

Benzo[a]pyrene and Groundwater

Benzo[a]pyrene

Benzo[a]pyrene (BaP) is a contaminant that belongs to a group of chemicals called polycyclic aromatic hydrocarbons (PAHs). BaP comes from many sources, usually as a byproduct from industrial processes, cigarette smoke, wood fires, vehicle exhaust, grilling or broiling foods, and many other activities that involving burning or combustion of organic materials. BaP is classified as 'carcinogenic to humans' by the US Environmental Protection Agency (EPA). Exposure to low levels of BaP can increase a person's risk of cancer.

BaP in Minnesota Waters

BaP is commonly found in the air and soil, but is found less frequently in water because it does not dissolve well in water. However, near some sites of contamination, levels of BaP in water can be high. In areas of significant, known contamination BaP has been reported at a maximum concentration in groundwater of 3,100 µg/L.* Near contaminated sites, BaP has been detected in groundwater used as a drinking water source at a maximum concentration of 124 µg/L.¹

BaP is a very rare contaminant in Minnesota's groundwater or drinking water. Routine sampling of Minnesota drinking water systems has resulted in only three detections of BaP since 1993, ranging from 0.02 µg/L to 0.30 µg/L. BaP is a regulated contaminant under the Safe Drinking Water Act. In 1994, the United States Environmental Protection Agency (US EPA) has set a maximum contaminant level goal for BaP of zero. US EPA has set an enforceable drinking water standard for BaP of 0.0002 mg/L (0.2 ppb).

*One microgram per liter (µg/L) is the same as one part per billion (ppb).

MDH Guidance Value

Based on available information, MDH developed a guidance value of 0.1 parts per billion (ppb) for BaP in drinking water. MDH develops guidance values to protect people who are most vulnerable to the potentially harmful effects of a contaminant. A person drinking water at or below the guidance value would be at little or no risk for harmful health effects.

Potential Health Effects

Exposure to BaP has the potential to increase your risk of certain types of cancer, including in the digestive tract and liver for drinking water exposures based on laboratory studies (US EPA, 2017).² In addition to cancer, BaP causes brain development and activity changes in young animals exposed in the laboratory. Animal studies have also shown male and female reproductive system changes.

Potential Exposure to BaP

People are exposed to BaP through air, food, water, and soil. The primary exposure route for most Minnesotans is through the diet (grilled/charred foods), but cigarette smoke, wood smoke, vehicle exhaust, and coal tar-based asphalt also increase exposure. To reduce your exposure to BaP, limit your intake of grilled/charred foods, quit smoking, and avoid wood smoke and combustion fumes.

You should also avoid contact with asphalt/seal coat produced from coal tar. BaP and other PAHs can be removed from drinking water with granular activated carbon filter treatment.

BaP in the Environment

BaP is not produced or used commercially, but is commonly found in the environment because it is formed when organic material is incompletely combusted (burned). BaP sticks to small particles in the air and then the air disperses BaP throughout the environment. BaP can then be breathed in or deposited in environment on soils, ponds, lakes, and rivers. Fish and other animals and plants may then take up BaP. BaP, and the chemicals it breaks down into, can persist for many years, especially in environments protected from sunlight.

Potential Environment Impacts of BaP

Aquatic life is exposed to BaP in the sediments of ponds, lakes, and rivers. BaP builds up in the tissue of aquatic invertebrates (e.g. bugs, mussels). Fish are able to break these chemicals down, so little accumulation of BaP occurs in fish.³ Similar to other PAHs, BaP is more toxic to aquatic life in the presence of UV light, increasing the risk to organisms in unshaded or shallow habitats.⁴ Adverse effects to aquatic life could be observed at concentrations that have been observed in Minnesota surface waters and bottom sediments.

Health Risk Assessment Unit

The MDH Health Risk Assessment Unit evaluates the health risks from contaminants in groundwater used as a drinking water source and develops health-based guidance values. MDH works in collaboration with the Minnesota Pollution Control Agency and the Minnesota Department of Agriculture to understand the occurrence and environmental effects of contaminants in water.

References

1. Minnesota Pollution Control Agency. (2017). 2017 Health Risk Limits Nominations.
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Minnesota Department of Health
Health Risk Assessment Unit
PO Box 64975, St. Paul MN 55164
651-201-4899
health.risk@state.mn.us
www.health.state.mn.us

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651-201-4899.