PCBs – Legacy and Non Legacy Impacts to Virginia’s Waters

What’s in Your Water? A Discussion of Threats to Virginia’s Water Quality
William & Mary School of Law

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DEQ Fish Tissue Monitoring

Monitor to assess the “Fishable” Goal of the Clean Water Act

Target lipophilic or “fat loving” contaminants that accumulate in tissue

- PCBs, Pesticides, etc.

Compare to fish trigger values
VA Water Quality Criterion-Total PCBs

- Acute/Chronic criterion
- Tissue and PWS - WQC represents concentration in the water column where the bioaccumulation of tPCBs in fish and drinking water is minimized for safe human consumption (back-calculated from fish tissue)

### PCB WQC

<table>
<thead>
<tr>
<th>Consumption Advisories</th>
<th>Water Quality Criterion (ppb)</th>
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<tbody>
<tr>
<td>Fish Tissue (ppb)</td>
<td></td>
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<tr>
<td>VDH (100)</td>
<td>DEQ (20)</td>
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<tr>
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<td>0.00064</td>
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</tbody>
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FDA Threshold for prohibition of interstate commerce in fish tissue = 2.0 ppm (or 2,000 ppb)

Listed on “dirty waters” report if exceeds – i.e., 303(d) report
VA Designated Use Non-Attainment

Figure B. Common causes of designated use non-attainment.

Draft 2014 305(b)/303(d) Integrated Report
>1,000 river miles
> 70,000 lake acres
> 2,000 estuarine sq miles
Polychlorinated Biphenyls

- Monsanto manufactured from 1929 until 1977
  - Sold under trade name of Aroclor
  - Known as “Miracle Chemical”
- Highly valued properties – chemically inert, non-flammable, heat resistant
  - Used as a coolant and insulating fluid in electrical transformers and capacitors
  - Other uses: plasticizers, lubricating oil, hydraulic fluid, carbonless copy paper
Polychlorinated Biphenyls

209 Distinct PCB compounds

Non-water loving (hydrophobic)
- Attaches to suspended particles in water
- Not detected in river water samples since the 1980’s

Historic studies were designed to look at river mud where PCBs concentrated.

Became known as Legacy Contaminant

Improved analytical methods now available
PCBs Continue to be an Issue – Why?

- Fish impairments based on human health concerns
  - Fish consumption is significant exposure pathway
    - Probable carcinogen (EPA)
      - IARC upgraded to carcinogen
    - Immunotoxicity, reproduction and developmental, hepatotoxicity (liver), etc.

- Persistent, bioaccumulates at low conc. (pg/L) & biomagnifies

- Confirmed on-going releases

[Image of sign: Do NOT Eat Big Catfish or C.C.L. or Cat]

[Image of fish with diagram: Biomagnification]

[Logo: Virginia Department of Environmental Quality]
Total Maximum Daily Load (TMDL)

- Waterbodies that have a fish consumption advisory = impaired
- Must be addressed with a TMDL (CWA)
  - Yields a Pollution Budget
  - Addresses categories of applicable sources within a watershed
  - Requires **multi-media** approach to address and resolve problem
Reducing existing pollutant load to the TMDL end point load is expected to restore water quality.
PCBs in the Environment

Pathway from pollution to exposure to potential health effects

Pollution generated enters air, water, land, food

People exposed to pollution via inhalation, skin contact and/or media

Wet Deposition

Dry Deposition

Non-point source runoff

SW runoff

Runoff

Off-gas

Contaminated site

PCB Contaminated sediment

Emissions

Point Sources

Non-point source

runoff

runoff

runoff
The PCB clean-up level of 1 mg/kg is not low enough to protect the fish consumption use. Significant need to develop an environmentally relevant PCB clean-up level when contaminated sites are co-located within PCB fish impaired waterbodies.

Current Guidance used for PCB site remediation developed during 1990’s

\[ WQC = 640 \text{ pg/L} \]
Example PCB TMDL
Roanoke River Completed 2009

Existing PCB Loadings in the Upper Roanoke River
- Permitted Dischargers: 15%
- Regulated Storm Water (MS4): 7%
- Contaminated sites: 67%
- Urban Background: 5%
- Atmospheric Deposition: 6%

Existing load = 162.9 g/yr

TMDL = 39.1 g/yr

Existing PCB Loadings in the Lower Roanoke River
- Permitted Dischargers: 4%
- Regulated SW (MS4): 4%
- Contaminated sites: 14%
- Urban Background: 78%

Existing load = 598.8 g/yr

TMDL = 25.8 g/yr
Toxics Substances Control Act (TSCA)

1976 Law regulates PCBs

- Bans the manufacture, processing, use and distribution in commerce
- Non-PCB Transformer defined as containing < 50 ppm PCB
- Inadvertent manufacture of PCBs – products up to 50 ppm allowed to leave site as long as annual average is < 25 ppm
  - Unintentional by-products of manufacturing processes

50 ppm compared to DEQ’s WQC - 6.4 X 10^{-7} ppm (0.00000064)
PCBs – The Perceived Legacy

Myth: PCBs are no longer manufactured.
Fact: PCBs are allowed as an inadvertent contaminant.

Myth: A product designated “PCB-free” has no PCBs.
Fact: A product can contain up to 50 ppm PCB and can be categorized as “PCB free”.

Myth: PCBs in the environment are from historical spills.
Fact: PCBs continue to be produced and are continuously released to the environment.
~65% Above Criterion

Percent Rank of Blank Corrected tPCB concentrations (pg/L) from Effluent Samples (n = 222) Collected in the Tidal James River Watershed
Unintentional PCB By-Products

Known inadvertent PCB sources

- Organic pigments, especially diarylide yellow, produce primarily PCB 11, among others
  65% of all diarylde yellow is used in printing
- Titanium dioxide (inorganic white pigment) produces PCBs 206, 208, and 209

Produced inadvertently during the making of titanium tetrachloride

Rodenburg 2012
Mean Concentrations of PCB 11 Detected in Effluents from Point Source Dischargers Located in Virginia's Rivers

- South Fork Shenandoah R.
- Tidal Potomac River
- Dan River
- Roanoke River
- New River
- Upper James R.
- Upper tidal James R.
- Elizabeth River

PCB 11 [µg/L]
Non Aroclor PCBs

Mean Concentrations of PCBs 206+208+209 Detected in Effluents from Point Source Dischargers Located in Virginia’s Rivers

PCBs 206+208+209 (pg/L)

- South Fork Shenandoah R.
- Tidal Potomac River
- Dan River
- Roanoke River
- New River
- Upper James R.
- Upper tidal James R.
- Elizabeth River
Other Prospective PCB Sources

Contaminated Sites (Pre/Post Remediation)
- May still be contributing PCBs via SW runoff
  - TSCA Clean-up levels 1 ppm (compared to $6.4 \times 10^{-7}$ ppm)
  - WQC
- Inconsistency between Laws & Programs

Atmospheric Contamination
- Burning of waste oil allowed at < 2 ppm
- Burn recycled oil in space heaters
  - PCBs not destroyed
- Potential for deposition to land/water
Thank You!

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