



ORRHES Brief

Oak Ridge Reservation Health Effects Subcommittee

Public Health Consultation, Y-12 Weapons Plant Chemical Releases into East Fork Poplar Creek, Oak Ridge, Tennessee, April 5, 1993

Site: Oak Ridge Reservation

Conducted by: Agency for Toxic Substances and Disease Registry

Time Period: Early 1990s

Location: East Fork Poplar Creek and Floodplain Area

Purpose

The purpose of the health consultation was to evaluate published environmental data and to assess health risks associated with Y-12 Weapons Plant releases at the Oak Ridge Reservation.

Background

Between 1950 and 1963, the Department of Energy (DOE) Y-12 Weapons Plant used mercury in a lithium separation process. DOE officials estimate that 110 metric tons of mercury were released to the East Fork Poplar Creek (EFPC), and that an additional 750 metric tons of mercury used during that period could not be accounted for. Releases of mercury to the creek contaminated instream sediments, and periodic flooding contaminated floodplain soils along the creek. Land uses along the floodplain are residential, commercial, and recreational. Furthermore, residents used the sediment to enrich private gardens, and the city of Oak Ridge used creek sediment as fill material on sewer belt lines. In 1983, the state of Tennessee publicly disclosed that sediment and soil in the EFPC floodplain were contaminated with mercury. That same year, the Oak Ridge Task Force initiated remediation of public and private lands within the city of Oak Ridge.

In 1992, during Phase IA of the EFPC remedial investigation, DOE conducted preliminary sampling of soil, sediment, surface water, and groundwater from the EFPC floodplain area. During 1990 and 1991, DOE sampled for contaminants in EFPC fish through its Biological Monitoring and Abatement Program.

Study design and method

This was a health consultation conducted by the Agency for Toxic Substances and Disease Registry (ATSDR). An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, chemical release, or the presence of hazardous material. In this case, DOE requested that ATSDR comment on the health threat posed by past and present chemical releases from the Y-12 Weapons Plant to the East Fork Poplar Creek. To conduct the consultation, ATSDR evaluated DOE's preliminary environmental sampling data for metals, volatile and semivolatile organic compounds, radionuclides, and polychlorinated biphenyls (PCBs).

Health consultations may lead to specific actions, such as environmental sampling, restricting site access, or removing contaminated material, or ATSDR may make recommendations for other activities to protect the public's health.

Study group

ATSDR did not conduct a study.

Exposures

ATSDR estimated human exposure to contaminated EFPC floodplain soil, sediments, surface water, groundwater, fish, and air.

Outcome measure

ATSDR did not review health outcome data.

Results

Only mercury in soil and sediment, and PCBs and mercury in fish, are at levels of public health concern. Other contaminants, including radionuclides found in soil, sediment, and surface water, are not at levels of public health concern. Data were not available on radionuclides in fish.

Elevated levels of mercury, up to 2,240 parts per million (ppm), were found in a few soil and sediment samples from all three creek areas sampled. The mercury in the EFPC soil consisted primarily of some

relatively insoluble inorganic forms of mercury (mercury salts and metallic mercury), with less than 1% of the mercury in organic form.

Mercury Salts in Soil

The primary routes of inorganic mercury exposure for people (particularly for children) who fish, play, or walk along the creek and floodplain, are through ingestion of soil from hand-to-mouth activities and from excessive dermal exposure. Following ingestion, absorption of inorganic mercury compounds across the gastrointestinal tract to the blood is low in both people and animals. Long-term exposure to the EFPC floodplain soil containing elevated levels of mercury may result in body burdens of mercury that could result in adverse health effects. The kidney is the organ most sensitive to the effects of ingestion of inorganic mercury salts. Effects on the kidney include increased urine protein levels and, in more severe cases, a reduction in the glomerular filtration rate, which is a sign of decreased blood-filtering capacity.

Metallic Mercury in Soil

The metallic mercury vapor levels in the ambient air at the three creek areas sampled are not at levels of public health concern. However, excavation of contaminated soil may result in mercury vapor being released from the soil, especially as the air temperature increases. Such releases may increase ambient air levels of mercury vapor, which could pose a health risk to unprotected workers and the public. Once inhaled, metallic mercury vapors are readily absorbed across the lungs into the blood; however, metallic mercury is poorly absorbed through dermal and oral routes. Exposure to mercury vapor may elicit consistent and pronounced neurologic effects.

Organic Mercury in Fish

Organic mercury is the primary form of mercury found in fish. Frequent ingestion of EFPC fish over the long term may result in neurotoxic effects. Concentrations of mercury in EFPC fish samples ranged from 0.08 ppm to 1.31 ppm. Studies on the retention and excretion of mercury have shown that approximately 95% of an oral dose of organic mercury is absorbed across the gastrointestinal tract. Neurodevelopmental effects have been seen in infants following prenatal exposure via maternal ingestion of organic mercury in fish.

PCBs in Fish

Frequent and long-term ingestion of EFPC fish could result in a moderate increased risk of developing cancer. Concentrations of PCBs in EFPC fish samples ranged from 0.01 ppm to 3.86 ppm. PCBs are widely distributed environmental pollutants commonly found in blood and fat tissue of the general population. PCBs

are classified as a probable human carcinogen by the U.S. Environmental Protection Agency. PCBs have been shown to produce liver tumors in mice and rats following intermediate and chronic oral exposure. Groundwater samples collected from shallow monitoring wells along the EFPC floodplain were shown to contain elevated levels of metals and volatile organic compounds. There was no evidence, however, that groundwater from shallow aquifers was being used for domestic purposes. The municipal water system, which is used by most Oak Ridge residents, receives water from Clinch River upstream of the DOE reservation.

Conclusions

In some locations along the creek, mercury levels in soil and sediment pose a threat to people (especially children) who ingest, inhale, or have dermal contact with contaminated soil, sediment, or dust while playing, fishing, or taking part in other activities along the creek's floodplain.

Mercury and PCBs were found in fish fillet samples collected from the creek. Although people who eat fish from the creek are not at risk for acute health threats, people who frequently ingest contaminated fish over a prolonged period have a moderate increased risk of (1) adverse effects to the central nervous system and kidney and (2) developing cancer.

ATSDR did not have enough information on groundwater use along the East Fork Poplar Creek to comment on the contamination of groundwater in shallow, private wells along the creek. However, contamination detected in wells along the creek does not pose a threat to people who receive municipal water.

ATSDR made the following recommendations.

- Determine the depth and extent of mercury contamination in the EFPC sediments and floodplain soil.
- As an interim measure, restrict access to the contaminated soil and sediment, or post advisories to warn the public of the hazards.
- Continue the Tennessee Department of Environment and Conservation EFPC fish advisory.
- Continue monitoring fish from the creek for the presence of mercury and PCBs.
- Complete the survey of well water use along the EFPC floodplain.
- Sample shallow private wells near the creek for PCBs, volatile organic compounds, and total and dissolved metals.