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Understanding PCB Risks at the
GE-Pittsfield/Housatonic River
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Understanding PCB Risks at the GE-Pittsfield/Housatonic River Site

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What are PCBs?

PCBs are a group of man-made organic chemicals consisting of carbon, hydrogen, and chlorine atoms. PCBs were manufactured in the US from 1929 until their manufacture was banned in 1979.

For more information on PCBs, please visit EPA's PCB webpage <https://epa.gov/pcbs>.

Printer-friendly Fact Sheets

- PCB Fact Sheet Regarding PCB Exposure Associated with the GE Pittsfield Facility and the Housatonic River (pdf) (483 K)
- ATSDR FAQs about PCBs

Fast Facts: Housatonic River PCBs

- The Housatonic River and its floodplain are heavily contaminated with PCBs originating from the GE Facility in Pittsfield, MA.
- Most of the contamination is found between the confluence of the East and West branches in Pittsfield and Woods Pond Dam in Lenox and further into Rising Pond in Great Barrington, MA.
- Currently, more than 50% of the PCBs that enter Woods Pond go over the dam and continue downstream, even into Connecticut. A distance of approximately 140 miles.

- PCBs are present in large quantities in river sediment and floodplain soil; estimates range from between 100,000 to nearly 600,000 pounds of PCBs.
- The PCBs found at this site are persistent in the environment and resistant to biodegradation. As a result, the rate of natural degradation of the type of PCBs in the Housatonic River is very slow --- on the scale of hundreds of years.
- Without cleanup, it would take decades if not hundreds of years, before PCB concentrations in fish would decrease to a level that would permit unlimited consumption.

GE/Housatonic River Site Update (pdf) (700 K) on how PCBs move through the environment, what EPA knows about the PCBs in the Housatonic River, and their health effects.

How do PCBs get into the environment?

PCBs entered the air, water, and soil during their manufacture, use, and disposal; from spills and leaks during their transport; and from leaks in products containing PCBs.

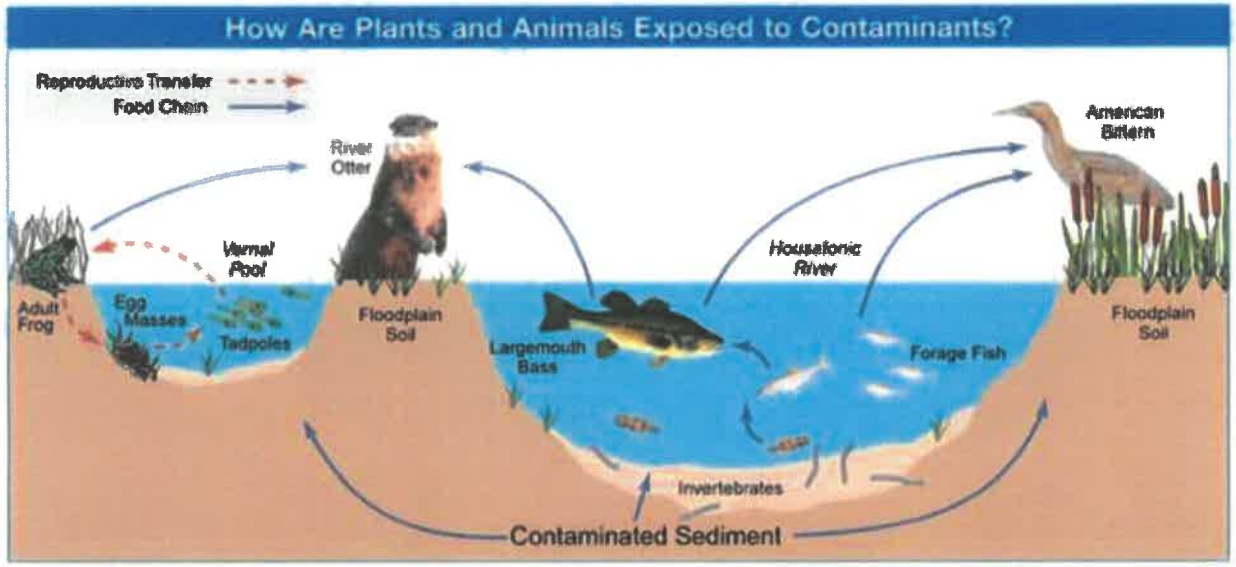
Once in the environment, most PCBs do not readily break down and may remain for very long periods of time. PCBs can travel long distances in the air and via suspended solids in water and be deposited in areas far from where they were originally released.

In water, a small amount of PCBs may be dissolved, but most stick to organic particles and soil/sediment. That is because soil and sediment consist not just of mineral particles, but also include organic carbon.

Each congener (PCB mixture) has a different potential for degradation. In general, "lighter" PCBs have a higher degradation potential. The heavier PCBs, such as the ones in the Housatonic watershed (Aroclors 1254 and 1260), are more persistent in the environment because they are more resistant to volatilization, weathering, biodegradation and other mechanisms of degradation.

Many different types of natural degradation have been documented in PCB-contaminated sediment and soil; however, although some PCB congeners eventually degrade, the rate of degradation of the type of PCBs found in the Housatonic watershed is very slow, on the scale of hundreds of years.

How do PCBs get into plants and animals?



View a larger version of this image <https://epa.gov/sites/default/files/2015-05/howplantsanimalsexposed2contaminants.jpg>.
Graphic derived from GE Housatonic Ecological Risk Assessment Fact Sheet

PCBs in the environment are taken up by many animals and a few plants in a process known as bioaccumulation.

Bioaccumulation can occur in wild populations and animals that are raised for food in both commercial and backyard operations. The rate of bioaccumulation and the concentration of PCBs in an organism depends on many factors, one of the most important being the amount of fat (lipid) in body. In general, organisms with high amounts of body fat will accumulate higher concentrations of PCBs than those with less fat. The vast majority of PCBs in any living organism will be found in the fat cells. Other factors controlling organism-specific bioaccumulation include life history and diet.

Studies show that while PCBs accumulate rapidly in most animals, they are slow to leave the body. Once they have entered the body, PCBs are moved to fat reservoirs where they tend to remain for long periods of time, typically for the life of the animal, reaching concentrations that may be many thousands of times higher than in water, sediment, or soil, a process known as **biomagnification**. PCBs have been measured at very high concentrations in biota in the Housatonic River watershed, leading to consumption advisories for fish, frogs, turtles and waterfowl in MA, and fish in CT.

In contrast, most plants do not bioaccumulate PCBs from contaminated soil due to the presence of a waxy layer, or cuticle, which binds the PCBs and prevents them from being absorbed into the plant. Some plants in the squash family appear to be able to accumulate PCBs from soil via their roots. Studies of tomatoes grown downwind from a PCB-contaminated sediment site demonstrated that lighter, more volatile, congeners released into the atmosphere can be taken up by the leaves and transported into edible portions of the plant.

Generally, however, most of the PCBs remain on the surface of fruits and vegetables, often as part of the soil deposited by wind or rainwater splash clinging to the plant.

Wildlife and Human Health Effects from PCBs

PCBs have been demonstrated to cause a wide variety of adverse health effects, as well as cancer. There are a number of serious non-cancer health effects in animals, including effects on the immune system, reproductive system, nervous system, endocrine system and other organs. Studies in humans provide supportive evidence for potential carcinogenic and non-

carcinogenic effects of PCBs. The different health effects of PCBs may be interrelated, as alterations in one system may have significant implications for the other systems of the body. Some PCB congeners exhibit dioxin-like effects.

Cancer

Studies definitively show that PCBs cause cancer in animals. The data strongly suggest that PCBs are probable human carcinogens, and EPA and the International Agency for Research on Cancer have classified them as such.

Immune Effects

Studies in animals have revealed serious effects on the immune system following exposures to PCBs, including a significant decrease in size of the thymus gland, reductions in the response of the immune system following a challenge with sheep red blood cells (a test of the antibody response and protective immunity), and decreased resistance to Epstein-Barr virus and other infections. Immune effects were also noted in humans who experienced exposure to rice oil contaminated with PCBs, dibenzofurans and dioxins.

Reproductive Effects

Reproductive effects of PCBs have been studied in animal species. Potentially serious effects on the re-productive system were seen following exposures to PCB mixtures. Most significantly, PCB exposures were found to reduce the birth weight, conception rates, and live birth rates of monkeys and other species, and PCB exposure reduced sperm counts in rats. Effects in monkeys were long-lasting and were observed long after the dosing with PCBs occurred. Studies of reproductive effects have also been carried out in human populations exposed to PCBs. Children born to women who worked with PCBs in factories, and studies in fishing populations, showed decreased birth weight and a significant decrease in gestational age with increasing exposures to PCBs.

Neurological Effects

Effects of PCBs on nervous system development have been studied in animal species. Newborn monkeys exposed to PCBs showed persistent and significant deficits in neurological development, including visual recognition, short-term memory and learning. Studies in humans have suggested effects similar to those observed in monkeys exposed to PCBs, including learning deficits and changes in activity associated with exposures to PCBs.

Endocrine Effects

PCBs have been demonstrated to exert effects on thyroid hormone levels in animals and humans.

Other Non-cancer Effects

A variety of other non-cancer effects of PCBs have been reported in animals and humans, including skin and eye effects and liver toxicity. Elevations in blood pressure, serum triglyceride, and serum cholesterol have also been reported with increasing serum levels of PCBs in humans.

Understanding the Housatonic Rest of River Risk Assessments

EPA's Human Health Risk Assessment (2005) for the Housatonic Rest of River and its floodplain, quantifies risks to adults and children exposed to PCBs originating from the GE Facility in Pittsfield, MA. For a risk, there must be an exposure; potential exposures could occur while living or working near the river and its floodplain, or using either for recreation or agriculture.

EPA's Ecological Risk Assessment (2004) quantifies risks from PCBs to the animals living and / or feeding in the Housatonic Rest of River and its floodplain.

Both the Ecological and Human Health Risk Assessments at this site were conducted by teams of experts working with EPA using state-of-the-art techniques. These assessments were based on an extensive site-specific database derived from thousands of samples collected over several years as well as laboratory and field studies. Both went through a public external review process and formal public comment period. The peer review panels were composed of internationally recognized experts in risk assessment.

NOTE: These risk assessments address what EPA considers the "Rest of River" which does not include the upper 2-mile reach which has since broken into the Upper ½ Mile reach and the 1 ½ mile reach and the floodplains adjacent to the 1 ½ Mile reach. To see risk assessment information for the upper section, or beginning portion of the river:

- Human Health Evaluation and Ecological Risk Assessment Regarding PCB Contamination in Two Mile Stretch of Housatonic River <https://epa.gov/ge-housatonic/fact-sheet-spring-1998-human-health-evaluation-and-ecological-risk-assessment>

Housatonic Rest of River Human Health Risks from PCBs

This assessment began with an initial screening of all environmental media (air, soil, water, food…) to determine the most serious routes of exposure to PCBs in the river and its floodplain. The routes of exposure were identified as:

- Direct contact with contaminated soil and sediment,
- Consumption of contaminated fish and waterfowl, and
- Consumption of contaminated agricultural products produced in the floodplain.

The assessment evaluated each of these pathways separately and provided insight into how these risks could be combined for individuals exposed to multiple pathways.

*Note: Risks from exposure to PCBs in river water and air were found to be below levels EPA considers to be unacceptable.

EPA identified carcinogenic, and non-carcinogenic risks from exposure to soil along the river, consumption of area fish and waterfowl, as well as risks from the consumption of agricultural products grown on commercial, backyard farms or gardens. For specific information as well as graphs summarizing the range of risks, see this Community Update regarding site risks (pdf) (1 MB).

Housatonic Rest of River Ecological Health Risks from PCBs

EPA's Ecological Risk Assessment (2004) of the Housatonic Rest of River and its floodplain studied risk to eight different groups of animals:

- Benthic Invertebrates
- Amphibians
- Fish
- Insectivorous (insect-eating) Birds
- Piscivorous (fish-eating) Birds
- Piscivorous Mammals
- Omnivorous / Carnivorous (plant and animals/ animal-eating) Mammals
- Threatened & Endangered Species

These groups are all important components of the Housatonic River ecosystem. Concentrations of PCBs in the environment that each group comes into contact with (generally by water, sediment, soil, and food) were compared to data on the toxicity of PCBs for the species in question. In addition, site-specific field surveys and toxicity studies using soil, sediment, water, and animals collected from the site were conducted for many species by scientists from around the country. Read the detailed findings about Ecological Risk Assessment Peer Review , or review the Fast Facts: Ecological Risk Assessment below.

Fast Facts: Ecological Risk Assessment

- For many species, PCBs in the river and / or floodplain are 10 or as much as 100 times greater than a concentration considered to not pose a risk to that species.

- Site-specific field and toxicity studies observed these and other effects:
  - Benthic invertebrate mortality and impaired development;
  - Reduced survival of larval fish, and various deformities including swim bladders that were malformed or formed outside of the body cavity;
  - Frogs with abnormal egg masses, malformations, impacts to metamorphosis (development from tadpoles to frogs), and sex changes;
  - Mortality in 50% of mink young within six weeks of birth from mothers that were fed a diet containing very low concentrations of PCBs in fish harvested from the Housatonic River. Jaw lesions were observed in the developing young that did survive, which results in eventual loss of teeth, leading to anorexia and finally death.
  - While not measured directly, there is expected impairment of reproduction in osprey and bald eagles.
- Many species of aquatic life and wildlife in the Housatonic River ecosystem are at an intermediate to high risk from their exposure to PCBs in both the river and floodplain.
- Similar risks extend to species beyond those specifically evaluated.

Effects to Ecological Receptors in the Rest of River

PCBs in the environment affect ecological receptors to varying degrees and in a variety of ways; these differences in the nature and extent of PCB effects depend in part on the specific PCB congeners present, as well as natural differences in basic physiological processes, diet, and life history among animal species. With the type of PCBs and concentrations measured in the Housatonic River and its floodplain, effects are considered likely. In a number of cases, significant adverse effects were documented in site-specific field and/or laboratory studies for the representative animal species evaluated in the Housatonic River Ecological Risk Assessment.

The known toxic effects of PCBs on aquatic species and wildlife include mortality, compromises in immune system function, and various adverse effects on reproduction, development, and endocrine function, in addition to a number of equally serious effects on other body systems. PCB exposure leads to a loss of liver function and death of liver tissue, and similar effects to the

tissues and organs of the digestive system. The nervous systems of animals are also affected, with resultant depression of motor activity and decreased perception. Other effects include behavioral abnormalities, impaired reproduction, and developmental toxicity. PCBs have been demonstrated in laboratory studies to promote cancer in a number of animal species. In sufficient doses, PCB exposure can lead to acute mortality in aquatic and wildlife species, and chronic exposure to lower doses can also result in mortality, leading to changes in community and ecosystem structure and function.

Benthic Invertebrates

PCBs in sufficient concentrations, which are exceeded in sediment in some areas of Housatonic River, are acutely toxic to aquatic organisms, particularly benthic invertebrates at the base of the aquatic food chain. These effects are commonly expressed by the absence of species of known sensitivity to PCBs, and as alterations in the structure of the benthic community when the more-sensitive species are replaced by more pollution-tolerant organisms. Non-lethal effects of PCBs on benthic organisms include reduction in growth and number of offspring. All of these types of effects were clearly demonstrated in the site-specific studies conducted using Housatonic River sediment and well-established sediment toxicity testing organisms. In addition, benthic community impairment also corresponded to PCB sediment concentration.

Fish

Fish from the Housatonic River that were captured and bred in captivity were shown to produce larvae with increased incidence of a wide variety of deformities, many of which are reported in the scientific literature to be related to PCB exposure. However, because of the large number of eggs fish produce and high natural mortality of the young, the effects of PCBs on the local fish populations do not appear to be significant.

Amphibians

Harmful effects can include damage to the reproductive organs of adults as well as decreased viability of offspring and life-threatening deformities in larvae. A number of reproductive effects such as deformed gonads (see pictures on page 5), impaired development, altered sex ratio, and larval deformities were observed in frogs and frog larvae exposed to PCBs from the Housatonic River floodplain vernal pools and backwaters.

Birds

PCB exposure has been demonstrated in species such as chickens and pheasants to cause decreased egg production and fertility with relatively low PCB exposure, and mortality with higher exposures. In contrast to the animal groups discussed above, however, some bird species such as hawks and finches appear to be less sensitive to the harmful effects of PCBs. Site-specific studies conducted on tree swallows, kingfishers, and robins in the Housatonic River study area did not identify severe effects as a result of PCB exposure. However, although no field study was conducted on wood ducks, measured exposures suggest that harm is likely for that species from dioxin-like PCBs. In addition, very high concentrations of PCBs were present in the migratory waterfowl sampled by EPA. Estimated exposure derived from their fish diet indicates the high probability of risk to fish eating birds such as osprey and bald eagles.

Piscivorous Mammals

Piscivorous (fish-eating) mammals such as mink and otter receive elevated exposure to PCBs with their diet of contaminated fish, due to bioaccumulation. In addition, certain piscivorous mammals, particularly mink, have been shown in the scientific literature to have unusually high sensitivity to the effects of PCBs.

In a carefully controlled dietary study conducted at the University of Michigan, the young (kits) of female mink fed a diet containing fish collected from the Housatonic River were shown to suffer from increased significant increased mortality and developed jaw lesions that would lead to death in the wild due to inability to consume a normal diet.

This study was corroborated by the result of field investigations indicating the absence of resident reproducing mink and otter, despite the highly suitable habitat present in the river and floodplain.

GE/Housatonic River Site Home <https://epa.gov/ge-housatonic>

Public Comment, Meetings and Events <https://epa.gov/ge-housatonic/public-comment-meetings-and-events-ge-pittsfield-housatonic-river-site>

Cleanup Areas in Focus <https://epa.gov/ge-housatonic/cleanup-areas-focus-ge-pittsfieldhousatonic-river-site>

Cleaning up the Housatonic <https://epa.gov/ge-housatonic/cleaning-housatonic>

Understanding PCB Risks

Cleanup Agreements <https://epa.gov/ge-housatonic/cleanup-agreements-ge-pittsfieldhousatonic-river-site>

Area Resources <https://epa.gov/ge-housatonic/federal-state-and-local-resources-ge-pittsfieldhousatonic-river-site>

Contact Us <https://epa.gov/ge-housatonic/forms/contact-us-about-ge-pittsfieldhousatonic-river-site> to ask a question, provide feedback, or report a problem.

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Grants <https://epa.gov/grants>

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