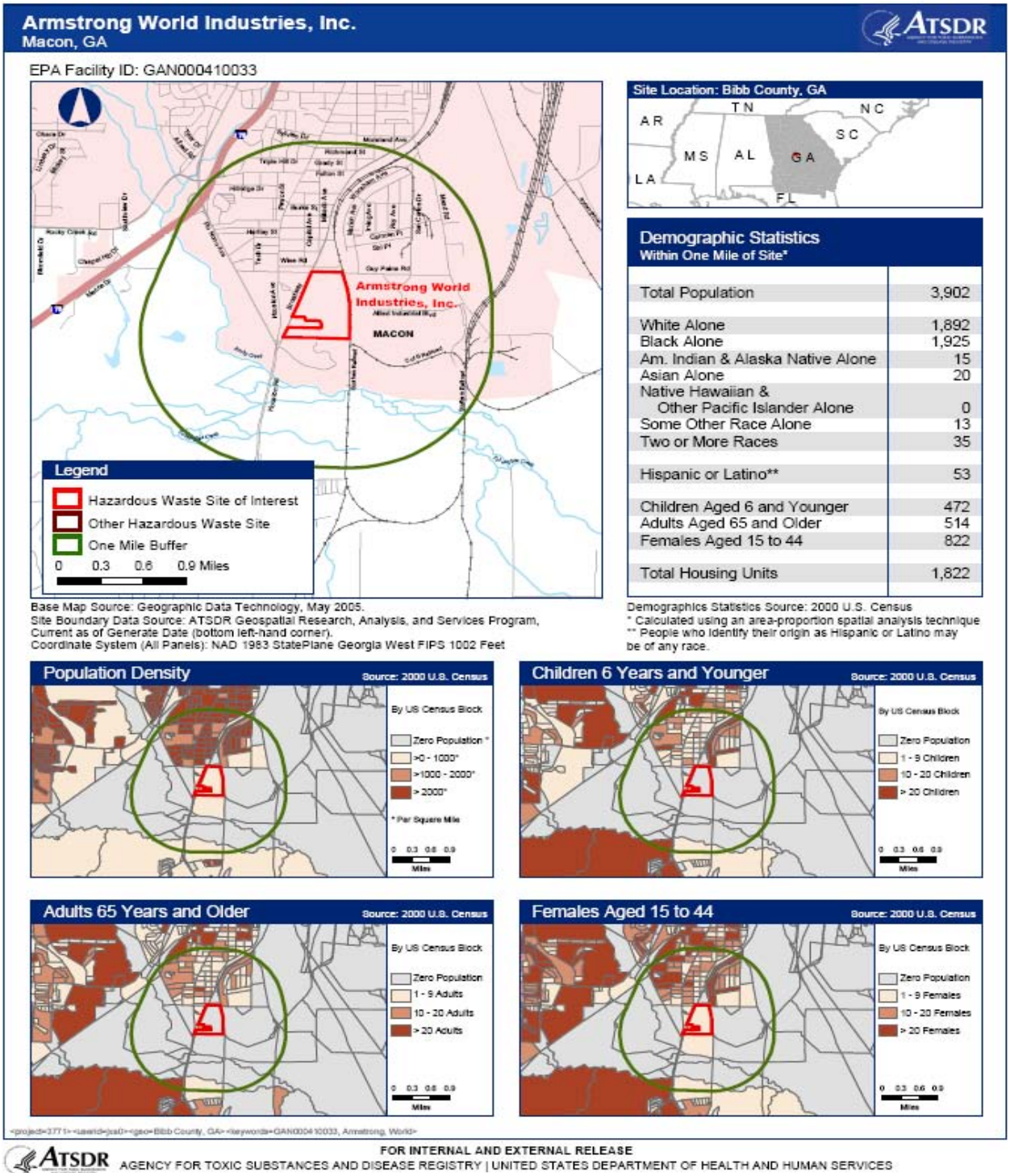


Figure 4-42. Total PCB Concentrnions in Fish (ug/kg)

4-171

Figure 3: Site Location and Demographic Map



APPENDICES

Appendix A: Soil Sampling Locations

Table A.1: Soil Sampling Descriptions

Station ID	Sample ID	Depth (inches bgs)	Location
AIP100	AIP-100-SF	0 to 6	Background location, northeastern corner of the AIP
	AIP-100-SB	12 to 24	
AWI Property			
AWI200	AWI-200-SW	NA	Woodyard landfill, runoff collection pond
	AWI-200-SD	0 to 3	
AWI201	AWI-201-SF	0 to 6	East side of the woodyard landfill
	AWI-201-SB	12 to 24	
AWI202	AWI-202-SF	0 to 6	Southeast side of the woodyard landfill
	AWI-202-SB	12 to 24	
AWI203	AWI-203-SF	0 to 6	Southwest side of the woodyard landfill
	AWI-203-SB	12 to 24	
AWI204	AWI-204-SF	0 to 6	West side of the woodyard landfill
	AWI-204-SB	12 to 24	
AWI205	AWI-205-SF	0 to 6	Northwestern corner of the woodyard landfill
	AWI-205-SF-DUP		
	AWI-205-SB	12 to 24	
	AWI-205-SB-DUP		
AWI206	AWI-206-SD	0 to 3	Woodyard landfill, runoff drainage ditch
AWI207	AWI-207-SF	0 to 6	Southeastern portion of the WWTP landfill
	AWI-207-SB	12 to 24	

Table A.1 continued

Station ID	Sample ID	Depth (inches bgs)	Location
AWI208	AWI-208-SF	0 to 6	Southern portion of the WWTP landfill
	AWI-208-SB	12 to 24	
AWI209	AWI-209-SF	0 to 6	Southern portion of the WWTP landfill
	AWI-209-SB	12 to 24	
AWI210	AWI-210-SF	0 to 6	Southern portion of the WWTP landfill
	AWI-210-SB	12 to 24	
AWI211	AWI-211-SF	0 to 6	Northern portion of the WWTP landfill
	AWI-211-SB	12 to 24	
AWI212	AWI-212-SF	0 to 6	Northwest of the WWTP landfill
	AWI-212-SB	12 to 24	
AWI Remote Landfill			
AWI213	AWI-213-SF	0 to 6	Northern portion of the Armstrong remote landfill
	AWI-213-SB	12 to 24	
AWI214	AWI-214-SF	0 to 6	Southern portion of the Armstrong remote landfill
	AWI-214-SB	12 to 24	
AWI215	AWI-215-SF	0 to 6	Between the Armstrong remote landfill and Rocky Creek
	AWI-215-SB	12 to 24	
AWI216	AWI-216-SF	0 to 6	Between the Armstrong remote landfill and Rocky Creek
	AWI-216-SB	12 to 24	

Identification: AIP: Allied Industrial Park; AWI: Armstrong World Industries; bgs: below ground surface; DUP: Duplicate; SF: Surface Soil; SB: Subsurface Soil; SD: Sediment; SW: Surface Water; WWTP: Waste Water Treatment Plant

Drainage Ditch

Table A.2: Surface Water and Sediment Sampling Descriptions

Station ID	Sample ID	Depth (inches bgs)	Location
Drainage Ditch 1			
DD500	DD-500-SD	0 to 3	Armstrong WWTP drainage
DD501	DD-501-SD	0 to 3	Armstrong drainage just before the ditch leaves the Armstrong property
Drainage Ditch 2			
DD502	DD-502-SD	0 to 3	Background location, AIP western boundary drainage
DD503	DD-503-SD	0 to 3	Background location, AIP boundary drainage
DD506	DD-506-SD	0 to 3	Drainage ditch that receives drainage from AIP and Armstrong
DD507	DD-507-SW	NA	Drainage ditch that receives drainage from AIP and Armstrong
	DD-507-SD	0 to 3	
DD508	DD-508-SW	NA	Drainage ditch that receives drainage from AIP, Armstrong, FMNOL
	DD-508-SD	0 to 3	
DD509	DD-509-SD	0 to 3	Drainage ditch that receives drainage from AIP, Armstrong, FMNOL
DD510	DD-510-SD	0 to 3	Drainage ditch that receives drainage from AIP, Armstrong, FMNOL
Drainage Ditch 3			
DD514	DD-514-SW	NA	Receives drainage from AIP, Armstrong, FMNOL, north of Rocky Creek
DD514	DD-514-SD	0 to 3	Receives drainage from AIP, Armstrong, FMNOL, north of Rocky Creek

Identification: AIP: Allied Industrial Park; bgs: below ground surface; DD: Drainage Ditch; FMNOL: Former Macon Naval Ordinance Landfill; SD: Sediment; SW: Surface Water; WWTP: Waste Water Treatment Plant.

Rocky Creek

Table A3: Surface Water and Sediment Sampling Descriptions

Station ID	Sample ID	Depth (inches bgs)	Location
RC400	RC-400-SW	NA	Background location, upstream, east of Broadway, south branch
	RC-400-SD	0 to 3	
RC401	RC-401-SW	NA	Background location, upstream, east of Broadway, north branch
	RC-401-SD	0 to 3	
RC402	RC-402-SW	NA	Background location, upstream, between Broadway and railroad
	RC-402-SD	0 to 3	
RC403	RC-403-SW	NA	Background location, west of railroad tracks and Armstrong remote landfill
	RC-403-SW-DUP		
	RC-403-SD	0 to 3	
	RC-403-SD-DUP		
RC404	RC-404-SW	NA	East of railroad tracks, south of Armstrong remote landfill
	RC-404-SD	0 to 3	
RC405	RC-405-SW	NA	Downstream from PPE 1
	RC-405-SD	0 to 3	
RC406	RC-406-SW	NA	At PPE 2
	RC-406-SD	0 to 3	
RC407	RC-407-SW	NA	Between PPE 2 and PPE 3
	RC-407-SD	0 to 3	
RC408	RC-408-SW	NA	At PPE 3
	RC-408-SD	0 to 3	
RC409	RC-409-SW	NA	Downstream from PPE 3
	RC-409-SD	0 to 3	

Identification: DUP: Duplicate; bgs: below ground surface; PPE: Probable Point of Entry; RC: Rocky Creek; SD: Sediment; SW: Surface Water

Appendix B: Local Fish Consumption Survey

CHEMICAL HAZARDS PROGRAM
Environmental Health Branch
Georgia Department of Public Health
Atlanta, GA

Phone: 404.657.6534
Fax: 404.657.6533
www.health.state.ga.us/programs/hazards

For Office Use Only
SURVEY ID: _____

COMMUNITY ENVIRONMENTAL HEALTH SURVEY
Macon, Bibb County, Georgia

The Georgia Department of Public Health is working with residents of Bibb County, Georgia to help address their environmental health concerns about the Armstrong World Industries proposed "Superfund" site. This survey is designed to assist in identifying health concerns so that appropriate public health programs are developed for the community.

The purpose of this survey is to collect information about eating fish caught in Rocky Creek, Tobesofkee Creek, and the Ocmulgee River in Bibb County.
Please mail or fax the completed survey to the address or fax number listed at the end of this survey.

The survey can also be completed online at www.health.state.ga.us/programs/hazards.

SURVEY RESULTS WILL BE USED TO ESTABLISH COMMUNITY HEALTH EDUCATION PROGRAMS. ALL REPORTS CREATED USING SURVEY RESULTS WILL NOT CONTAIN ANY PERSONAL IDENTIFIERS SUCH AS NAME OR ADDRESS. THESE REPORTS WILL CONTAIN GROUPED INFORMATION ONLY.

INSTRUCTIONS
Complete one survey for each person in the household. Surveys for minors age 17 and under are to be completed by a parent or guardian. You can refuse to answer any question.

Name _____ Age _____ Are you: Male Female

Complete Address is required *for statistical purposes.*

Address **(Required)**: Street Number and Name _____
(No P.O. Boxes, please)

Address **(Required)**: City _____ State _____ ZIP Code _____

1. Did you or do you catch fish in Rocky Creek? **Yes** **No**
2. Did you or do you catch fish in Tobesofkee Creek? **Yes** **No**
3. Did you or do you catch fish in the Ocmulgee River in Bibb County? **Yes** **No**

4. Did you or do you eat fish caught in Rocky Creek? **Yes** **No**

5. Did you or do you eat fish caught in Tobesofkee Creek? **Yes** **No**

6. Did you or do you eat fish caught in the Ocmulgee River in Bibb County? **Yes** **No**

7. Approximately how often did you or do you eat fish caught in Rocky Creek?

___ Less than once a month
___ About once a month
___ More than once a month
___ About once a week
___ More than once a week
___ I did not and do not eat fish caught from Rocky Creek

8. Approximately how often did you or do you eat fish caught in Tobesofkee Creek?

___ Less than once a month
___ About once a month
___ More than once a month
___ About once a week
___ More than once a week
___ I did not and do not eat fish caught from Tobesofkee Creek

9. Approximately how often did you or do you eat fish caught in the Ocmulgee River in Bibb County?

___ Less than once a month
___ About once a month
___ More than once a month\
___ About once a week
___ More than once a week
___ I did not and do not eat fish caught from the Ocmulgee River

10. How many years have you been eating fish caught from (number of years for all that apply):

_____ Rocky Creek
_____ Tobesofkee Creek
_____ Ocmulgee River in Bibb County
___ I did not and do not eat fish caught from any of these areas

11. Are you aware of the Guidelines for Eating Fish from Georgia Waters? **Yes** **No**

12. Do you follow the Guidelines for Eating Fish from Georgia Waters? **Yes** **No**

13. Would you like a copy of Guidelines for Eating Fish from Georgia Waters? **Yes** **No**

If you would like a copy of the Guidelines for Eating Fish from Georgia Waters mailed to you, please include your mailing address at the top of this survey.

14. What are the best ways to get health information to you? (check all that apply)

___ Fact sheets
___ Newspaper
___ Internet sources
___ Doctor / Healthcare professional
___ Community events
___ Other source (please specify) _____

15. Have you heard of PCBs (polychlorinated biphenyls), a group of chemical compounds? **Yes** **No**

16. Would you like information about PCBs (polychlorinated biphenyls)? **Yes** **No**

17. Have you heard of Armstrong World Industries in south Macon? **Yes** **No**

18. Do you have any health concerns about Armstrong World Industries in south Macon? **Yes** **No**

19. Would you like information about Armstrong World Industries in south Macon? **Yes** **No**

20. Do you have any concerns about environmental contamination in your community? **Yes** **No**
If yes, please describe your concerns:

_____

_____

_____

The following questions are for statistical purposes only.

21. What is your race / ethnicity? Please check all that apply.

___ Black or African American
___ White or Caucasian
___ Hispanic / Latino
___ Asian
___ Multiracial
___ Other (Please Specify) _____

22. What is the primary language spoken in your home? _____

23. How many years have you lived in Bibb County? _____

24. What is the highest level of education you have completed?

___ Less than High School
___ High School / GED
___ Some College
___ Technical School / Associates Degree
___ 4-year College Degree (BA, BS)
___ Graduate / Professional Degree

Please use this space to ask questions or describe any concerns you have:

THANK YOU FOR YOUR TIME AND PARTICIPATION.

THIS SURVEY MAY BE COPIED

Please return completed survey(s) by **August 15, 2011** to:

Chemical Hazards Program
Georgia Department of Public Health
2 Peachtree Street, NW 13th Floor
Atlanta, Georgia 30303

404-657-6533 (fax)

Appendix C: Explanation of Evaluation Process

Step 1--The Screening Process

In order to evaluate the available data, GDPH 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) 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, or EPA's reference concentrations for ingestion and 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 site contaminants. A brief explanation of the calculation of estimated exposure doses used in this PHA are presented below.

Consumption of contaminants present in redbreast sunfish caught in Rocky Creek south and southeast of the Armstrong site sources of contamination. Exposure doses for the consumption of contaminants present in fish were calculated using the measured concentration of PCBs in milligrams per kilogram (mg/kg) of fish tissue. The following equation is used to estimate the exposure doses resulting from ingestion of contaminated fish:

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

where;

ED_F = exposure dose from eating fish (mg/kg/day)
C = contaminant concentration (mg/kg)
IR = intake rate of contaminated medium (based on the 95th percentile nationwide for recreational freshwater anglers, which is 25,000 mg/kg/day or approximately 6 ounces per week).
AF = bioavailability factor. The bioavailability factor used for this analysis was 0.5. This is to account for a 50% loss of PCBs in fish after fat trimming and cooking methods are taken into account.
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 one. This is the most conservative exposure factor assuming exposure is occurring 24 hours per day, 7 days per week.
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (based on average for an adult; and a child): 70 kg; 16 kg

For example, the following is an estimated exposure dose for an adult recreational fisher eating fish with a PCB concentration of 2.55 mg/kg:

$$ED_F = \frac{2.55 \text{ mg/kg} \times 25{,}000 \text{ mg/day} \times 0.5 \times 1 \times 10^{-6} \text{ kg/mg}}{70 \text{ kg}}$$

$$= 0.00045 \text{ mg/kg/day}$$

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[5]) or an EPA reference dose, 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, MRLs 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 MRL, the exposure is unlikely to result in non-cancer health effects. If the calculated exposure dose is greater than the MRL, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA.

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 a theoretical 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 theoretical 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

Exposure Dose x CSF x years of exposure/70 years

Therefore,

Adult Cancer Risk = 0.00045 mg/kg/day x 2.0 $(mg/kg/day)^{-1}$ for PCBs x 40/70
= 5.14×10^{-4}

[5] **Minimal Risk Levels (MRLs)** are developed by ATSDR for contaminants commonly found at hazardous waste sites. The MRL is developed for ingestion and inhalation exposure, and for lengths of exposures: acute (less than 14 days); intermediate (between 15-364 days), and chronic (365 days or greater). ATSDR has not developed MRLs for dermal exposure (absorption through skin).

APPENDIX D: Glossary of Terms

This glossary defines words used by GDPH in communications with the public. It is not a complete dictionary of environmental health terms.

General Terms

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

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

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

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

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

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

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

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

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

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

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

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

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

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.
Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.
Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.
Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.
CAP [see Community Assistance Panel.]
Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.
Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.
Carcinogen
A substance that causes cancer.
Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.
Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.
CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.
Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.
CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]
Chronic
Occurring over a long time [compare with acute].
Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]
Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.
Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide

information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

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

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration

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

Contaminant

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

Delayed health effect

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

Dermal

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

Dermal contact

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

Descriptive epidemiology

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

Detection limit

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

Disease prevention

Measures used to prevent a disease or reduce its severity.

Disease registry

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

DOD

United States Department of Defense.

DOE

United States Department of Energy.

Dose (for chemicals that are not radioactive)

The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed

dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

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

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

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

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

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

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

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

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

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

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

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

Exposure registry
A system of ongoing follow-up of people who have had documented environmental exposures.

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

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data.

For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds

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

Groundwater

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

Half-life (t½)

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

Hazard

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

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

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

Health consultation

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

Health education

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

Health investigation

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

Health promotion

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

Health statistics review

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

Indeterminate public health hazard

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

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].
Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].
Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].
In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].
In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].
Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.
Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.
Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.
Metabolite
Any product of metabolism.
mg/kg
Milligram per kilogram.
mg/cm2
Milligram per square centimeter (of a surface).
mg/m3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.
Migration
Moving from one location to another.
Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].
Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.
Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).
Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.
National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.
National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.
No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.
No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.
No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.
NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]
Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.
Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.
Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.
Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].
Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).
Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.
ppb
Parts per billion.
ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].
Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.
Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.
Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.
Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.
Public health action
A list of steps to protect public health.
Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.
Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].
Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.
Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.
Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.
Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.
Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.
Radionuclide
Any radioactive isotope (form) of any element.
RCRA [see Resource Conservation and Recovery Act (1976, 1984)]
Receptor population
People who could come into contact with hazardous substances [see exposure pathway].
Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.
Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].
Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.
Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.
RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.
RfD [see reference dose]
Risk
The probability that something will cause injury or harm.
Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.
Risk communication
The exchange of information to increase understanding of health risks.
Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
Safety factor [see uncertainty factor]
SARA [see Superfund Amendments and Reauthorization Act]
Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.
Sample size
The number of units chosen from a population or an environment.
Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).
Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.
Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.
Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.
Substance
A chemical.
Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.
Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)
Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.
Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].
Surveillance [see public health surveillance]
Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].
Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].
Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.
Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.
Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological

profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology

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

Tumor

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

Uncertainty factor

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

Urgent public health hazard

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

Volatile organic compounds (VOCs)

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