Health Consultation

SAWYER LUDWIG PARK TRIBUTARY

CITY OF MARION, MARION COUNTY, OHIO

JUNE 18, 2007

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

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

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HEALTH CONSULTATION

SAWYER LUDWIG PARK TRIBUTARY

CITY OF MARION, MARION COUNTY, OHIO

Prepared By:

Health Assessment Section
Bureau of Environmental Health and Toxicology
Ohio Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

Summary

The Health Assessment Section (HAS) of the Ohio Department of Health was asked by the Ohio Environmental Protection Agency (Ohio EPA) to review environmental sampling data from Sawyer-Ludwig Park resulting from a state-funded cleanup of contaminated sediments. The cleanup goal was to remove gross contamination of stream/ditch sediments of polycyclic aromatic hydrocarbons (PAHs) and to remove lead contamination detected in lakebed sediments that were above U.S. EPA's cleanup action level. In August 1998, Ohio EPA discovered contaminated sediments in an unnamed tributary of the Columbia Street Ditch which traverses east to northwest through Sawyer Ludwig Park in Marion, Ohio. In 1999, HAS evaluated whether levels of PAHs in the sediments posed a health threat to users of the park and in January 2000, HAS recommended that the Marion City Health Department issue a no physical contact advisory for sediments in the unnamed tributary in the Park. A Health Consultation evaluating the contamination in the stream/ditch sediments in the park was produced by HAS July 11, 2000 (HAS, 2000).

The Ohio EPA began work in October 2005 to clean up the contaminated sediment and soil from the stream/ditch in Sawyer-Ludwig Park using funds from Ohio's Hazardous Waste Cleanup Fund. Ohio EPA established project partnerships with the City of Marion, the Ohio Department of Natural Resources, U.S. Army Corps of Engineers, and U.S. Environmental Protection Agency (EPA). By September 2006, Ohio EPA and its partners completed clean up of the site. The park cleanup is the first that Ohio EPA has undertaken entirely with state funds. To be eligible for Ohio's Hazardous Waste Cleanup Fund, a project must meet, at a minimum, the following requirements; no party responsible for the pollution is available to pay for the cleanup, the site data clearly indicates what cleanup is required, and the required cleanup is within the means of the available funding.

The Sawyer-Ludwig Park site currently poses a *"no apparent public health hazard"* to visitors of the park from contact with lead and PAH contaminated lakebed and stream sediments or soils. Although, some sediments and soils with low concentrations of PAHs and lead may remain on site, the concentrations are at levels that are not known to pose a health threat, even to sensitive populations such as children.

Background / Statement of Issues

Sawyer-Ludwig Park is off of White Oaks Road at the southwest edge of the city of Marion, in Marion County, Ohio (Figure 1 - Location Map). The topography of the area is characterized as gently sloping hills, with a few moderately steep valley sides, and extensive nearly level plains and basins. The topographic features are generally uniform across Marion County with a relief of only 235 feet. Soils were formed from the glacial till deposits and can be characterized as moderately well drained to somewhat poorly drained. The two barrow areas located within the park that were used for backfilling the stream bed after the sediment removal consist of these glacial till soils.

Sawyer-Ludwig Park is an 80-acre park with baseball diamonds, shelter houses, a frisbee golf course, hiking trails, and some wooded areas. This heavily-utilized park is owned and operated by the city of Marion. An unnamed tributary of the Little Scioto River transects Sawyer-Ludwig Park and is the primary storm water drainage channel for the southwest portion of Marion City (Figure 2). Various hiking and bicycle trails pass over and adjacent to the stream/ditch. Also, a popular frisbee golf course is adjacent to this tributary.

The tributary of the Little Scioto River enters the east end of the park from a storm sewer outfall that passes under White Oaks Road (also known as Davids Street). The approximate dimensions of this tributary in the park vary in width from 4 to 10 feet and in depth from 6 to 18 inches. The average flow rate is approximately 1.5 feet per second. The tributary first flows through a wooded area in the park and then through a 2.5 acre open area. The 2.5 acre open area was formerly the man-made Sawyer Lake that was recently been drained (approximately in 1998). The tributary then flows through another wooded area before exiting the northwest corner of the park as it passes under Bellefontaine Avenue (Figure 2).

After leaving the park, the tributary becomes a channelized ditch which flows to the north. It passes within fifty yards of the McKinley Elementary School. It then passes through a residential neighborhood. This tributary feeds into to the Columbia Street Ditch which, in turn, feeds into the Little Scioto River.

The park is bordered to the east by an industrial complex on the east side of White Oaks Road. The areas to the north, west, and south are residential areas of the City of Marion. McKinley Elementary School, and Marion Head Start and Senior Center are located on the north side of the Park.

In 1998, a 2,800-foot long segment of the tributary was found to have sediments contaminated with PAHs. The contamination in the stream channel began at White Oaks Road in the southeast end of the park and extended downstream to the former Sawyer Lake area. Children have been observed playing on the park trails next to the stream. It is possible that children playing in the park may have been exposed through dermal contact with PAH and lead contaminants in the sediment of the ditch. However, exposures would likely have been incidental, short-term and on a seasonal basis. The exposure times would likely have been shorter than what is thought would have been required to cause health affects.

Site History

Site Discovery

In August 1998, Ohio EPA began a study to identify potential environmental problems in and around the City of Marion. Several streams were sampled as part of the study to assess water quality in Marion's urban areas as well as the Little Scioto River watershed (*Biological Water*

Quality Study of Marion Area Streams, 1998 (Ohio EPA, 2000)). Surface water samples collected in the upper sections of Columbia Ditch in Sawyer-Ludwig Park found concentrations of copper, lead, zinc, and 10 PAH compounds that exceeded Ohio Water Quality Standards criteria (Ohio EPA, 2000). Results for the sediment samples indicated that the concentrations of these contaminants in Sawyer-Ludwig Park had levels of copper, lead, and zinc that are considered at the *"Severe Effects Level"*. The "*Severe Effects Level*" is defined in the report as a level at which contaminants would have an adverse ecological impact on aquatic organisms living in the sediment; with concentrations of chemical compounds that could cause detrimental impacts on the majority of aquatic species; and with a likely significant effect on aquatic biological resources. High levels of lead and many PAH compounds were also found in the sediment of Sawyer Lake. A short time after this study, Sawyer Lake was drained.

Prior to this stream study, intermittent oil discharges from industries upstream of the park had been reported in this tributary. One of the upstream industries is Marion Steel. Marion Steel had a permit to discharge copper, lead, zinc, and other metal parameters to a storm sewer upstream of Sawyer Lake prior to 1995.

In December 1999, Ohio EPA referred the site to the U.S. EPA for consideration of a removal action due to the elevated contamination in the sediments. U.S. EPA's assessment of the site determined that in addition to the PAH and lead contamination in the sediment at the site, there was an ongoing sewage pollution problem emanating from the city storm sewer outfall at White Oaks Road, (the beginning point of the stream/ditch) (EarthTech, 2006). The U.S. EPA recommended that the sewage issues be addressed before further consideration of a removal action.

Ohio EPA asked HAS to review the PAH sediment data and to evaluate whether levels of PAHs in the sediment posed a health threat to users of the park. Ohio EPA also asked HAS to evaluate whether it was necessary to issue a contact advisory for the tributary in the park. In a letter to Marion City Health Department, the Ohio Department of Health recommended a "precautionary contact advisory" to limit contact that children using the park would have with PAH contaminated sediments based on the gross nature of the contamination of the stream sediment. The Marion City Health Department issued a "no physical contact" advisory in January 2000 for the section of the tributary in the park beginning at White Oaks Road and ending at Bellefontaine Avenue. The City of Marion posted "no physical contact" advisory signs.

HAS also produced a report, *Health Consultation for Sawyer-Ludwig Tributary to Columbia Ditch, Marion, Marion County, Ohio, July 11, 2000*. This Health Consultation concluded that the Sawyer-Ludwig Park Tributary posed an "***indeterminate public health threat***" to visitors of the park due to the lack of a confirmed exposure pathway and the need for further sampling to identify the extent of the contamination in both the sediments and surface water of the tributary.

HAS made three recommendations in the 2000 Health Consultation;

1) The regulatory agencies should investigate the contributing contaminant source to the

tributary.

2) The regulatory agencies should collect further samples to determine the extent of contamination.
3) HAS will review any future data to determine whether the contact advisory should remain in place.

Site Characterization

In 2002, the Ohio EPA conducted a Site Inspection (SI) to determine possible sources of PAH contamination to the stream/ditch of Columbia Ditch (Ohio EPA, 2005). The federally-funded SI evaluates a site for potential listing on the National Priorities List (Superfund Sites). The SI concluded that at least one source of the contamination was from the city storm water sewer. In addition, the industrial areas to the east of the site were suspected sources of both past and ongoing discharges to the storm sewer. The City of Marion investigated potential sources of contaminants to the storm sewer, which included investigation of unauthorized taps into the storm sewer. Several illegal taps were corrected by the City of Marion.

In the fall of 2004, Ohio EPA's further characterization of the lakebed sediments and found elevated concentrations of lead in the upper six inches of lakebed sediments, with lead at levels up to 1410 ppm. The stream sediments in the park were found to contain significant visible PAH contamination, with levels up to 5000 ppm (Ohio EPA 2006a).

Site Clean-up

During the summer of 2005, Ohio EPA developed a plan and secured funding for the removal of contaminated sediments at the site. The Ohio EPA adopted the **cleanup action level established by US EPA of 400 ppm for lead in residential soils.** The removal action value for PAHs was calculated following Ohio EPA-DERR Remedial Response Program guidance for calculating background values. OEPA established a **removal action level of 16 ppm for PAH** compounds based on sediment PAH concentrations in local streams most similar to the Sawyer-Ludwig Park tributary that were not found to be contaminated by organic compounds above urban background concentrations.

Discussion

To determine whether the cleanup activities impacted the downstream environment, samples were collected at two locations downstream of Bellefontaine Avenue and adjacent to the William McKinley Elementary School both before and after cleanup activities. PCB's were detected in low concentrations (53 to 56 ppb) in samples collected after the cleanup activities. Ohio EPA concluded, aside from the low level PCB's, that contaminant concentrations following cleanup were similar to pre-cleanup concentrations and that there were no downstream sediment impacts from site cleanup activities.

Chemicals of Concern

Polycyclic Aromatic Hydrocarbons

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of naturally-occurring chemicals found in coal, coal tars, oil, wood, tobacco, and other organic materials (See Attached Fact Sheet for PAHs). There are more than 100 different chemical compounds referred to as PAHs. They are usually present as waxy solids in asphalt, crude oil, coal, coal pitch tar, creosote, and roofing tar. PAHs are ubiquitous in all types of environments. Urban environments tend to have higher levels of PAHs present in the environment due to the increased amounts of gas and oil burned by internal combustion engines as well as the increased use of asphalt and tar on roads, parking lots, and roofs of buildings.

People are typically exposed to mixtures of PAHs in the environment rather than individual chemical compounds. Primary exposures include inhalation of PAH compounds in tobacco smoke, wood smoke, auto, bus, and truck exhausts, and releases to the air from industrial facilities, especially coke ovens and creosote plants. Smoke and residual deposits of PAHs in soils and sediments may contain both light (vapor) and heavy (solid particles in soot or ash) PAHs. Other exposure pathways include dermal contact with PAHs in asphalt, coal tar, and creosote-treated wood products and eating smoked, barbecued, or charcoal-broiled foods.

Heavier (higher molecular weight) PAHs do not readily dissolve in water but tend to stick to solid particles and accumulate in the sediments on bottoms of lakes, rivers, and streams. These "fat" PAHs stick to soils and sediments and will generally take months to years to break down in the environment. Micro-organisms in the soil and sediments are the main agents of the chemical break down of the PAH compounds. These heavier PAHs have been found to cause cancer in laboratory animal studies and at least 15 of these compounds are "reasonably anticipated" to cause cancer in humans with prolonged exposure to high concentrations of these particular PAHs (National Toxicology Program, 2005).

Waste oil sludges were observed in the stream/ditch at the park in 2000 and in July, 2005, prior to the Ohio EPA removal action. Ohio EPA analyses of these wastes in 1998 and 1999 indicated total PAH concentrations of up to 1,074 parts per million (Table 1). Elevated levels (up to 153 ppm) of four of these heavier weight PAHs were detected in on-site sludge samples. The main exposure route of concern at the Sawyer-Ludwig Park site was incidental dermal contact with these contaminated sediments in the stream/ditch. PAHs do not usually enter the body through the skin under normal conditions, but small amounts could enter the body if there was prolonged contact with products or oils with high concentrations of PAHs. Dermal contact with some PAH compounds may also result in rashes or dermatitis and may make the skin photo-sensitive to sunlight (ATSDR, 1995).

Lead

Lead is a naturally-occurring metal found in small amounts in native soils (See Attached Fact Sheet for Lead). Smelting of lead-containing ores results in nearly pure deposits of elemental lead that have historically been used in a variety of products, including fabricated metal, ammunition, batteries, in paints (prior to 1978), and as an additive in gasoline (prior to 1995). Lead does not readily break down in soils but most of the high levels of lead detected in the environment come from human activities. Lead released to the air or dumped on the ground usually attaches to soil or sediment particles. It does not dissolve readily in surface waters in most areas in Ohio due to the alkaline nature of these waters.

Children (especially infants and toddlers) are the primary concern when it comes to exposure to lead because their bodies tend to absorb more lead than adults. About 99% of the lead taken into the body of an adult will leave in the body as waste within a couple of weeks, but only about 32% of the lead taken in by children will be eliminated by the body in the same manner (ATSDR, 1999). Children are also more sensitive to the effects of lead exposure than are adults. Even at low levels, lead can affect a child’s mental and physical development, in part because their brains and nervous systems are still developing. The major adverse health effect from exposures to excessive amounts of lead is damage to the nervous system potentially resulting in prolonged or permanent neuro-behavioral disorders (ATSDR, 2000).

The main exposure routes with regard to lead poisoning are via ingestion (eating or drinking) or inhalation (breathing it in). The major pathway of concern, especially with regard to infants and toddlers, is via incidental ingestion of lead-contaminated soil/dusts resulting from repeated hand-to-hand mouth action. Small children and infants are closer to and spend more time on the ground where they may come into contact with lead-contaminated soil and dust outdoors and lead paint chips and dust indoors. In addition, gastro-intestinal adsorption of lead is five to ten times greater in infants and young children than in adults. Inhalation of lead-contaminated dust is another major route for exposure to lead in the environment, but more commonly affects adults in specific occupational settings rather than small children in their homes or outdoors in their yards.

At other lead sites in Ohio, the HAS and US EPA have used a 400 parts per million level of lead in residential soils as an “action level” for lead soil removal actions. The rationale for the use of this level is found in a US EPA Solid Waste and Emergency Response directive (US EPA, 1994). US EPA determined that a residential soil lead screening level of 400 ppm lead was protective of children in that exposure to lead levels in soils at 400 ppm or less was not expected to result in increased blood lead levels. It is believed that this conservative clean-up level is fully protective of public health, including sensitive segments of the population like small children.

SITE VISIT TO SAWYER-LUDWIG PARK

HAS staff visited the Sawyer-Ludwig Park site in Marion Friday, March 9, 2007 to observe conditions at the site following the completion of the Ohio EPA removal action and bank-restoration project. HAS staff had previously made four trips to the site prior to the removal action; twice in the summer of 1999, once in the winter of 2000, and the fourth on July 21, 2005.

In all site visits prior to the March 9^{th} visit, HAS staff observed visible, gross sediment contamination in the section of the stream/ditch west of the culvert under White Oak Road and east of the site of the former “Sawyer Lake” (near sample sites CDT-SE-01, ETQ17/MEMB67, and 99OJ01S04 See Figure 3 – Sample Locations). A layer of semi-solid, black sludge, 2 to 24 inches thick, was observed in the channel of the stream, buried under a thin (1 to 3 inch) veneer of silt, sand, and gravel. When poked with a stout stick, an oily sheen developed on the surface of the water and the end of the stick was covered with a thick coating of black, viscous material that smelled strongly of petroleum. Sampling of this material by Ohio EPA in 1998 and 1999 revealed that these sludges had a composition consisting of numerous polycyclic aromatic hydrocarbon compounds (PAHs) with individual concentrations at the parts per million level.

The March 9^{th}, 2007 visit documented the results of the Ohio EPA removal action and bank restoration project completed in June, 2006. Thick brush and numerous small trees had been removed with the steep banks and sludge-contaminated channel-fill deposits in upstream portions of the stream/ditch had been excavated down to the native clay and removed off-site for disposal. HAS staff walked the length of the stream/ditch from the culvert under White Oak Road, west across the park to the wooded area northwest and downstream of the rock-check dam constructed at the site of the old earthen dam that created the former “lake” (Figure 2). Live and dead specimens of a small sunfish were observed in this portion of the stream/ditch. Much of the bottom along this stretch of the stream/ditch is now firm, compact, native clay. Remaining isolated pockets of soft sediments, when prodded with a stick, resulted in tan silt plumes with no visible oil sheen. Sediments adhering to the distal end of the stick consisted only of clays and silts with no petroleum smell. There was no visible evidence of the previously observed, grossly-contaminated sediments remaining in any portion of the stream/ditch assessed by HAS staff in the latest site visit.

The visible gross sediment contamination, the basis of the recommendation to issue a contact advisory warning visitors to the park to avoid contact with the stream/ditch, is no longer present in stream/ditch sediments at the park.

Children’s Health

ATSDR and HAS recognize the unique vulnerabilities of children exposed to environmental contamination and hazards. Children are especially sensitive to lead toxicity. As part of this health assessment, HAS considered the greater sensitivity of the children who live in the area and may visit the park when drawing conclusions and making recommendations regarding health effects from exposure to chemicals at the site.

HAS evaluated the likelihood that children playing in or near the Sawyer Ludwig Tributary and determined this was likely given the proximity of the park to nearby residential areas and the attraction water bodies usually hold for children.

Conclusions

The site, following the Ohio EPA removal action, currently *poses* a *"no apparent public health hazard"* to visitors of the park. Although, stream/ditch sediment and soil with high concentrations of PAHs and lead were removed from the site, some sediments and soils with lower concentrations of PAHs and lead remain on site. Visitors of the park may come into contact with low concentrations of these chemical compounds that are comparable to concentrations in other urban areas across the state. These concentrations are at levels that are not likely to pose a health threat to sensitive segments of the population, including children.

The initial ODH concerns regarding the health threat posed by the gross sediment contamination by waste oil sludges at the park, have been eliminated by the Ohio EPA Sediment Removal Action.

Recommendations

The PAH and lead contaminated sediments have been removed and more natural configuration for the stream/ditch has been restored. HAS was informed that the water from the storm sewer outfall has had high concentrations of fecal coliform bacteria in the past (Ohio EPA, 2006c). Until the source of these bacteria is eliminated, a contact advisory for the water should remain for this stream/ditch in Sawyer-Ludwig Park. However the contact advisory based on the gross sediment contamination should be removed.

Public Health Action Plan

The purpose of the public health action plan (PHAP) is to ensure that this health consultation goes beyond presenting HAS conclusions and recommendations about public health issues at the Sawyer-Ludwig Tributary site. The PHAP describes activities that have been completed and future activities that are designed to educate the public and ease concerns about contamination at the site.

Actions taken:

1. Ohio EPA collected sediment samples from areas of the tributary in August and November of 1998 and then again in March and October of 1999. Samples were analyzed for volatile compounds, semi-volatile compounds and metals, and pesticides.

2. On December 7, 1999 Ohio EPA submitted a letter to the United States Environmental Protection Agency requesting a removal action on the portion of the tributary that runs through Sawyer Ludwig Park.

3. In January 2000, HAS submitted a letter to the City of Marion Health Department recommending that they issue a precautionary contact advisory for the stream/ditch to Columbia Street Ditch due to elevated PAH levels in the subsurface sediment and the presence of a visible sheen on the water's surface when the sediment was disturbed.

4. A public availability session was conducted by OEPA and HAS on January 26, 2000 to allow citizens to have their health and environmental questions answered by various state and local agencies.

5. Ohio EPA Stream Sediment Removal Action (2006) removed gross contamination from stream sediments and restored the stream to a more natural configuration.

6. HAS reviewed the results of Ohio EPA Sediment Removal Action (March, 2007) and determined that bulk of gross contamination in stream sediments has been removed and that contaminants in the stream/ditch sediments no longer pose a public health threat through incidental contact.

7. HAS has contacted the Marion City Health Department who will be sampling for coliform bacteria in stream/ditch surface waters in the park.

Actions planned:

HAS will evaluate any additional environmental data from further investigations.

Prepared by

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Peter Ferron

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CERTIFICATION

This Sawyer Ludwig Tributary to Columbia Ditch Health Consultation was prepared by the Ohio Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun. Editorial review completed by the Cooperative Agreement Partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

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

Jennifer A Freed for

Team Lead, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

TABLES

TABLE 1 - LEAD AND PAH LEVELS PRE AND POST CLEANUP					
PRE-CLEANUP			**POST-CLEANUP**		
	Lead (ppm)	**Total PAHs (ppm)**		**Lead (ppm)**	**Total PAHs (ppm)**
Sediment Samples from Creek	**Action Level 400 ppm**	**Action Level 16 ppm**	**Sediment Samples from Creek**	**Action Level 400 ppm**	**Action Level 16 ppm**
CDT-SE-01		115	**SPR-27/28**	ND	ND
CDT-SE-02	41.8	7	**CDT-SE-02-06**	51.3	2
CDT-SE-03	80.7	10	**CDT-SE-03-06**	88.8	7
			CDT-SE-04-06*	58.5	<1
ETQ17/MEMB67	510	295	**SPR-34**	ND	ND
99OJ01S04	64	1074	**SPR-34**	ND	ND
Soil Samples from Lakebed			**Soil Samples from Lakebed**		
CDT-SO-01	1020	26	**SPR-11**	368	10.9
CDT-SO-02	905	24	**SPR-12**	332	8
CDT-SO-03	40.4	33	**SPR-10**	332	5.6
CDT-SO-04	882	24	**SPR-17**	283	3.3
CDT-SO-05	46.4	6	**SPR-16**	212	2.9
CDT-SO-06	671	10	**SPR-14**	380	ND
CDT-SO-07	261	22	**SPR-38**	ND	0.157
CDT-SO-08	61.4		**SPR-08**	176	2.9
CDT-SO-09	111	2	**SPR-09**	240	6.9
CDT-SO-10	76	0.4	**SPR-10**	332	5.6
CDT-SO-11	43.5		**SPR-22**	134	2

*Duplicate of CDT-SE-03-06

SHADED AREAS - ABOVE ACTION LEVELS

FIGURES

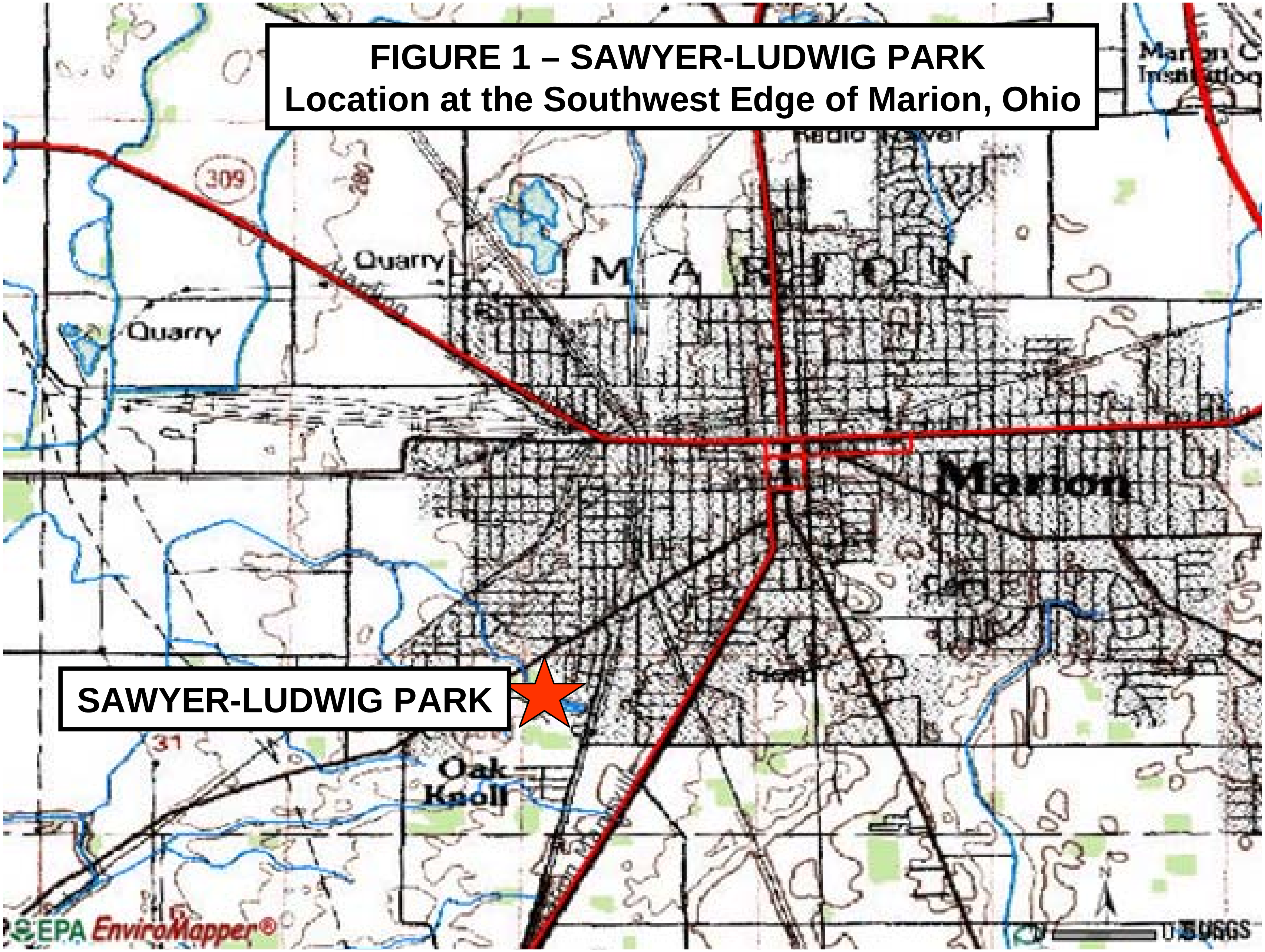
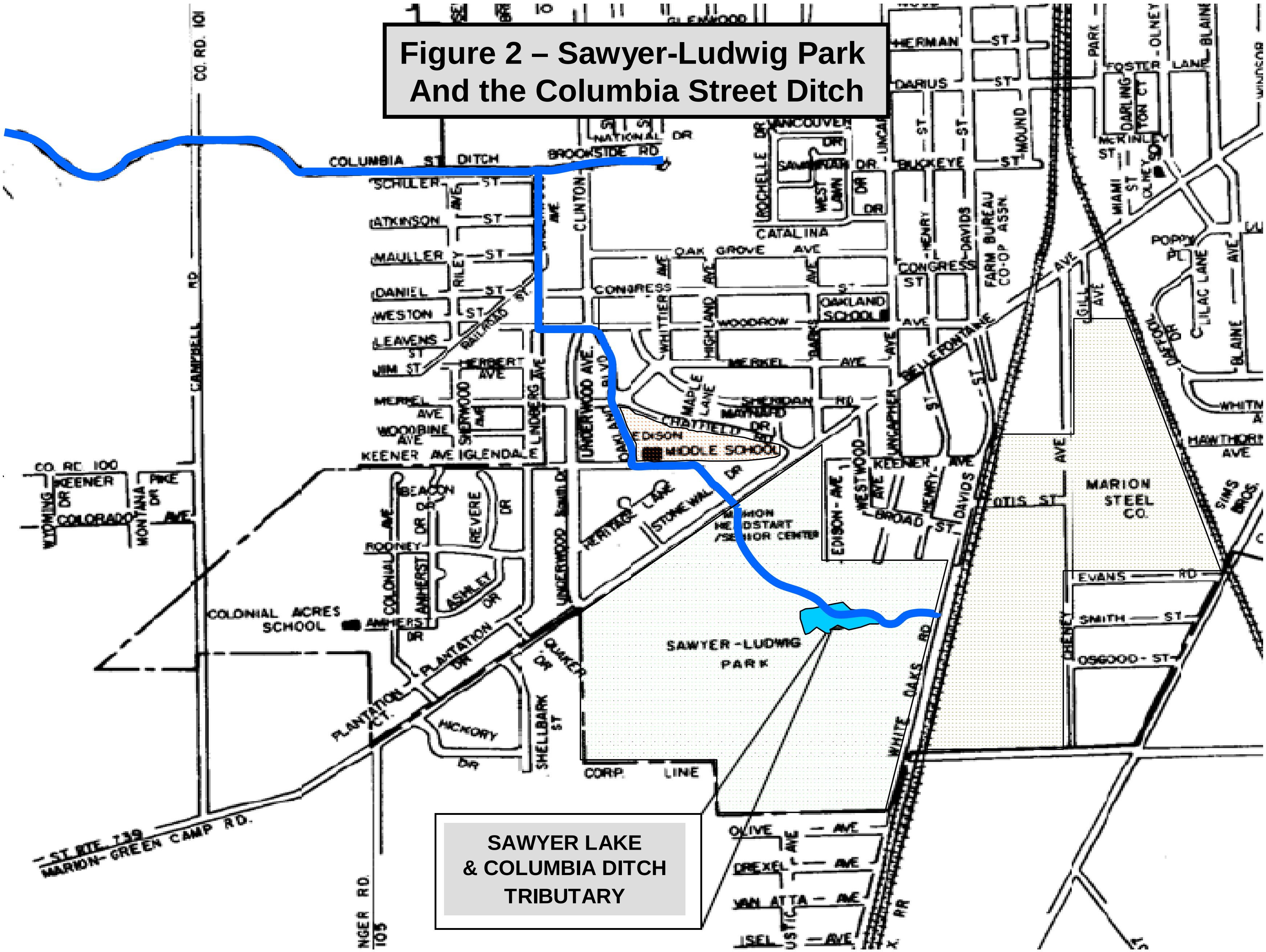


FIGURE 1 – SAWYER-LUDWIG PARK
Location at the Southwest Edge of Marion, Ohio
SAWYER-LUDWIG PARK
Marion
MARION
Quarry
Quarry
309
Radio Tower
Oak Knoll
31
EPA EnviroMapper®
USGS

Figure 2 – Sawyer-Ludwig Park And the Columbia Street Ditch



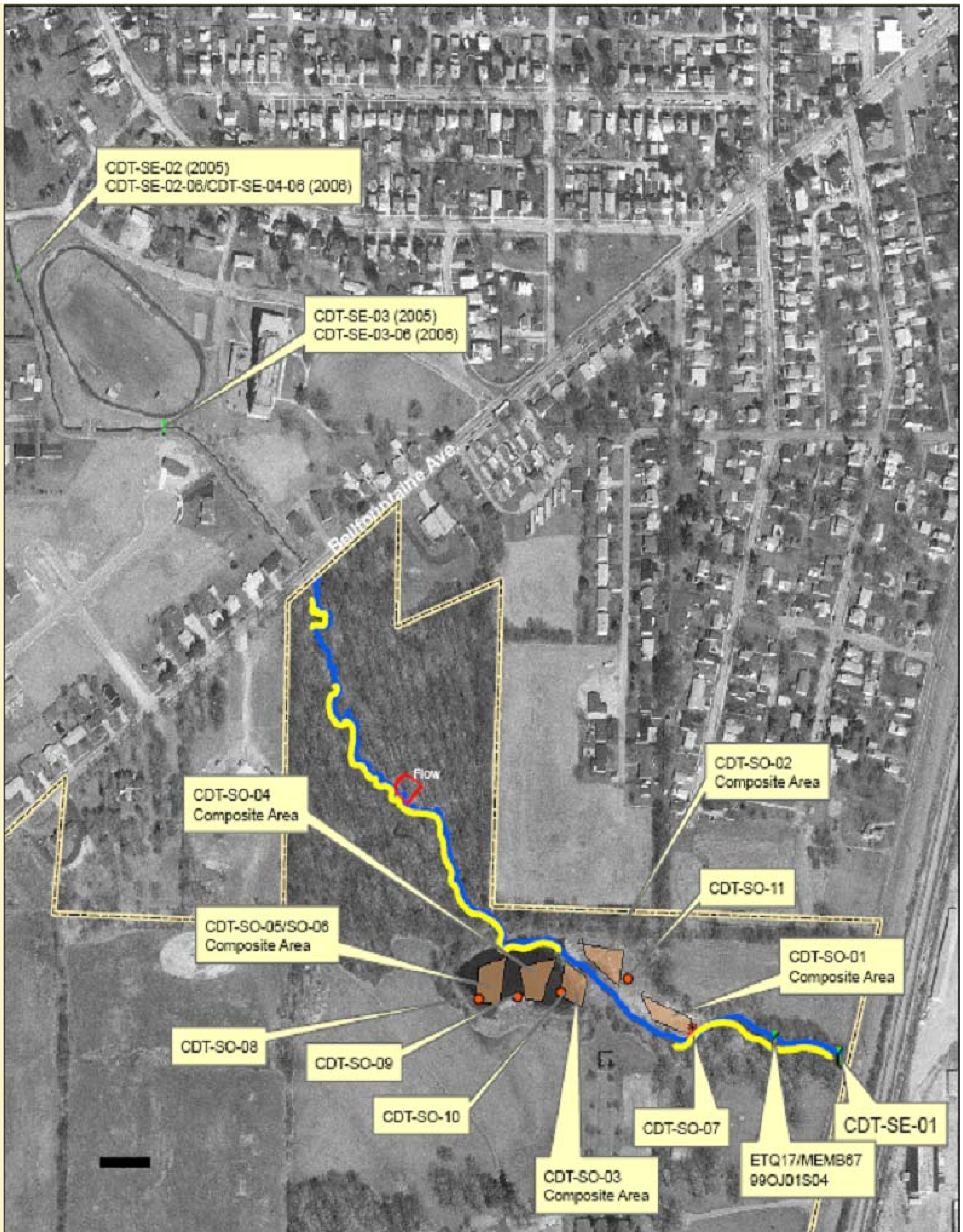


Figure 3 - Sample Locations

FACT SHEETS

Bureau of Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Polycyclic Aromatic Hydrocarbons (PAHs)

Answers to Frequently Asked Health Questions

What are Polycyclic Aromatic Hydrocarbons (PAHs)?

PAHs are a group of chemicals naturally found in coal, coal tars, oil, wood, tobacco and other organic materials. PAHs are released into the environment as the result of the incomplete burning of these materials.

There are more than 100 different PAHs. PAHs are the waxy solids found in asphalt, crude oil, coal, coal tar pitch, creosote and roofing tar. Some types of PAHs are used in medicines and to make dyes, plastics and pesticides.

PAHs are ubiquitous (are everywhere) throughout the world and can be found in every type of environment. Urban environments (cities) tend to have higher levels of PAHs due to the increased amounts of gas and oil burned as well as the increased use of asphalt and tars on roads and shingles on roofs.

What happens to PAHs when they enter the environment?

PAHs can enter the environment in the air from volcanoes, forest fires, residential wood burning and exhaust from cars and trucks.

In urban (city) environments, PAHs can enter creek and river sediments (soils) from water running off asphalt roads, parking lots and driveways. PAHs are also found in roofing shingles and tars and can run off roofs to be carried to downspouts and drainage systems during rain events.

Some of the PAHs are lighter (or a lower molecular weight) and can volatize (evaporate) into the air. These PAHs break down by reacting with sunlight and other chemicals in the air. This generally takes days to weeks. The more sunlight, the quicker these PAHs will breakdown. These lighter (low molecular weight) PAHs are less toxic to humans and are not carcinogenic (cancer causing).

Heavier (or a higher molecular weight) PAHs do not dissolve in water, but stick to solid particles and settle to the sediments in bottoms of lakes, rivers or streams. These "fat" PAHs stick to soils and sediments and will generally take weeks to months to break down in the environment. Microorganisms in soils and sediments are the main cause of breakdown. These heavy PAHs are carcinogenic (cancer causing) to lab animals and may be carcinogenic to humans.

How might I be exposed to PAHs?

For most of the U.S. population, the primary sources of exposure to PAHs are inhalation of compounds in tobacco smoke, wood smoke and the ambient (outside) air. Smoke may contain both light (vapors) and heavy (soot or ash) PAHs.

You may also be exposed to PAHs by incidental (minor or casual) contact to lake, river or creek sediments or by eating smoked or charbroiled foods.

Overall exposure to PAHs will increase if persons come in contact with PAHs in their workplace. PAHs have been found in industries such as coal tar production plants, smoke houses, coking plants, aluminum production plants, coal tarring facilities and municipal trash incinerators. Also, PAHs can be found in industries such as mining, oil refining, metalworking, chemical production, transportation and the electrical industry. PAHs have also been found in other facilities where petroleum and petroleum products are used or where coal, oil, wood or cellulose is burned.

PAHs are present throughout the environment and you may be exposed to these substances at home, outside or at the workplace. Typically, you will not be exposed to an individual PAH, but to a mixture of PAHs.

How do PAHs enter and leave my body?

PAHs can enter your body through your lungs when you breathe air. However, it is not known how rapidly or completely your lungs absorb PAHs.

PAHs can enter your body through drinking water and swallowing food, soil or dust particles that contain PAHs. But absorption is generally slow when PAHs are swallowed and generally you will not be ingesting (swallowing) large amounts of PAHs.

Under normal conditions of environmental exposure, PAHs could enter your body if your skin comes into contact with soil that contains high levels of PAHs. Studies have shown that low molecular weight (lighter) PAHs can be absorbed through the skin but the absorption of high molecular weight (heavy) PAHs is quite limited.

Once in the human body, PAHs are changed into different substances and stored in tissue and fat cells.

Results from animal studies show that PAHs do not tend to be stored in your body for a long time. Most PAHs that enter the body leave within a few days, primarily in the feces and urine.

Can PAHs make you sick?

Yes, you can get sick from PAHs. But getting sick will depend on:

- How much you were exposed to (dose).
- How long you were exposed (duration).
- How often you were exposed (frequency).
- Route of exposure: Ingesting (eating) and inhaling (breathing) is more of a risk than dermal (skin) exposure.
- General Health, age, lifestyle: Young children, the elderly and people with chronic (on going) health problems are more at risk to chemical exposures.

PAH's have a low acute toxicity. What this means is that if you were exposed to high levels of PAH's for a short period of time, you will most likely not experience harmful health effects.

Chemicals with high acute toxicity are chemicals that would cause immediate harmful health effects or even death if you came in contact with a high dose. Examples of chemicals with a high acute toxicity are cyanide or arsenic. If you were to come in contact with high levels of arsenic or cyanide, you could die. This is not the case with PAHs.

Do PAHs cause cancer?

It is uncertain if PAHs are carcinogenic (cancer causing) to humans.

Several studies have shown that PAHs have caused tumors in laboratory animals when they breathed these substances in the air, when they ate them or when they had long periods of skin contact with them. Studies in animals have also shown that PAHs can cause harmful effects on skin and the body's system for fighting disease after both short and long-term exposure. But these effects have not been reported in humans.

Studies of people show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds may develop cancer. But the studies were uncertain if the cancer was caused by PAHs or the other associated chemicals.

The U.S. Department of Health and Human Services (HHS) has determined some PAHs are known animal carcinogens.

The International Agency for Research on Cancer (IARC) has determined some PAHs are probably carcinogenic to humans, some PAHs are possibly carcinogenic to humans and some PAHs are not classifiable as to their carcinogenicity to humans.

The U.S. Environmental Protection Agency (EPA) has determined some PAHs are probable human carcinogens and some PAHs are not classifiable as to human carcinogenicity.

Is there a medical test to determine whether I have been exposed to PAHs?

Yes. Many PAHs can be measured in the blood or urine soon after exposure. Although these tests can show that you have been exposed to PAHs, these tests cannot be used to predict whether any health effects will occur or to determine the extent or source of your exposure to the PAHs. It is not known how effective or informative the tests are after exposure has stopped. The medical tests used to identify PAHs or their products are not routinely available at a doctor's office because special equipment is required to detect these chemicals. Seek medical advice if you have any symptoms you think may be related to chemical exposure.

What recommendations has the federal government made to protect human health?

Water: Drinking Water MCL (Maximum Contaminant Level) for *Benzo (a) pyrene* is 0.2 ppb (parts per billion). *Benzo (a) pyrene* is a heavy (or a higher molecular weight) PAH.

Air: No standards exist for the amount of PAHs allowed in the air of private homes. However, air standards have been set for occupational (work) settings.

The Occupational Safety and Health Administration (OSHA) has set a limit of 0.2 milligrams of PAHs per cubic meter of air (0.2 mg/m^3). The OSHA Permissible Exposure Limit (PEL) for mineral oil mist that contains PAHs is 5 mg/m^3 averaged over an 8-hour exposure period.

The National Institute for Occupational Safety and Health (NIOSH) recommends that the average workplace air levels for coal tar products not exceed 0.1 mg/m^3 for a 10-hour workday, within a 40-hour workweek. There are other limits for workplace exposure for things that contain PAHs, such as coal, coal tar and mineral oil.

For more information about PAHs:

For detailed information about PAHs, visit the Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for PAHs.
Web Site: http://www.atsdr.cdc.gov/toxprofiles/tp69.html
E-mail: ATSDRIC@cdc.gov
Toll-free: 1-888-422-8737

References:

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons (PAHs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

ATSDR. 1990. Polynuclear Aromatic Hydrocarbon (PAH) Toxicity. Case Studies in Environmental Health Medicine #13. U.S. Department of Health and Human Services. 19p.

Wisconsin Department of Health and Family Services, Division of Public Health, Bureau of Environmental Health, Chemical Fact Sheet, PAHs, 2004.

Bureau of
Environmental Health
Health Assessment Section

"To protect and improve the health of all Ohioans"

Lead

Answers to Frequently Asked Health Questions

What is lead?

Lead is a naturally occurring bluish-gray metal found in small amounts of the earth's crust. Prior to our current knowledge of the health hazards of lead, it was widely found in many of the products we used every day. Products such as gasoline, paints, batteries, metal products and ammunition just to name a few. Because lead is toxic, its use has been dramatically reduced since the 1980's.

Lead in the environment:

Lead does not break down in the environment. And although lead occurs naturally in the environment, most of the high levels of lead found come from human activities.

Once lead falls on to soil, it usually sticks to the soil particles. If the soil is uncovered and open to the air or becomes disturbed, lead-contaminated dust is created and carried by the wind. This dust is easily breathed in or swallowed. With construction activities, the possibility of lead-contaminated dust is an important concern.

Gardens grown in lead-contaminated soils may contain lead. Produce of fruits, grains and vegetables (especially root vegetables such as beets, carrots, parsnips, radishes, turnips, and rutabagas) absorb some of the lead through their roots. There is also the possibility of lead-contaminated dust falling onto crops.

Inside the house, lead can be found in lead-based paint, lead-contaminated dust, older lead pipes that carry water and some glazed pottery. A child can easily eat lead paint chips, breathe or ingest the dust on their fingers.

How does lead get in your body?

You may be exposed to lead by breathing (inhalation), eating/drinking (ingestion) or by skin contact (dermal contact). However, only very small amounts of lead can get into your body through dermal contact. Inhalation and ingestion of lead-contaminated dust and soil are the main health concerns.

How does lead affect your health?

The harmful effects of lead are the same whether it is breathed or swallowed. The main target for lead toxicity is the nervous system, including the brain. But lead can negatively affect every organ of the body.

Children are most vulnerable to lead poisoning because they play outside, close to the ground or in the dirt. Small children also put their fingers in their mouths. Compared to adults, a bigger proportion of the amount of lead swallowed will enter the blood in children. About 99% of the amount of lead taken into the body of an adult will leave in the waste within a couple of weeks. But only about 32% of the lead taken into the body of a child will leave in the waste.

Lead exposure in the womb, in infancy, or in early childhood may also slow mental development and lower intelligence later in childhood. Lead can cause irritability and aggressive behavior in children. If pregnant women have high levels of lead in their bodies, fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. In some cases, pregnant women with high levels of exposure to lead may have miscarriages.

Some other harmful health effects of lead include damaged kidneys, damaged male reproductive system, severe "stomachaches," a poor appetite, sleep disorders, and hearing problems. Lead can also decrease reaction time and affect the memory.

Is there a medical test to determine whether I have been exposed to lead?

Yes, there is a test to see if you have been exposed to lead. The primary screening method is the measurement of total lead in the blood. This test can tell if you have been recently exposed to lead.

Also, exposure to lead can be evaluated by measuring the erythrocyte protoporphyrin (EP) in the blood sample. EP is a part of red blood cells known to increase when the amount of lead in the blood is high. However, the EP level is not sensitive enough to identify children with elevated blood lead levels below about 25 micrograms per deciliter (µg/dL). For this reason, total lead is the primary method of screening.

Lead can also be measured lead in teeth or bones by X-ray techniques. These tests can tell about long-term exposure but are not widely available..

How can families reduce the risk of exposure to lead?

The most important way a family can lower exposures to lead is to avoid exposure to lead-contaminated soil and dust sources, avoid lead-based paint chips, avoid water from lead-lined pipes and avoid some plastic products made outside the United States.

The swallowing of lead-contaminated soil or dust is a very important exposure pathway for children. This problem can be reduced in many ways. Regular hand and face washing to remove lead dust and soil, especially before meals, can lower the possibility that lead on the skin is accidentally swallowed while eating. Families can lower exposures to lead by regularly cleaning the home of dust and tracked-in soil. Door mats can help lower the amount of soil that is tracked into the home and removing your shoes before you enter the house will also help. Planting grass and shrubs over bare soil areas in the yard can lower contact that children and pets may have with soil and the tracking of soil into the home. Also, wash all produce grown in lead-contaminated soils before eating.

Families whose members are exposed to lead-contaminated soil and dust can minimize the exposure to children by changing and bagging their work clothes before they are brought into the home for cleaning. Also, they should immediately wash their hands or shower.

It is important that children have proper nutrition and eat a balanced diet of foods that supply adequate amounts of vitamins and minerals, especially a diet high in calcium and iron. Good nutrition lowers the amount of swallowed lead that passes to the bloodstream and also may lower some of the toxic effects of lead.

The Ohio Department of Health has a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), Public Health Service, U.S. Department of Health and Human Services.

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Has the federal government made recommendations to protect human health?

The Centers for Disease Control and Prevention (CDC) considers children to have an elevated level of lead if the amount of lead in the blood is at least 10 µg/dL. Medical evaluation and environmental investigation and remediation should be done for all children with blood lead levels equal to or greater than 20 µg/dL. Medical treatment may be necessary in children if the lead concentration in blood is higher than 45 µg/dL.

The Environmental Protection Agency (EPA) requires that the concentration of lead in air that the public breathes be no higher than 1.5 micrograms per cubic meter ($\mu g/m^3$) averaged over 3 months. EPA regulations no longer allow lead in gasoline. The Clean Air Act Amendments (CAAA) of 1990 banned the sale of leaded gasoline as of December 31, 1995.

The EPA regulations also limit lead in drinking water to 0.015 milligrams per liter (mg/L). The 1988 Lead Contamination Control Act requires the Consumer Product Safety Commission (CPSC), EPA, and the states to recall or repair water coolers containing lead. This law also requires new coolers to be lead-free. In addition, drinking water in schools must be tested for lead, and the sources of lead in this water must be removed.

To help protect small children, CPSC requires that the concentration of lead in most paints available through normal consumer channels be not more than 0.06%. The Federal Hazardous Substance Act (FHSA) bans children's products containing hazardous amounts of lead.

The EPA has also developed standards for lead paint hazards, lead in dust, and lead in soil. To educate parents, homeowners, and tenants about lead hazards, lead poisoning prevention in the home, and the lead abatement process, EPA has published several general information pamphlets. Copies of these pamphlets can be obtained from the National Lead Information Center or from various Internet sites, including http://www.epa.gov/opptintr/lead.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 1997. Toxicological profile for lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information?

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