Health Consultation

POLYCHLORINATED BIPHENYL (PCB)
CONTAMINATION: TAKU GARDENS
FORT WAINWRIGHT, ALASKA

April 26, 2010

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

Health Consultation: A Note of Explanation

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

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

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HEALTH CONSULTATION

POLYCHLORINATED BIPHENYL (PCB)
CONTAMINATION: TAKU GARDENS

FORT WAINWRIGHT, ALASKA

Prepared By:

Site and Radiological Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency (EPA) and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high-risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate the possible health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments related to the document are addressed in the final version of the report.

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.
Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Manager, ATSDR Record Center Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (F-09), Atlanta, GA 30333.

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Acronyms

ADEC	Alaska Department of Environmental Conservation
ATSDR	Agency for Toxic Substances and Disease Registry
CEL	cancer effect levels
DHHS	Department of Health and Human Services
EPA	U.S. Environmental Protection Agency
IARC	International Agency for Research on Cancer
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilograms per day
MRL	minimal risk level
PCB	polychlorinated biphenyl
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
USACE	U.S. Army Corps of Engineers

I. Summary

INTRODUCTION The Agency for Toxic Substances and Disease Registry (ATSDR) recognizes your need for more information about potential past exposures to polychlorinated biphenyls (PCBs) in the Taku Garden area. Our primary objective in writing this health consultation is to provide you with the information you need to protect your health.

Background In April 2005, construction of the 54-acre Taku Gardens housing development began in an area that formerly included a community garden in the southwest corner. In June 2005, workers noted a solvent-like odor when excavating the foundation for Building 52. During subsequent 2005 and 2006 site investigations, a "hot spot" of PCB-contaminated soil (with concentrations as high as 111,000[1] milligrams per kilogram [mg/kg]) was identified near the footprint of Building 52. Low levels of PCBs (or no PCBs) were detected at the remainder of the site.

Through the health assessment process, ATSDR determined that people who gardened in the former community garden in the past and the construction workers who excavated Building 52's foundation are the main receptor populations potentially exposed to PCB contamination at Taku Gardens.

The garden area was intermittently used from 1954 to 2005. According to historical photos, the western portion of the garden area became overgrown in 1967. It was in this western portion that the hot spot was located. Therefore, high levels of PCBs were not located within the garden area that existed from 1967 to 2005.

CONCLUSIONS ATSDR reached five important conclusions in this health consultation:

Conclusion 1 People who gardened in the community garden between 1954 and 1967 might have been exposed to PCB contamination through incidental (accidental) ingestion of contaminated soil, dermal contact with the soil while gardening, and ingestion of produce grown in PCB-contaminated soil. If people gardened where the highest levels of PCBs were detected, exposures could have resulted in harmful noncancer health effects (e.g., dermatological, neurological, hepatic, or gastrointestinal effects). In addition, eating produce grown in soil that was highly contaminated with PCBs could have resulted in exposure to harmful levels of PCBs.

[1] The *2007/2008 Former Communications Site Drum And Debris and PCB Remedial Investigation* (Jacobs 2009) noted that past environmental sampling indicated that PCB concentrations as high as 119,000 mg/kg were detected in the soil. However, this higher concentration could not be verified in the original reports.

Harmful health effects are not expected for people who gardened outside the hot spot area and did not eat produce grown in the highly contaminated area. Harmful health effects are also not expected for people who gardened in the community garden after 1967. An increase in cancer incidence is not expected regardless of where or when a person gardened.

Basis for Conclusion

A person's exposure is dependent on where his/her garden was located. If a person's garden was located in the area with the highest levels of PCB contamination, his/her exposure could have resulted in harmful noncancer health effects. If a person's garden was not located within the hot spot, he/she would not have been exposed to elevated levels of PCBs, and thus no harmful health effects would have resulted.

A person's exposure is also dependent on when the person gardened. Only people who gardened in the community garden from 1954 to 1967 had the potential to garden in the area where the hot spot was located. If a person gardened in the community garden area after 1967, it was not possible for his/her garden to be located within the hot spot.

In general, eating produce grown in soil contaminated with low levels of PCBs is not expected to result in harmful health effects because uptake of PCBs through the roots is limited. However, if someone ate produce grown in highly contaminated soil, such as the hot spot, it could have resulted in the person being exposed to harmful levels of PCBs.

Conclusion 2

Constructions workers may have been acutely exposed to high levels of PCB contamination when they were excavating the foundation for Building 52 in 2005.

Basis for Conclusion

In June 2005, during the excavation of the foundation for Building 52, workers noted a solvent-like odor. As soon as the contamination was confirmed, construction workers were evacuated from the site and appropriate precautions to prevent further exposures were implemented. Workers were taken to Fairbanks Memorial Hospital and offered screening for PCBs. Because the U.S. Army Corps of Engineers (USACE) worked with the construction workers on their exposure issues, ATDSR is assuming that all appropriate medical follow-up and care were given to the workers.

Conclusion 3

ATSDR does not expect that adjacent residents were exposed to harmful levels of dust-borne PCB contamination during construction and remedial activities.

Basis for Conclusion	The safety of nearby residences was the primary focus of activities conducted in 2005. Extensive sampling of outdoor recreational equipment, the fence fabric, units within the adjacent housing complex, the perimeter air, soil at the gate entrances, stockpiled soil, and flower pots confirmed that PCBs were not spread off site. Further, protective measures, such as continually spraying water on dry surfaces, were implemented to control off-site contamination.
Conclusion 4	No one is currently being exposed to harmful levels of contamination at Taku Gardens.
Basis for Conclusion	Institutional controls are in place to prevent exposure. Access to the Taku Gardens housing development is restricted and remedial activities have removed PCB-contaminated soil.
Conclusion 5	As long as the site is adequately characterized and all necessary remediation is completed, ATSDR does not expect that future residents of Taku Gardens will be exposed to harmful levels of PCBs.
Basis for Conclusion	The housing units will not be occupied until USACE, the Alaska Department of Environmental Conservation (ADEC), and the U.S. Environmental Protection Agency (EPA) agree that the site is safe for residential occupation.
NEXT STEPS	If you gardened in the community garden between 1954 and 1967, and you think your garden plot was located in the southwest corner near where the area of highest PCB contamination was detected, talk to your physician about taking an exposure history (especially if you experienced skin irritation).
FOR MORE INFORMATION	If you have questions or comments, you can call ATSDR toll-free at 1-800-CDC-INFO and ask for information on the Fort Wainwright: Taku Gardens site. Detailed information about the toxicology of PCBs is available in ATSDR's Toxicological Profile for PCBs at http://www.atsdr.cdc.gov/toxprofiles/tp17.html.

II. Purpose and Health Issues

The purpose of this public health consultation is to determine whether people were exposed in the past, are currently being exposed, or will be exposed in the future to harmful levels of PCBs[2] in the soil of the Taku Gardens housing development.

- People who gardened in the community garden in the southwest corner of the site in the past might have been exposed to PCB contamination through (1) incidental ingestion of contaminated soil, (2) dermal contact with the soil while gardening, and (3) ingestion of produce grown in PCB-contaminated soil. The construction workers, who were excavating the foundation for Building 52 in 2005, may have been exposed to PCB-contaminated soil. Residents living in the adjacent housing development may have also been exposed to low levels of PCBs during construction and remedial activities.

- No one is currently being exposed to harmful levels of contamination at the Taku Gardens construction site. Access to the site is restricted by a fence and institutional controls are in place to prevent exposure.

- Future residents of Taku Gardens are not expected to be exposed to harmful levels of contamination. Institutional controls dictate that the housing units not be released for residential occupation until USACE, ADEC, and EPA agree that Taku Gardens is safe.

What are PCBs?

PCBs are a group of synthetic organic chemicals that can cause a number of different harmful effects. There are no known natural sources of PCBs in the environment. Because they don't burn easily and are good insulating materials, PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the United States in August 1977, because there was evidence that PCBs build up in the environment and may cause harmful effects (ATSDR 2000).

PCBs enter the environment as mixtures containing a variety of individual chlorinated biphenyl components, known as congeners. There are 209 possible PCB congeners. Aroclors are commercial PCB mixtures, containing different congener compositions. Aroclors widely used in the United States were 1016, 1232, 1242, 1248, 1254, and 1260. The first two digits indicate the type of mixture and second two digits reveal how much chlorine by weight is in the mixture. Toxicity is highly associated with the amount of chlorine in the congener.

[2] Other contaminants (e.g., volatile organic compounds) have been detected in the soil and groundwater of the Taku Gardens housing development (CH2MHILL 2008b). ATSDR was asked to specifically evaluate potential exposures to PCBs, which is the focus of this health consultation.

III. Background

Taku Gardens is a (future) housing development located between Alder and Neely roads, east of White Street, and west of the Fort Wainwright Power Plant (see Figure 1) (CH2MHILL 2008b). The 54-acre construction site is located in an area known as the Former Communication Site within the main post of Fort Wainwright (OASIS 2007). Fort Wainwright is an active army installation in Fairbanks North Star Borough, Alaska.

> ATSDR completed a public health assessment on Fort Wainwright in September 2003 (see http://www.atsdr.cdc.gov/HAC/pha/fortwainwright/wai_toc.html).

In 2002–2003, the Former Communication Site was selected as a future military family housing area. Before construction began, an Environmental Assessment, two Geophysical Surveys, two Geotechnical Surveys, and two Chemical Surveys were performed by the Army, USACE, and their contractors (OASIS 2007).

Prior to the construction of the housing units in April 2005, the Former Communication Site was in a relatively natural state (OASIS 2007). The northern portion of the site was cleared and used to store snow. The remainder of the site was vegetated with a dense cover of second or third growth alder, aspen, scattered spruce, and birch. Several trails passed through the site and a community garden[3] was located in the southwest corner (USACE 2004).

In June 2005, during the excavation of the foundation for Building 52 (located within Subarea E), workers noted a solvent-like odor. Ensuing investigations discovered high levels of PCBs in the soil. Construction activities were halted and environmental investigations began. The source of the PCB contamination is believed to be related to leaking transformer(s), inadequate storage and disposal of transformers, and other historical installation activities (OASIS 2007). According to historical records, Subarea E housed U.S. Air Force communications operations in the 1950s (CH2MHILL 2008b; North Wind 2006).

In July 2005, an Army contractor (North Wind) conducted an emergency site investigation and collected soil samples near the footprint of Building 52. PCBs (specifically Aroclor 1260) were detected in the soil at concentrations as high as 111,000 mg/kg[4] (OASIS 2007). During this summer/fall 2005 field investigation (North Wind 2006), the contractor collected surface and subsurface soil samples from across the construction site, soil piles, a nearby residential building (Building 4394), three permanent groundwater monitoring wells, and seven temporary groundwater monitoring wells. The contractor also collected surface wipe samples from four outdoor recreational areas, adjacent residences, and on-site construction equipment remaining after workers were evacuated in August 2005. Low levels of PCBs were detected across the entire site at depths ranging from 0–96 inches (North Wind 2006). However, the only areas where PCBs were detected above EPA and ADEC cleanup criteria (1 mg/kg) during this

[3] Used by personnel stationed at Fort Wainwright (North Wind 2006).

[4] The *2007/2008 Former Communications Site Drum And Debris and PCB Remedial Investigation* (Jacobs 2009) noted that past environmental sampling indicated that PCB concentrations as high as 119,000 mg/kg were detected in the soil. However, this higher concentration could not be verified in the original reports.

investigation were within the “exclusion zone” in the southwest corner of the construction site, with the highest levels near Building 52 (North Wind 2006; OASIS 2007). Most of the PCBs were identified as Aroclor 1260; a few results were identified as Aroclor 1254 (North Wind 2006).

> The “exclusion zone” is the approximately 5-acre area where Buildings 50 through 59 were supposed to be constructed. However, the Army no longer plans to build these units (CH2MHILL 2008b; OASIS 2007).

In August 2005, the exclusion zone was secured with a chain-link fence and signs were posted to warn on-site personnel that this area was contaminated with PCBs (North Wind 2006). North Wind also installed additional fencing around the (non-continuous) perimeter fence of the Taku Gardens housing project to secure the entire site.

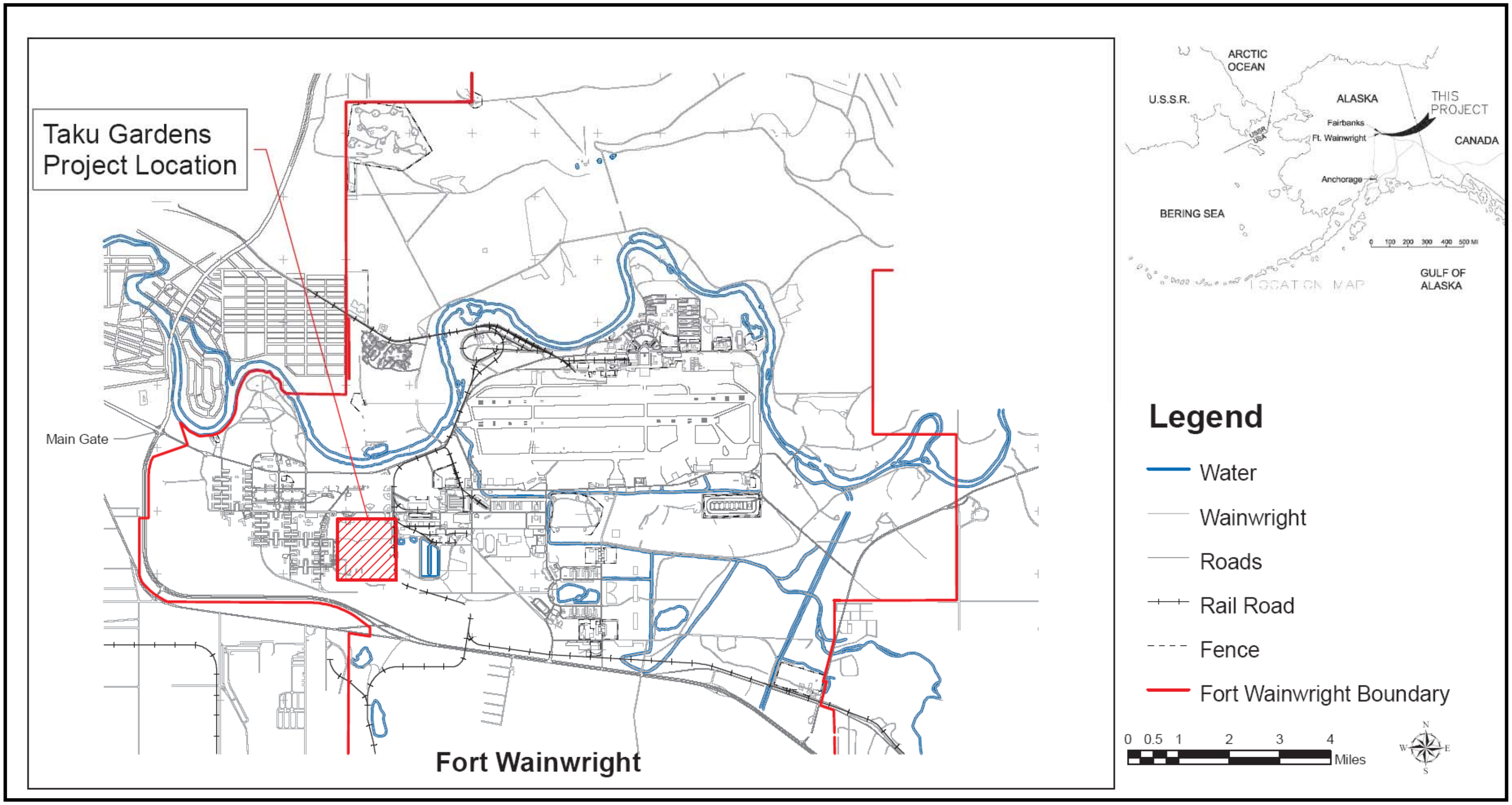
In September 2005, Fort Wainwright Directorate of Public Works removed 230 cubic yards of PCB-contaminated soil from the location of Building 52 to an approved off-site facility (OASIS 2007). Stockpiled soil from Building 54’s excavation was used to fill in Building 52’s excavated area so that snow and rainwater would not accumulate during the winter and spring thaw (North Wind 2006). During the removal action, air monitoring samples were collected from on-site personnel and from the perimeter near the housing area to the west of the construction site. PCBs were not detected in any of the air samples (North Wind 2006; OASIS 2007).

During the summer and fall of 2006, North Wind conducted a preliminary source evaluation of the Taku Gardens site to provide sufficient information to determine appropriate follow on action (North Wind 2007). One of the primary objectives of this investigation was to look for large PCB contaminated source areas, in addition to the known contaminated area near Building 52. Soil from two additional areas were tested for PCBs—(1) a former Transformer Service Area located east of Building 26 near the current border of the Taku Gardens site and (2) the Southern Sound Berm, which is a large stockpile of soil located in the southeastern side of the Taku Gardens site. Substantial PCB contamination was found to be primarily limited to a 60 by 90 foot area near the Building 52 excavation (North Wind 2007).

In the summer of 2007, the entire 54-acre Taku Gardens site was fenced (CH2MHILL 2008b). As part of the Remedial Investigation and Feasibility Study, a contractor for USACE (CH2MHILL) removed PCB-contaminated soil from the exclusion zone in September–October 2007 (CH2MHILL 2008a). Excavation occurred in areas identified by previous investigations and continued until screening samples were less than 1 mg/kg. Soil with PCB concentrations greater than 10 mg/kg was shipped to a Resource Conservation and Recovery Act (RCRA) treatment, storage and disposal facility. Soil with PCB concentrations less than 10 mg/kg (about 10,500 cubic yards) was disposed of in the Fort Wainwright landfill (ADEC 2009a). Confirmation samples were collected and sent to a laboratory for analysis to determine whether additional soil removal was needed. Three confirmation samples at the Building 52 area exceeded the 1 mg/kg cleanup level for PCBs (values were 1.4, 9.2, and 15 mg/kg) (CH2MHILL 2008b).

From August 2007 to October 2008, Jacobs Engineering Group Inc. performed a Drum and Debris and PCB Remedial Investigation at Taku Gardens (Jacobs 2009). One of the primary objectives of the Remedial Investigation was to remove known areas of PCB contamination and ensure that the areas surrounding the excavation did not exceed 1 mg/kg. The investigation was conducted mainly in the exclusion zone (primarily around Building 52), however, some soil was also removed from the former Transformer Service Area (116 cubic yards of PCB-contaminated soil was removed from this area). During the Remedial Investigation, 1,168 tons of Toxic Substances Control Act-regulated PCB-contaminated soil (i.e., with concentration greater than 50 mg/kg) and 691 tons of nonregulated PCB-contaminated soil (i.e., with concentrations greater than 10 mg/kg, but less than 50 mg/kg) was removed and shipped to an approved off-site facility for disposal. Additionally, about 1,900 cubic yards of PCB-contaminated soil with concentrations less than 10 mg/kg was removed and disposed of in the Fort Wainwright Landfill (Jacobs 2009). After excavation was complete, the PCB exclusion zone fence was removed (ADEC 2009a).

Figure 1. Location of Taku Gardens



Source: North Wind 2007

IV. Discussion

IV.A. Past Exposures

People gardening in the community garden between 1954 and 1967 and construction workers excavating Building 52's foundation in 2005, are the main receptor populations exposed to PCB contamination at Taku Gardens. Adjacent residents could also have potentially been exposed during construction and remedial activities. It is unlikely that any other past exposure scenarios would have resulted in people being exposed to harmful levels of site-related contamination. Prior to construction of the housing development, the northern portion of the site was cleared for snow storage and the southern portion was densely vegetated. People may have occasionally walked the trails that traversed the site; however, this kind of exposure would be too infrequent and insignificant to present a health hazard.

IV.A.1. People Gardening

People who gardened in the community garden in the southwest corner of the site in the past (between 1954 and 1967) might have been exposed to PCB contamination through (1) incidental ingestion of contaminated soil, (2) dermal contact with the soil while gardening, and (3) ingestion of produce grown in PCB-contaminated soil. According to historical photos, the community garden was in use as early as 1954. However, gardening in this area may have been intermittent since aerial photos from 1959 show that the garden area was overgrown (OASIS 2007). In 1967, the western portion of the garden area became overgrown—that portion of the community garden does not appear to have been in use since. People reported gardening in the community garden as recently as 2000 (John Bunten, Alaska Department of Environmental Conservation, personal communication, November 28, 2007), and the community garden was present during the geotechnical survey in 2004 (USACE 2004). Figure 2 shows a series of historical maps of the former community garden area.

As will be discussed below, it is in the western portion of the former community garden area that the "hot spot" of PCB contamination was located. Figure 3 shows the location of the hot spot in relation to the community garden area in 1964 and from 1996 to 1999. It is very important to note that the community garden has not extended into the area where the hot spot was located since 1967 (OASIS 2007).

Figure 2. Historical Photos of the Former Community Garden Area

Source: OASIS 2007

Figure 3. Location of the "Hot Spot" of PCB Contamination

Extent of Contamination

During the summer and fall 2005 field investigation (North Wind 2006), over 900 soil samples and 136 wipe samples were tested for PCBs. In addition, 765 soil samples were field screened with the Ensys test kit to determine Aroclor 1260 levels. Samples were collected around each of the building foundations (four soil borings and six surface samples), trench side walls, surface of high traffic areas, surface of recreation and construction equipment, surface of the fabric covering the perimeter fence, and stockpiled soil. Low levels of PCBs were detected on recreational equipment located inside the fenced area; in soil samples collected near Areas 50, 51, 52, 54, and 56; in stockpiled soil near Areas 50, 52, and 54; and in soil samples collected near the area where outdoor recreational equipment was staged. The highest levels of contamination were found in the Building 52 excavation and stockpiled soil. The only areas outside of Building 52's excavation area with PCB concentrations greater than the cleanup criteria (1 mg/kg) include one surface sample collected from the traffic area between Building 52 and Building 54 (6.8 mg/kg), two surface samples collected from the soil near the recreational equipment area (2.42 mg/kg and 1.44 mg/kg), and one sample collected from the soil excavated from Building 54 (2.45 mg/kg) (North Wind 2006).

> The USACE, Directorate of Public Works, ADEC, and EPA were continually updated as analytical data were received (North Wind 2006).

> There was some concern that workers had tracked PCB-contaminated soil outside of the exclusion zone. To test for this, samples were collected from surfaces of high traffic areas and from outside the north and south gate entrances during the 2005 field activities (North Wind 2006).

In June 2005, PCBs were not detected in three soil samples collected from the bottom of the excavation of Building 52 (depth: 38–52 inches). A second round of sampling in July 2005 detected the presence of PCB contamination in the Building 52 stockpiles and excavation. The highest levels of Aroclor 1260 were detected at depths of 0–2.5 feet (111,000 mg/kg), and decreased with increasing depths (highest level at 2.5–6 feet = 4,830 mg/kg; highest level at 6–8.5 feet = 35.7 mg/kg; highest level at 8.5–11 feet = 0.658 mg/kg). The second highest level (59,000 mg/kg) was detected in a stockpile near the Building 52 excavation (North Wind 2006).

During the summer and fall 2006 field investigation (North Wind 2007), approximately 460 surface and subsurface soil samples were collected from 156 borings within the exclusion zone. The samples were screened[5] for PCB contamination using HACH field test kits, which can conservatively screen areas of contamination greater than 1 mg/kg. A few samples were sent to a laboratory for analysis. The results indicate that PCB soil contamination is primarily limited to an approximately 60 by 90 foot area[6] near where Building 52 was to be built. Six smaller, isolated areas of contamination (1–5 mg/kg) may exist to the north and west of this area, but because the field test method is known to produce false positives, additional sampling is required

[5] The report states that "because field screening methods are semi-quantitative and yield occasional false positive detections, contaminated areas targeted by field screening should be further investigated using fixed laboratory analysis to verify detections and to quantify contaminant concentrations" (North Wind 2007).

[6] The report notes that the investigation was designed to identify large hot spots; "these results should not be used to attempt to delineate the known contamination area with any resolution" (North Wind 2007).

to verify the detections. Aroclor 1260 was detected (0.51–1.23 mg/kg) in one soil pile located immediately adjacent to the exclusion zone. This soil pile was assumed to be comprised of topsoil from the Building 52 excavation (North Wind 2007).

During the 2007/2008 PCB Remedial Investigation (Jacobs 2009), the excavated soil as well as the soil surrounding the excavated areas, was tested to ensure all soil with PCB concentrations above the cleanup criteria (1 mg/kg) was removed from the site. All concentrations detected outside of the exclusion zone were below 10 mg/kg, many were below 1 mg/kg. The highest PCB concentration detected outside the exclusion zone was 9.14 mg/kg from an area just north of the exclusion zone (Jacobs 2009).

Health Evaluation of Incidentally Ingesting Contaminated Soil

During typical behavior patterns, people incidentally (i.e., accidentally) ingest soil when they eat non-washed homegrown produce, smoke a cigarette, or put their fingers in their mouths because soil or dust particles can adhere to produce, cigarettes, and hands. As a result of a normal phase of childhood in which they display hand-to-mouth behavior, children are particularly sensitive because they are more likely to ingest more soil than adults.

The past investigations were not designed to characterize the extent of PCB contamination in the former community garden, so it is difficult to accurately estimate potential exposures. The information presented in the 2005 and 2006 field investigation reports (North Wind 2006; North Wind 2007) shows clearly that there was a “hot spot” of contamination about 60 x 90 feet in size, and that there was very little PCB contamination outside of this area. The historical photos indicate that, after 1967, the community garden plots did not extend into the area where the highest levels of PCBs were detected. Prior to 1967, the hot spot was located in the southwest corner of the former community garden area (see Figure 3). If people gardened in this specific area between 1954 and 1967, they could have been exposed to high levels of PCB contamination in the soil. Incidentally ingesting soil with the highest level of PCBs could have resulted in harmful noncancer health effects. However, no PCBs or very low levels of PCBs were detected in the majority of the former community garden area. Incidentally ingesting soil outside of the hot spot would not have resulted in harmful health effects. Based on a review of studies evaluating cancer effects, ATSDR does not think that cancer is a likely health outcome for people exposed to PCBs in the soil of the former community garden, even those who may have gardened in the hot spot.

Detailed information is not available about past gardening practices. This information would help ATSDR more accurately evaluate the magnitude of exposure to PCBs in garden soil. Due to this uncertainty, ATSDR chose to use very conservative assumptions about exposure to PCBs from past gardening practices that would likely overestimate exposures. For example, ATSDR assumed people gardened 7 days a week throughout the growing period, gardened annually for 14 years at the same location, consistently contacted the most contaminated area, and that all the PCBs in the soil were absorbed into the body. See Appendix B for more information on how ATSDR evaluated exposure to PCBs in soil.*Health Evaluation of Dermal Exposure to Contaminated Soil*

Skin contact with contaminated soil represents a potential route of exposure to PCBs for people who gardened in the PCB-contaminated area without gloves between 1954 and 1967. As noted above, there was a "hot spot" of contamination about 60 x 90 feet in size, and very little PCB contamination outside of this area (North Wind 2006; North Wind 2007). The hot spot was co-located with the southwest corner of the former community garden area from 1954 to 1967 (see Figure 3). If people gardened in this specific area, during that time frame, they could have been exposed to high levels of PCB contamination in the soil. Dermal exposure to soil with the highest level of PCBs could have resulted in harmful noncancer health effects. However, since no PCBs or very low levels of PCBs were detected in the majority of the former community garden area, dermal exposure to the soil outside of the hot spot would not have resulted in harmful health effects. Based on a review of studies evaluating cancer effects, ATSDR does not think that cancer is a likely health outcome for people dermally exposed to PCBs in the soil of the former community garden, even those who may have gardened in the hot spot. See Appendix B for information on how ATSDR arrived at these conclusions.

How can I tell if I was exposed?

There are a couple ways you might be able to determine whether you were exposed to high levels of PCBs in the soil at the former community garden.

- Remember when you gardened in the community garden. If it was after 1967, you were not exposed to high levels of PCBs in the soil.
- If you gardened in the community garden between 1954 and 1967, look at Figure 3 and determine whether your garden area was located in the "hot spot" in the southwest corner of the former community garden. If your garden was not located in this area, you were probably not exposed to high levels of PCBs in the soil.
- Think about whether you noticed a solvent-like odor when you were gardening. When the construction workers were excavating for Building 52, they noticed a solvent-like odor. If you gardened in the hot spot, it is likely that you might have also noticed a similar odor.
- The most easily recognized effect of exposure to PCBs is chloracne (a skin condition resembling acne) (Rice and Cohen 1996), and its presence is indicative of exposure. Therefore, if you were exposed to high levels of PCBs in the soil, you might have developed this condition. However, the absence of this condition does not preclude exposure (ATSDR 2000).

Health Evaluation of Ingestion of Produce Grown in Contaminated Soil

PCBs can accumulate in terrestrial vegetation grown in contaminated soil. PCBs can also adhere to the outer surfaces of plants, especially root crops such as carrots and potatoes. However, without actual produce samples, it is very difficult to evaluate whether people who ate produce grown in the former community garden ingested harmful levels of PCBs. There are many factors that affect the uptake of PCBs into vegetation from the soil, such as the type of crop. Also, PCBs partition differently to various parts of the plant (e.g., roots, stems, leaves).

Generally, vegetation grown in soil with low levels of PCBs would not accumulate high enough amounts of PCBs to cause harmful health effects in people who eat them. Strong sorption of PCBs to soil organic matter and clay inhibits the uptake of PCBs in vegetation through the roots

(Bacci and Gaggi 1985; Chu et al. 1999; Gan and Berthouex 1994; Paterson et al. 1990; Strek et al. 1982; Webber et al. 1994; Ye et al. 1992). Bioaccumulation factors of PCBs from soil are estimated to be <0.02 for most terrestrial plant species (Cullen et al. 1996; O'Connor et al. 1990; Pal et al. 1980). Therefore, ATSDR does not expect that people who consumed produce grown outside of the hot spot would have experienced harmful health effects.

A study conducted for the Department of Energy found that PCBs at concentrations of 40-1000 mg/kg were toxic to plants (Efroymson et al. 1997). The PCB concentration at the hotspot was 111,000 mg/kg, exceeding the phytotoxic level in the aforementioned study by more than two orders of magnitude (greater than 100 times). This implies that produce might not have even grown in the soil in the hotspot. However, because the levels of PCBs detected in the hot spot were so high (potentially resulting in the accumulation of high levels of PCBs in produce), it is possible that people who ate produce from this area between 1954 and 1967 could have been exposed to harmful levels.

IV.A.2. Construction Workers

Construction workers excavating the foundation for Building 52 noted a solvent-like odor in June 2005. Initial soil samples collected in June 2005 did not detect PCBs. After additional samples collected in July 2005 confirmed the presence of high levels of PCBs (up to 111,000 mg/kg), construction workers were evacuated from the Taku Gardens construction site (in August 2005) to control soil and contamination movement and limit potential personal exposure (North Wind 2006; OASIS 2007). Environmental field investigation workers were brought on site to screen soil for PCBs so construction activities could continue.

- Construction equipment was required to remain on site until surface wipe samples were collected and analyzed. Equipment with a positive PCB result (regardless of level) was decontaminated before it was used again at the site. Only two pieces of construction equipment had detectable levels of PCBs (less than 10 µg/wipe), and required decontamination (North Wind 2006). Each wipe covered 100 cm^2.

- After construction activities were allowed to resume, the construction contractor collected a soil sample for every 100 feet of excavation performed. Only three samples tested positive for PCBs, and the results in these samples were all less than the cleanup criteria of 1 mg/kg (concentrations ranged from 0.0239 to 0.274 mg/kg) (North Wind 2006).

The safety of on-site workers and nearby residences was the primary focus in 2005. To protect site workers and nearby residences, dust control measures were implemented and PCB clearance of surface and subsurface soil was initiated. Air monitoring devices were placed on workers performing activities in contaminated areas as well as along the perimeter of the site near the existing housing development. PCBs were not detected in any of the samples (North Wind 2006). Construction workers were not allowed to continue construction activities on site until the Army's project team determined it was safe to reenter an area (North Wind 2006; OASIS 2007). The exclusion zone was fenced and locked at all times. Only those individuals with permission, appropriate safety training, and personal protective equipment were allowed to enter the exclusion zone (North Wind 2006).

Occupational medicine experts recommended a minimal set of diagnostic procedures for evaluating workers potentially exposed to PCBs during construction activities at Taku Gardens (Nortech ND). They included the following:

- Basic medical history with emphasis on past exposures and symptoms related to chemicals in the workplace and in hobbies.
- Blood draw to establish baselines for organ system functions, including complete blood count, comprehensive metabolic panel, lipid panel, and dip urinalysis.
- Blood sample for PCB analysis.

The construction workers who were excavating the foundation for Building 52 in June 2005, were exposed to PCBs in the soil for a short duration. Skin conditions, such as acne and rashes, may occur in people exposed to high levels of PCBs (ATSDR 2000). Chloracne (a skin condition resembling acne) is the most easily recognizable effect of PCB exposure in humans (Rice and Cohen 1996). USACE was responsible for working with the construction workers on their exposure issues. ATSDR does not have information about the specific diagnoses of exposed workers, but it is assumed that all appropriate medical follow-up and care were given. It is well documented that all appropriate precautions were taken to protect construction workers once they were allowed back on site (see North Wind 2006). The Occupational Safety and Health Administration (OSHA) is the federal agency ultimately responsible for worker safety.

IV.A.3. Adjacent Residents

There is an existing housing area to the west of Taku Gardens. This area may have been impacted by airborne contamination during construction or remedial activities. To evaluate potential exposures to those adjacent residents, North Wind collected samples and analyzed them for PCBs during the 2005 field activities. Their approach "allowed rapid characterization of the site…to assure the community that proper controls were maintained during construction which limited personal exposure to the contaminants in the soil" (North Wind 2006).

- There are four outdoor recreational areas within and near the site—one located within the fenced area of Taku Gardens, another to the north of the site, and two in the adjacent housing area west of the site. Surfaces of the equipment located in these areas were tested for PCBs. PCBs were not detected in any of the wipe samples taken from equipment located outside of Taku Gardens. The recreational equipment within the exclusion zone tested positive for low levels of PCBs (less than 10 µg/wipe), and as a result was dismantled and made unusable in 2005.
- The six-foot chain link fence that surrounds the entire perimeter of the site is covered by green fabric. To determine whether the fabric was a potential collection point for PCB contaminated dust and whether airborne PCBs were moving off site, North Wind collected wipe samples from the fence fabric. PCBs were not detected in any of the samples.

- To determine whether dust generated during the construction activities impacted the adjacent housing area, one wipe sample was collected from the window surface of each duplex unit (total of two samples per building). PCBs were not detected.

- To determine whether contaminated soil was tracked off site by equipment or vehicles, surface soil samples were collected from outside the north and south gate entrances. Samples were also collected from the north entrance car wash. PCBs were not detected in any of the samples.

- Soil that was stockpiled outside the fenced area to the southwest of the site was easily accessible to adjacent residents. These stockpiles were covered until samples confirmed that PCBs were not present.

- During excavation activities, air sample collection apparatuses were placed around the perimeter of the site. PCBs were not detected in any of the air samples collected.

- At the request of a resident, North Wind tested soil in flower beds and pots to determine whether contaminated soil from the site had been used as potting soil. One of the flower pots showed PCB contamination. The flower pot and soil was disposed of with the other PCB contaminated soil and materials.

Preventative measures were also taken to control dustborne contamination from spreading to the adjacent housing area. A water truck continually sprayed water on dry surfaces until adequate data were collected to characterize road surfaces, stockpiles, and excavations near the housing area. Further, the PCB contaminated soil in Areas 52 and 54 was not excavated until an air monitoring program was in place (North Wind 2006). Given the extensive sampling that confirmed that PCBs were not spread off site and the protective measures taken to control off-site contamination, ATSDR does not expect that adjacent residents were exposed to harmful levels of PCBs.

IV.B. Current Exposures

No one is currently being exposed to harmful levels of contamination at Taku Gardens. Institutional controls are in place to prevent exposures to remaining site contamination. The housing units will not be occupied until USACE, ADEC, and EPA agree that the site is safe for residential occupation. No excavation is allowed and drinking water wells cannot be installed. Further, an 8-foot high fence with 3-strand barbed wire surrounds the perimeter of the entire Taku Gardens site, restricting unauthorized access (ADEC 2009b; CH2MHILL 2008b).

Environmental field investigators have been and are continuing to take all appropriate precautions while conducting site characterization and remedial actions. For example, during the 2005 time-critical removal action, air monitoring samples were collected from personnel actively involved on site—PCBs were not detected (North Wind 2006; OASIS 2007). During the 2006 field investigation, weekly meetings were held to ensure all parties had access to the most up-to-date information about the constantly changing site conditions (OASIS 2007). During the 2007 field investigation, personal protective equipment was worn as needed (CH2MHILL 2008a).

IV.C. Future Exposures

In March 1992, EPA, the U.S. Department of Defense, and ADEC established a Federal Facilities Agreement to ensure that environmental impacts associated with past and present activities at the site are thoroughly investigated and appropriate remedial actions are taken to protect public health and the environment (CH2MHILL 2008b). The institutional controls in place for Taku Gardens were formalized in the Federal Facilities Agreement (ADEC 2009b). One of the institutional controls ensures that housing units will not be occupied until USACE, ADEC, and EPA agree that Taku Gardens is appropriate for residential occupation (ADEC 2009b; CH2MHILL 2008b). Therefore, as long as Taku Gardens is adequately characterized and all necessary remediation is completed, ATSDR does not expect future residents will be exposed to harmful levels of contamination in the future.

The Army is currently in the process of determining the potential risks to human health and the environment associated with the site. Several investigations and remedial actions have been conducted since contamination was discovered in 2005 (see ADEC 2009a; CH2MHILL 2008a; Jacobs 2009; North Wind 2006; North Wind 2007). A Remedial Investigation and Baseline Risk Assessment for Taku Gardens are expected to be released in 2010.

V. Conclusions

- People who gardened in the community garden between 1954 and 1967 might have been exposed to PCB contamination. If people gardened where the highest levels of PCBs were detected, exposures could have resulted in harmful noncancer health effects (e.g., dermatological, neurological, hepatic, or gastrointestinal effects). In addition, eating produce grown in soil that was highly contaminated with PCBs could have resulted in exposure to harmful levels of PCBs. However, no PCBs or very low levels of PCBs were detected in the majority of the former community garden area. Additionally, PCBs remain bound to soil and do not migrate easily. Harmful health effects are not expected for people who gardened outside the hot spot area and did not eat produce grown in the highly contaminated area. Harmful health effects are also not expected for people who gardened in the community garden after 1967. An increase in cancer incidence is not expected regardless of where or when a person gardened.

- Constructions workers may have been acutely exposed to high levels of PCB contamination when they were excavating the foundation for Building 52 in 2005. USACE worked with the construction workers on their exposure issues. Appropriate precautions were taken to prevent further exposures. No health effects data are currently available.

- Given the extensive sampling that confirmed that PCBs were not spread off site and the protective measures taken to control off-site contamination, ATSDR does not expect that adjacent residents were exposed to harmful levels of PCBs.

- Because access is restricted, no one is currently being exposed to harmful levels of contamination at the Taku Gardens construction site.

- As long as the site is adequately characterized and all necessary remediation is completed, future residents of Taku Gardens are not expected to be exposed to harmful levels of contamination.

VI. Recommendations

- If you gardened in the community garden between 1954 and 1967, and you think your garden plot was located in the southwest corner near where the area of highest PCB contamination was detected (see Figure 3), talk to your physician about taking an exposure history. A document on how to take an exposure history is available at http://www.atsdr.cdc.gov/csem/exphistory/ehcover_page.html. The Toxicological Profile for PCBs is available at http://www.atsdr.cdc.gov/toxprofiles/tp17.html.

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Appendix A. ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call the agency's toll-free number, 1-800-CDC-INFO (1-800-232-4636).

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].

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

Ambient
Surrounding (for example, ambient air).

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.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

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.

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.

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]

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].

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.

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].

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

Dose
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-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.

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 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.

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.

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

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

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].

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.

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.

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].

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.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

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).

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

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 meeting
A public forum with community members for communication about a site.

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.

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

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]

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.

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.

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.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

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.

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.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Library of Medicine (NIH) (http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

Appendix B. Overview of ATSDR's Methodology for Evaluating Potential Public Health Effects

Introduction

What is meant by exposure?

An exposure pathway has five elements: (1) a source of contamination, (2) an environmental media, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. The source is the place where the chemical or radioactive material was released. The environmental media (such as groundwater, soil, surface water, or air) transport the contaminants. The point of exposure is the place where people come into contact with the contaminated media. The route of exposure (for example, ingestion, inhalation, or dermal contact) is the way the contaminant enters the body. The people actually exposed are the receptor population.

ATSDR's public health evaluations are driven by exposure to, or contact with, environmental contaminants. Contaminants released into the environment have the potential to cause harmful health effects. Nevertheless, *a release does not always result in exposure.* People can only be exposed to a contaminant if they come into contact with that contaminant—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant. If no one comes into contact with a contaminant, then no exposure occurs, and thus no health effects could occur. Often the general public does not have access to the source area of contamination or areas where contaminants are moving through the environment. This lack of access to these areas becomes important in determining whether people could come into contact with the contaminants.

The route of a contaminant's movement is the pathway. ATSDR identifies and evaluates exposure pathways by considering how people might come into contact with a contaminant. An exposure pathway could involve air, surface water, groundwater, soil, dust, or even plants and animals. Exposure can occur by breathing, eating, drinking, or by skin contact with a substance containing the chemical contaminant.

How does ATSDR determine which exposure situations to evaluate?

ATSDR scientists evaluate site conditions to determine if people could have been, are, or could be exposed (i.e., exposed in a past scenario, a current scenario, or a future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

You can find out more about the ATSDR evaluation process by contacting ATSDR directly at 1-800-CDC-INFO (1-800-232-4636) or reading ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/PHAManual/.

If someone is exposed, will they get sick?

Exposure does not always result in harmful health effects. The type and severity of health effects a person can experience because of contact with a contaminant depend on the exposure concentration (how much), the frequency (how often) and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the multiplicity of exposure (combination of contaminants). Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how the individual absorbs, distributes, metabolizes, and excretes the contaminant. Together, these factors and characteristics determine the health effects that may occur.

In almost any situation, there is considerable uncertainty about the true level of exposure to environmental contamination. To account for this uncertainty and to be protective of public health, ATSDR scientists typically use worst-case exposure level estimates as the basis for determining whether adverse health effects are possible. These estimated exposure levels usually are much higher than the levels that people are really exposed to. If the exposure levels indicate that adverse health effects are possible, ATSDR performs a more detailed review of exposure and consults the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

Methodology

ATSDR analyzed the weight of evidence of available toxicologic, medical, and epidemiologic health effects data to determine whether exposures might be associated with harmful health effects (noncancer and cancer). As a first step in evaluating noncancer effects, ATSDR compared estimated exposure doses to ATSDR's minimal risk level (MRL) and EPA's reference dose (RfD). Both ATSDR and EPA derived the same value for chronic oral exposure to Aroclor 1254 (2.0×10^{-5} mg/kg/day). Neither ATSDR nor EPA has developed a health guideline for Aroclor 1260. The MRL and RfD are conservative estimates of daily human exposure to a substance that are unlikely to result in noncancer effects over a specified duration. *Estimated exposure doses that are less than health guidelines were not considered to be of health concern.* To maximize human health protection, MRLs and RfDs have built-in uncertainty or safety factors, making these values considerably lower than levels at which health effects have been observed. The result is that even if an exposure dose is higher than the MRL or RfD, it does not necessarily follow that harmful health effects will occur. It simply indicates to ATSDR that further evaluation is required before a conclusion can be drawn. This process enables ATSDR to weigh the available evidence in light of uncertainties and offer perspective on the plausibility of harmful health outcomes under site-specific conditions.

Exposure doses represent the amount of chemical a person is exposed to over time, and are expressed in milligrams per kilogram per day (mg/kg/day).

Sources for Toxicologic, Medical, and Epidemiologic Data

By Congressional mandate, ATSDR prepares toxicological profiles for hazardous substances found at contaminated sites. ATSDR's Toxicological Profile for PCBs was used to evaluate potential health effects in this health consultation (ATSDR 2000). A ToxFAQs for PCBs is provided in Appendix C. ATSDR's toxicological profiles are available on the Internet at http://www.atsdr.cdc.gov/toxpro2.html or by contacting the National Technical Information Service (NTIS) at 1-800-553-6847.

EPA also develops health effects guidelines. These guidelines are found in EPA's Integrated Risk Information System (IRIS)—a database of human health effects that could result from exposure to various substances found in the environment. IRIS is available on the Internet at http://www.epa.gov/iris. For more information about IRIS, please call EPA's IRIS hotline at 1-301-345-2870 or e-mail at Hotline.IRIS@epamail.epa.gov.

Evaluating Incidental Ingestion

PCBs can enter your body if you incidentally (accidentally) ingest soil contaminated with PCBs. Adults and children might incidentally ingest soil when gardening or children might incidentally ingest soil while playing when their parents are gardening. Once inside your body, PCBs tend to accumulate in lipid-rich tissues, such as the liver, fat, skin, and breast milk. Some PCBs may leave your body in feces within a few days, but some may stay in your body for months to years (ATSDR 2000).

The following equation was used to estimate incidental ingestion of PCBs in soil. Where possible, ATSDR used site-specific information regarding the frequency and duration of exposures. When site-specific information was not available, ATSDR employed several conservative assumptions to estimate exposures.

$$\text{Estimated exposure dose} = \frac{C \times IR \times EF \times ED}{BW \times AT}$$

where:

C: Concentration of chemical in soil (mg/kg)

IR: Ingestion rate (adult = 100 mg/day and child = 200 mg/day, which are default exposure values; ATSDR 2005); 1 mg = 10^{-6} kg

EF: Exposure frequency (84 days/year, which represents exposure for 7 days per week for 12 weeks of the year)

ED: Exposure duration (14 years, which represents the maximum exposure duration from 1954–1967)

BW: Body weight (adult = 70 kg and child = 16 kg, which are standard body weights for an average adult and children 1 through 6 years old; ATSDR 2005)

AT: Averaging time, or the period over which cumulative exposures are averaged (14 years x 365 days/year)

Table B-1. Estimated Incidental Ingestion Exposure Doses

Concentration (mg/kg)	*Estimated Child Dose (mg/kg/day)*	*Estimated Adult Dose (mg/kg/day)*	*Estimated Lifetime Dose[7] (mg/kg/day)*	*Notes*
111,000[8]	3.2×10^{-1}	3.6×10^{-2}	7.3×10^{-3}	Highest detected concentration in the Building 52 hot spot
9.14	2.6×10^{-5}	3.0×10^{-6}	6.0×10^{-7}	Highest detected concentration outside of the Building 52 hot spot

ATSDR reviewed the scientific literature for noncancerous effects from exposure to PCBs. The estimated doses for children (3.2×10^{-1} mg/kg/day) and adults (3.6×10^{-2} mg/kg/day) exposed to the highest detected concentration of PCBs (111,000 mg/kg) were one to two orders of magnitude higher than doses in which health effects were observed in animals. Immunological health effects (specifically, decreased antibody response and eyelid and toe/finger nail changes) were observed in female Rhesus monkeys chronically exposed to 5.0×10^{-3} mg/kg/day of Aroclor 1254 (Arnold et al. 1993; Tryphonas et al. 1989; Tryphonas et al. 1991). This is the lowest-observed-adverse-effect-level (LOAEL) identified in the scientific literature for chronic exposure to PCB mixtures. Neurobehavioral effects were observed in infant monkeys exposed to 7.5×10^{-3} mg/kg/day (Rice 1997; Rice 1998; Rice 1999; Rice and Hayward 1997; Rice and Hayward 1999).

The estimated dose for adults (3.0×10^{-6} mg/kg/day) exposed to the highest detected concentration of PCBs outside of the hot spot (9.14 mg/kg) was lower than ATSDR's MRL and EPA's RfD (2.0×10^{-5} mg/kg/day), and are not of health concern. The estimated dose for children (2.6×10^{-5} mg/kg/day) was slightly higher than the MRL and RfD. However, the dose was two orders of magnitude lower than doses in which health effects were observed in animals (noted above).

Studies of workers provide evidence that exposure to PCBs is associated with certain types of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate commercial PCB mixtures throughout their lives developed liver cancer. Based on the evidence for cancer in animals, the Department of Health and Human Services (DHHS) has stated that PCBs may reasonably be anticipated to be carcinogens. Both EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans. The estimated lifetime dose (7.3×10^{-3} mg/kg/day) from incidentally ingesting PCB-contaminated soil in the hot spot is three orders of magnitude lower than the cancer effect levels (CELs) reported in the literature (CELs ranged from 1.0–5.4 mg/kg/day in animals; no CELs exist for humans; ATSDR 2000). The estimated lifetime dose (6.0×10^{-7} mg/kg/day) from incidentally ingesting the highest detected concentration of PCBs outside of the hot spot is seven

[7] The lifetime exposure scenario assumed that a person was exposed to PCBs for 14 years, and the exposure is averaged over a 70-year lifetime.

[8] The *2007/2008 Former Communications Site Drum And Debris and PCB Remedial Investigation* (Jacobs 2009) noted that past environmental sampling indicated that PCB concentrations as high as 119,000 mg/kg were detected in the soil. However, this higher concentration could not be verified in the original reports.

orders of magnitude lower. As such, no excess cancers from PCB exposure are expected from incidentally ingesting contaminated soil in the former community garden.

Evaluating Dermal Exposure

PCBs can be absorbed through the skin; however, they are incompletely absorbed. Further, PCBs remain tightly bound in soil, and are therefore not readily available for absorption by the skin. Limited human *in vitro* studies report that up to 2.6% of the dose was retained in cadaver skin following dermal exposure to soil contaminated with PCBs (Wester et al. 1990; Wester et al. 1993). In related *in vivo* studies, the same authors determined that 14% of the dose was absorbed when PCB-contaminated soil was applied topically to Rhesus monkeys (Wester et al. 1990; Wester et al. 1993). Only the fraction of the contaminant that is in direct contact with the skin is amenable to absorption.

The following equation was used to estimate dermal exposure to PCBs in soil. Adults and children touch soil when gardening without gloves and children might touch soil while playing when their parents are gardening. Where possible, ATSDR used site-specific information regarding the frequency and duration of exposures. When site-specific information was not available, ATSDR employed several conservative assumptions to estimate exposures.

$$\text{Estimated exposure dose} = \frac{C \times A \times AF \times EF \times CF}{BW}$$

where:

- C: Concentration of chemical in soil (mg/kg)
- A: Total soil adhered (adult = 326 mg and child = 525 mg, which are default dermal exposure values; ATSDR 2005)
- AF: Absorption factor (0.14, which is the recommended dermal absorption fraction from soil for PCBs; EPA 2004)
- EF: Exposure factor (0.23, which represents exposure for 7 days per week for 12 weeks of the year)
- CF: Conversion factor (10^{-6} mg/kg)
- BW: Body weight (adult = 70 kg and child = 16 kg, which are standard body weights for an average adult and children 1 through 6 years old; ATSDR 2005)

Table B-2. Estimated Dermal Exposure Doses

Concentration (mg/kg)	*Estimated Child Dose (mg/kg/day)*	*Estimated Adult Dose (mg/kg/day)*	*Estimated Lifetime Dose[9] (mg/kg/day)*	*Notes*
111,000	1.2×10^{-1}	1.7×10^{-2}	3.3×10^{-3}	Highest detected concentration in the Building 52 hot spot
9.14	9.7×10^{-6}	1.4×10^{-6}	2.7×10^{-7}	Highest detected concentration outside of the Building 52 hot spot

The estimated doses for children (1.2×10^{-1} mg/kg/day) and adults (1.7×10^{-2} mg/kg/day) dermally exposed to the highest detected concentration of PCBs (111,000 mg/kg) were one to two orders of magnitude higher than doses in which health effects were observed in animals. Immunological health effects (specifically, decreased antibody response and eyelid and toe/finger nail changes) were observed in female Rhesus monkeys chronically exposed to 5.0×10^{-3} mg/kg/day of Aroclor 1254 (Arnold et al. 1993; Tryphonas et al. 1989; Tryphonas et al. 1991). Neurobehavioral effects were observed in infant monkeys exposed to 7.5×10^{-3} mg/kg/day (Rice 1997; Rice 1998; Rice 1999; Rice and Hayward 1997; Rice and Hayward 1999).

The estimated doses for children (9.7×10^{-6} mg/kg/day) and adults (1.4×10^{-6} mg/kg/day) dermally exposed to the highest detected concentration of PCBs outside of the hot spot (9.14 mg/kg) were lower than ATSDR's MRL and EPA's RfD (2.0×10^{-5} mg/kg/day).[10] Exposure doses lower than the MRL and RfD are not considered to be of health concern.

The estimated lifetime dose (3.3×10^{-3} mg/kg/day) from dermal contact with PCB-contaminated soil in the hot spot is three orders of magnitude lower than the CELs reported in the literature (CELs ranged from 1.0–5.4 mg/kg/day in animals; no CELs exist for humans; ATSDR 2000). The estimate lifetime dose (2.7×10^{-7} mg/kg/day) from dermal contact with the highest detected concentration of PCBs outside of the hot spot is seven orders of magnitude lower. As such, no excess cancers from PCB exposure are expected from dermal contact with contaminated soil in the former community garden.

Combined Ingestion and Dermal Exposure

To evaluate the potential combined effects from incidentally ingesting and dermally contacting PCB-contaminated soil, ATSDR summed the estimated exposure doses from the two pathways.

$$\text{Estimated Ingestion Dose} + \text{Estimated Dermal Dose} = \text{Combined Dose}$$

[9] The lifetime exposure scenario assumed that a person was exposed to PCBs for 14 years, and the exposure is averaged over a 70-year lifetime.

[10] Even though the MRL and RfD are based on oral exposure to PCBs, it is appropriate to compare the dermal absorbed dose to them since oral absorption of PCBs is essentially complete. EPA does not recommend that the PCB health guideline be adjusted to account for the difference in exposure route (EPA 2004).

Table B-3. Combined Ingestion and Dermal Exposure Doses

Concentration (mg/kg)	*Estimated Child Dose (mg/kg/day)*	*Estimated Adult Dose (mg/kg/day)*	*Estimated Lifetime Dose[11] (mg/kg/day)*	*Notes*
111,000	4.4×10^{-1}	5.3×10^{-2}	1.1×10^{-2}	Highest detected concentration in the Building 52 hot spot
9.14	3.6×10^{-5}	4.4×10^{-6}	8.8×10^{-7}	Highest detected concentration outside of the Building 52 hot spot

The combined doses for children (4.4×10^{-1} mg/kg/day) and adults (5.3×10^{-2} mg/kg/day) exposed to the highest detected concentration of PCBs (111,000 mg/kg) were one to two orders of magnitude higher than doses in which noncancer health effects were observed in animals. Immunological health effects (specifically, decreased antibody response and eyelid and toe/finger nail changes) were observed in female Rhesus monkeys chronically exposed to 5.0×10^{-3} mg/kg/day of Aroclor 1254 (Arnold et al. 1993; Tryphonas et al. 1989; Tryphonas et al. 1991). Neurobehavioral effects were observed in infant monkeys exposed to 7.5×10^{-3} mg/kg/day (Rice 1997; Rice 1998; Rice 1999; Rice and Hayward 1997; Rice and Hayward 1999).

The combined dose for adults (4.4×10^{-6} mg/kg/day) exposed to the highest detected concentration of PCBs outside of the hot spot (9.14 mg/kg) was lower than ATSDR's MRL and EPA's RfD (2.0×10^{-5} mg/kg/day), and are not of health concern. The combined dose for children (3.6×10^{-5} mg/kg/day) was slightly higher than the MRL and RfD. However, the combined dose was two orders of magnitude lower than doses in which health effects were observed in animals (noted above).

The combined lifetime dose (1.1×10^{-2} mg/kg/day) from contact with PCB-contaminated soil in the hot spot is two orders of magnitude lower than the CELs reported in the literature (CELs ranged from 1.0–5.4 mg/kg/day in animals; no CELs exist for humans; ATSDR 2000). The combined lifetime dose (8.8×10^{-7} mg/kg/day) from contact with the highest detected concentration of PCBs outside of the hot spot is seven orders of magnitude lower. As such, no excess cancers from PCB exposure are expected from incidental ingestion of or dermal contact with contaminated soil in the former community garden.

[11] The lifetime exposure scenario assumed that a person was exposed to PCBs for 14 years, and the exposure is averaged over a 70-year lifetime.

Appendix C. ToxFAQs for Polychlorinated Biphenyls (PCBs)

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

POLYCHLORINATED BIPHENYLS

Division of Toxicology ToxFAQs™ **February 2001**

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

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

❑ PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.
❑ PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.
❑ PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.
❑ PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

❑ Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.
❑ Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.
❑ Breathing air near hazardous waste sites and drinking contaminated well water.
❑ In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Service
Agency for Toxic Substances and Disease Registry

The "exclusion zone" is the approxima

of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to PCBs?

❑ You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

❑ Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.

❑ Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.

❑ If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

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

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

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

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